Go, Change the world®

RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Scheme and Syllabus of I – IV semester

(Autonomous System of 2022 Scheme)

Master of Technology (M. Tech.)

in

POWER ELECTRONICS (MPE)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS

Academic Year 2022-23

Estd.1963

Go, change the world

RV COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, 8th Mile, Mysuru Road, Bengaluru - 560 059.

2022 Ranked 89th in Engineering Category

One of the most preferred Technical Institutions

Accredited by NBA

PROGRAMS OFFERED

B.E. Programs : AI, AS, BT, CH, CS, CV, CD, CY, EC, EE, EI, 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

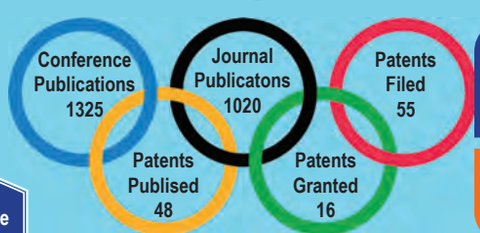
Five RVCE Alumni cleared Civil Services Exam in 2020-21

Ranked in top 10 Pvt. College in the Country by various magazines

Ranked 3rd in Sports & Cultural Activities under VTU (2019-20)

Use of ICT in Teaching Learning Process

e-Journals e-books | QEE 48 Courses | SWAYAM | NPTEL 9,300+ Enrolled 68th place in the country (Jul-Oct-2019) | Wikispace | MOOCS | MODULE



Holistic development of students through NCC, NSS Cultural activities, Community service & Sports.

16 Centres of Excellences
07 Centres of Competence

MoUs: 90+with Industries / Academic Institutions in India & abroad

Executed more than Rs. 40 crores worth sponsored research projects & consultancy works sicnce 3 years

UPSC Results (2020): RVCE-Alumni

Name : Kushal Jain
Rank : 40
ISE-2016 Pass out

Name : Naveen Kumar
Rank : 62
ME - Pass out

Name : Deepak R. Shet
Rank : 311
ECE – 2013 Pass out

Human Resource

- Faculty with Industrial experience 104
- Visiting Adjunct Faculty 05
- Total Number of Faculty 347
- Faculty with Ph.D. Qualification 240
- Faculty Pursuing Ph.D. 87
- Technical & Admin Staff 221

RVCE - Greaves Cotton Ltd Centre of excellence in e-mobility

RV-Mercedes Benz Centre for Automotive Mechatronics

THE World University Rankings 2023	
World University Rankings	1501+
Subject Ranking - Engineering	1001+
Subject Ranking - Computer Science	801+

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

DEPARTMENT OF ELECTRICAL AND ELECTRONICS VISION

Promotion of technical excellence in Electrical and Electronics Engineering by offering programs to produce Engineers with dynamic well rounded personalities adaptable to ever increasing demands of emerging technologies involving analytical and practical skills, with commitment to research and development

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 a research and development centre of repute so as to encourage active participation with industry by faculty and students to take on practical problems of industry and to provide feasible solutions.
3. To establish tie-ups with institutions of national and international repute and to foster building up of a wide knowledge base to keep in tune with ever increasing demands of technologies

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.

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19	22HSS42	Professional Skills Development-II	-

M.Tech in Power Electronics: MPE

I SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MAT11AT	Computational Mathematics	3	1	0	**4**	MA	Theory	1.5	100	3	100
2	22MPE12TL	Power Converters	3	0	1	**4**	EE	Theory+Lab	1.5	100	3	100
3	22MPE13T	Analysis and Control of AC and DC Drives	3	1	0	**4**	EE	Theory	1.5	100	3	100
4	22MPE14L	Software Programming for Power Electronics	1	0	1	**2**	EE	Lab	1.5	50	3	50
5	22MPE1AXT	Elective A (Professional Elective)	3	0	0	**3**	EE	Theory	1.5	100	3	100
6	22MPE1BXT	Elective B (Professional Elective)	3	0	0	**3**	EE	Theory	1.5	100	3	100

Note: For the course code 22HSS42, Students need to select one ONLINE MOOC course as recommended by HSS BoS. This course can be selected anytime between I to III semester and it will be evaluated during IV semester.

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Code	Elective A (Professional Elective)	Code	Elective B (Professional Elective)
22MPE1A1T	Generalized Theory of Electrical Machines	22MPE1B1T	Microcontoller and applications in Power Electronics
22MPE1A2T	EV and HEV - Architecture and Design	22MPE1B2T	VLSI and Applications in Power Electronics
22MPE1A3T	Power Quality Problems and Mitigation	22MPE1B3T	Advanced Control Systems
22MPE1A4T	Smart Grid and Challanges	22MPE1B4T	Switching Techniques for Power Converters

II SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/ SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22IM21T	Research Methodology	3	0	0	**3**	IM	Theory	1.5	100	3	100
2	22MPE22TL	Advanced Power Converters and Applications	3	0	1	**4**	EE	Theory+Lab	1.5	100	3	100
3	22MPE23T	PLC and SCADA Systems	3	0	0	**3**	EE	Theory	1.5	100	3	100
4	22MPE2CXT	Elective C (Professional Elective)	3	0	0	**3**	EE	Theory	1.5	100	3	100
5	22MPE2DXXT	Elective D (Global Elective)	3	0	0	**3**	Res. BoS	Theory	1.5	100	3	100
6	22MPE24L	Embedded Systems Lab	1	0	1	**2**	EE	Lab	1.5	50	3	50
7	22HSS25T	Professional Skills Development-I	0	0	2	**2**	HSS	Theory*	1.5	50	2	50

** External Agency will be conducting the classes and both CIE and SEE will be evaluated by the Agency.*

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Code	Elective C (Professional Elective)
22MPE2C1T	EMI and EMC in Power Electronics System Design
22MPE2C2T	FACTS and Custom Power Devices
22MPE2C3T	Intelligent control techniques in drives
22MPE2C4T	IoT applications in smart grid

Elective D (Global Elective)			
22BT2D01T	Bioinspired Engineering	22ET2D08T	Tracking and Navigation Systems
22BT2D02T	Health Informatics	22IM2D09T	Project Management
22CS2D03T	Business Analytics	22IS2D10T	Database and Information Systems
22CV2D04T	Industrial and Occupational Health and Safety	22IS2D11T	Management Information Systems
22CV2D05T	Intelligent Transportation Systems	22MAT2D12T	Statistical and Optimization Methods
22EC2D06T	Electronic System Design	22ME2D13T	Industry 4.0
22EC2D07T	Evolution of Wireless Technologies		

III SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MPE31T	Modelling of Power Electronic Circuits	3	1	0	**4**	EE	Theory	1.5	100	3	100
2	22MPE3EXT	Elective E (Professional Elective)	3	1	0	**4**	EE	Theory	1.5	100	3	100
3	22MPE32N	Internship	0	0	6	**6**	EE	Project	1.5	50	3	50
4	22MPE33P	Minor Project	0	0	6	**6**	EE	Project	1.5	50	3	50
						20						

Code	Elective E (Professional Elective)
22MPE3E1T	Embedded Systems for EV applications
22MPE3E2T	Communication Systems and Networking
22MPE3E3T	HVDC power transmission Systems
22MPE3E4T	Power Electronics for Renewable Energy Systems

IV SEMESTER M.Tech

Sl. No.	Course Code	Course Title	Credit Allocation L	T/SDA	P	Total	BoS	Category	CIE Duration (H)	Max Marks CIE	SEE Duration (H)	Max Marks SEE
1	22MPE41P	Major Project	0	0	18	**18**	EE	Project	1.5	100	3	100
2	22HSS42	Professional Skills Development-II	0	0	2	**2**	HSS	NPTEL	--	50	ONLINE	50

Student need to submit the certificate for the evaluation of Course code 22HSS42

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SEMESTER: I						
Course Code	:	22MAT11AT	**COMPUTATIONAL MATHEMATICS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L+28T	*Common Course (MPD, MMD, MPE, MBT, MST, MHT)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. A Sujatha			

UNIT - I	**09 Hrs**
Vector Spaces and Orthogonality: Vector spaces and subspaces, linear independence, basis and dimension, four fundamental subspaces, change of basis. Inner product, orthogonal vectors, orthogonal projections, orthogonal bases. Eigen subspaces, Gram-Schmidt orthogonalization process, QR factorization and singular value decomposition.	
UNIT - II	**09 Hrs**
Multiple Random variables: Joint probability mass functions and probability density functions, marginal density function, conditioning of random variables, statistical independence, correlation and covariance functions, covariance and correlation matrices, transformation of random variables, Markov and Chebyshev inequalities, Gaussian distribution-Multivariate normal density and its properties.	
UNIT - III	**08 Hrs**
Principal component analysis and Factor analysis: Overview of principal component analysis and factor analysis, eigen structure of covariance or correlation matrix. Principal component-standardized variables, covariance matrices. Factor model-principal component method, maximum likelihood method, factor scores, factor rotation.	
UNIT - IV	**08 Hrs**
Engineering optimization: Engineering applications of optimization, statement of an optimization problem-design vector, design constraints, constraint surface, objective function and objective function surface. Multivariable optimization with inequality constraints-Kuhn-Tucker conditions, constraint qualification.	
UNIT - V	**08 Hrs**
Numerical solution of differential equations: Boundary value problems–finite difference method for linear and nonlinear problems, shooting method and Galerkin method. Finite difference methods for parabolic, elliptic and hyperbolic partial differential equations.	

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

CO1	:	Illustrate the fundamental concepts of distributions, linear algebra, differential equations and optimization arising in various fields engineering.
CO2	:	Derive the solution by applying the acquired knowledge and skills of statistical/numerical/optimization techniques to solve problems of probability distributions, linear algebra and differential equations.
CO3	:	Evaluate the solution of the problems using appropriate statistical numerical and optimization techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of probability distributions, linear algebra and optimization methods gained to engage in life – long learning.

Reference Books

1. Richard A Johnson and Dean W Wichern, “Applied Multivariate Statistical Analysis”, Pearson Prentice Hall, 6th Edition, 2007, ISBN-13: 978-0-13-187715-3, ISBN-10: 0-13-187715-1.

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

3. Edgar G. Goodaire, “Linear Algebra: Pure & Applied Kindle Edition”, World Scientific, 1st Edition, 2013, ISBN-13: 978-9814508360.

4. M K Jain, S. R. K. Iyengar, R. K. Jain; Numerical methods for scientific and engineering computation; New Age International Publishers; 6th edition; 2012; ISBN-13: 978-81-224-2001-2.

5. Singiresu S. Rao, Engineering Optimization Theory and Practice, New Age International (P)Ltd., 3rd edition, 1996, ISBN: 81-224-1149-5.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE12TL	**POWER CONVERTERS**	CIE Marks	:	100
Credits L-T-P	:	3-0-1	***(Theory & Practice)***	SEE Marks	:	100
Hours	:	42L + 28P	***(Professional Core - 1)***	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Hemalatha J N				

UNIT - I	**8 Hrs**
Single Phase AC-DC Converters: Structure, working Principle and Static and Dynamic Characteristics of SCR and GTO, Gate drive circuit and Protection of SCR/GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - performance parameters analysis using Fourier Series, effect of source impedance. **Three phase AC-DC converters:** Half controlled and fully controlled converters with R, R-L, R-L-E loads and freewheeling diodes ,performance parameters analysis using Fourier Series,	
UNIT - II	**8 Hrs**
Choppers: Analysis of Step down, step up, step up-down choppers, Classification and Analysis of choppers **AC Voltage Controllers:** Principle of on-off control, phase control: single and 3 phase controllers – Design and analysis with R and R-L loads. Single phase and 3 phase dual converter	
UNIT - III	**8 Hrs**
Single Phase Inverters: Introduction to self-commutated switches : MOSFET and IGBT- Structure, working, charecteristics - Principle of operation of half and full bridge inverters – Performance parameters Analysis	
UNIT - IV	**9 Hrs**
Three Phase Inverters: Multilevel Inverters: 180 degree and 120 degree conduction mode inverters– voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – VSR operation-Application of Inverters– Current source inverters.	
UNIT - V	**9 Hrs**
Advanced converters and Inverters: 12 pulse converter, Dual converters. Applications of phase controlled converters. Multilevel concept – diode clamped – flying capacitor – cascaded type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI.	
LABORATORY	**28 Hrs**
1. Static characteristic of Thyristors, MOSFET,IGBT. 2. Design, Simulation and performance Analysis of Step-down, step-up, step up/down choppers. 3. Design and practical implementation of two and four quadrant choppers. 4. Design and Simulation of single phase fully controlled and semi-controlled converter for RL load. 5. Performance testing of single phase fully controlled and semi-controlled converter for RL load for continuous & discontinuous current mode. 6. Performance analysis of three phase fully controlled and semi-controlled converter for RL load for continuous & discontinuous current mode. 7. Design and Simulation and Performance analysis of single phase bridge inverter for RL load and voltage control by single pulse width modulation. 8. Design and Performance analysis of diode clamped multilevel Inverter.	

Course Outcomes:

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

CO1	:	Understand the basic concepts of various DC-DC converters
CO2	:	Analyse the operation of power converters under different operating conditions.
CO3	:	Design of various control techniques of power converters.
CO4	:	Evaluate the performance parameters of power converters.

Reference Books

1. B. JayantBaliga , Fundamentals of Power Semiconductor Devices, 1 st Edition, International Thompson Computer Press, 1995, ISBN:9780387473130.

2. Ned Mohan, Tore M. Undeland, William P Robbins, Power Electronics Converters, Applications, and Design, 3rd Edition, 2011, Wiley India Pvt Ltd., ISBN: 978-0-471-22693-2.

3. M. H. Rashid, Power Electronics, Circuit Devices and Applications, 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 9780070583894.

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: I						
Course Code	:	22MPE13T	**ANALYSIS AND CONTROL OF AC AND DC DRIVES**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	***(Professional Core - 1)***	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Pandry Naerndra Rao			

UNIT - I	**8 Hrs**
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, 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, status of DC AC drives.	
UNIT - II	**8 Hrs**
DC Motor Drives: DC motors and their performance, starting, braking, speed control. **Converter Control of DC Drives:** Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations. **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	**8 Hrs**
AC Machines drives: Introduction, Induction machines, rotating magnetic field, torque production, equivalent circuit, torque speed curve, variable voltage operation, variable frequency and V/F operation, drive operating regions, variable stator current operation, effect of harmonics, dynamic d-q model. synchronous machines, wound field machine, synchronous reluctance machine, permanent magnet machine, variable reluctance machines.	
UNIT - IV	**9 Hrs**
Induction motor drives: Introduction, Induction motor control with small signal model, scalar control, open loop v/f control, Current fed inverter control: Independent current and frequency control. Vector or field-oriented control, d c drive analogy, equivalent circuit and phasor diagram, principles of Vector control, direct or feedback vector control, flux vector estimation: voltage model. Indirect or feed forward vector control, direct torque and flux control,	
UNIT - V	**9 Hrs**
Synchronous motor drives: Introduction, sinusoidal SPM machine drives, open loop v/f self-control model, absolute position encoder, optical analog resolver with decoder, vector control (field weakening mode), synchronous reluctance machine drives, trapezoidal SPM machine drives: drive operation with inverters, torque speed curve, machine dynamic model, drive control, Torque pulsation, extended speed operation, switched reluctance motor drives.	

Course Outcomes:

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

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

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 and Variable frequency drives, Bimal.K. Bose, Student Edition, 2010, Wiley Publications, ISBN No: 9788126529346.

4. Power Electronics in Motor Drives: Principles, Application and Design, Martin Brown, 1st Edition, 2010, Gazelle Distribution Publisher, ISBN:978-0905705897.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE14L	**SOFTWARE PROGRAMMING FOR POWER ELECTRONICS**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Suresh C and Dr. Pandry Narendra Rao			

Content **28 Hrs**

CYCLE 1

Software-MATLAB /SIMULINK

1. Half-wave and full wave controlled rectifier fed DC motor,
2. Simulate of 3 phase Inverters for 120 degree and 180 degree modes.
3. Simulation of Stator Voltage Control of Induction Motor using SPWM Technique
4. To Implement a closed loop control of High-power factor converter.

CYCLE 2

Programming with Aurdiuno IDE

1. Sample programs Using Conditionals, Loops, Addresses, Pointers and Handles
2 Basic Functions using Arduino programming: - Blink, Digital I/O Function, Read Analog I/O function, Timer Function.
3. Interfacing Sensors with Arduino: Temperature sensors, Humidity Sensors, light sensitive sensors, Ultrasonic sensors, Proximity sensors
4. Electro Mechanical Control Using PWM : DC motor, Stepper motor

CYCLE 3

EL - Component

1. Design and simulate a Bidirectional DC-DC converter for EV Application in MATLAB/SIMUKLINK
2. Design and simulate a converter topology for Grid Integration of Renewable energy sources.
3. Node MCU/ESP 32 - Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)- Motor driver Interfacing (L298) -LCD Interfacing (HD44780)
4.a) LCD Interfacing (HD44780) b) Servo motor control with Aurdino

Course Outcomes:

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

CO1	:	Acquire a basic knowledge about fundamentals of MATLAB/SIMULINK and Aurduino programming
CO2	:	Acquire a basic knowledge about programming and system control to perform a specific task .
CO3	:	Develop programming skills in developing power electronic systems
CO4	:	Design and development of Power Electronic circuits using MATLAB/SIMULINK and Aurduino

Reference Books

1.Modeling and Simulation using MATLAB - Simulink, 2nd Edition, ISBN: 9788126551972.

2.Simulation of Power Electronics Circuits with MATLAB®/Simulink® Design, Analyze, and Prototype Power Electronics ISBN: 978-1-4842-8220-5.

3.Programming and Interfacing with Aurdino ,Dr Yogesh Mishra ,CRC Press ISBN: 978-1- 032-05985-3.

4. Programming in Aurdino, Simon Monk, McGraw Hill, 2nd Edition, 2016, ISBN: 978-1259641633.

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30 Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will be evaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

	RUBRIC FOR CIE			RUBRIC FOR SEE		
	Sl.No	Content	Marks	Content	Marks	
	1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40	
	2	Innovative Experiment/Concept Design & Implementation	10			
	3	Laboratory Internal	10	Viva Voce	10	
		Total Marks	50	Total Marks	50	

SEMESTER: I							
Course Code	:	22MPE1A1T	**GENERALIZED THEORY OF ELECTRICAL MACHINES**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Parth Sarathi Panigarhy			

UNIT - I	**8 Hrs**
Basic Concepts of Modelling: Basic two pole machine representation of commutator machines, 3-phase synchronous machine with and without damper bar and 3-phase induction machine, Kron's primitive machine, voltage, current and torque equations. Transformations in Electrical Machines: Three-phase to Two-phase Transformation (abc - αβo), Two-phase to Two-axis Transformation (αβ-dq), Three-phase to Two-axis Transformation (abc - dqo), Physical Concepts of Park's Transformations, Transformed Impedance Matrix.	
UNIT - II	**8 Hrs**
DC Machine Modelling: Mathematical model of separately excited DC motor-steady state and transient state analysis, sudden application of inertia load, transfer function of separately excited DC motor, mathematical model of dc series motor, shunt motor, linearization techniques for small perturbations.	
UNIT - III	**8 Hrs**
Dynamic Modelling of Three Phase Induction Machine: Generalized model in arbitrary frame, electromagnetic torque, deviation of commonly used induction motor models-stator reference frames model, rotor reference frames model, synchronously rotating reference frames model, equations in flux linkages, per unit model, dynamic simulation. **Small Signal Equations of the Induction Machine:** Derivation of small signal equations of induction machine, space phasor model, DQ flux linkages model derivation, control principle of the induction motor.	
UNIT - IV	**9 Hrs**
Modelling of Synchronous Machines: Introduction, voltage equations and torque equation in machine variables, stator voltage equations in arbitrary and rotor reference frame variables, Park's equations, torque equations in substitute variables, rotor angle and angle between rotors, per unit system, analysis of steady state operation.	
UNIT - V	**9 Hrs**
Dynamic Analysis of Synchronous Machines: Dynamic performance during sudden change in input torque and during a 3-phase fault at the machine terminals, approximate transient torque versus rotor angle characteristics, comparison of actual and approximate transient torque-angle characteristics during a sudden change in input torque; Case study on sudden short circuit fault of three phase alternator.	

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

CO1	:	Understand and explain modelling concepts of electrical machines
CO2	:	Analyze mathematical models for stator ad rotor reference frames
CO3	:	Evaluate the state characteristics for different operational scenarios
CO4	:	Model electrical machines to perform steady ,transient and dynamic analysis under fault conditions

Reference Books

1. Generalized Theory of Electrical Machines, P.S.Bimbra, Khanna Publications, 5th Edition, 1995, ISBN: 978-9391505080.
2. Electric Motor Drives - Modelling, Analysis & Control, R. Krishnan, Pearson, 1st Edition, ISBN : 978-9332549715.
3. Analysis of Electrical Machinery and Drive Systems, P.C.Krause, et al, Wiley, 2nd Edition, 2010, ISBN: 978-8126525126.
4. Power System Analysis, Arthur R Bergen and Vijay Vittal, Pearson, 2nd Edition, 2009, ISBN:978-0136919902.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1A2T	**EV AND HEV - ARCHITECTURE AND DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani			

UNIT - I	**8 Hrs**
Introduction to Hybrid Electric Vehicles: 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. **Hybrid Electric Drive trains:** Basic concept of hybrid traction, introduction to hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	
UNIT - II	**8 Hrs**
Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, 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	**8 Hrs**
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 Hrs**
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 Hrs**
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	:	understand and explain the configuration and propulsion system 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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1A3T	**POWER QUALITY PROBLEMS AND MITIGATION**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Smt. Sushmita Sarkar			

UNIT - I	**8 Hrs**
Power Quality: Introduction, State of the Art on Power Quality, Classification of Power Quality Problems, Causes and effects of Power Quality Problems, Classification of Mitigation Techniques for Power Quality Problems, Power Quality Standards and Monitoring, Power Quality Terminologies, Numerical Examples. Loads That Cause Power Quality Problems: Introduction, Nonlinear Loads, Classification of Nonlinear Loads, Power Quality Problems Caused by Nonlinear Loads, Analysis of Nonlinear Loads, Modeling, Simulation, and Performance of Nonlinear Loads, Grounding techniques, Numerical Examples.	
UNIT - II	**8 Hrs**
Active Shunt Compensation: Introduction, State of the Art on DSTATCOMs, Classification of DSTATCOMs, Principle of Operation and Control of DSTATCOMs, Analysis and Design of DSTATCOMs, Modelling, Simulation, and Performance of DSTATCOMs, Numerical Examples	
UNIT - III	**8 Hrs**
Active Series Compensation: Introduction, State of the Art on Active Series Compensators, Classification of Active Series Compensators, Principle of Operation and Control of Active Series Compensators, Analysis and Design of Active Series Compensators, Modelling, Simulation, and Performance of Active Series Compensators, Numerical Examples	
UNIT - IV	**9 Hrs**
Unified Power Quality Compensators: Introduction, State of the Art on Unified Power Quality Compensators, Classification of Unified Power Quality Compensators, Principle of Operation and Control of Unified Power Quality Compensators, Analysis and Design of Unified Power Quality Compensators, Modeling, Simulation, and Performance of UPQCs, Numerical Examples	
UNIT - V	**9 Hrs**
Passive Power Filters: Introduction to Passive Power Filters, Classification, Principle of Operation , Analysis and Design , Modeling, Simulation, and Performance , Limitations , Parallel Resonance of Passive Filters with the Supply System and Its Mitigation. **Shunt and Series Active Power Filters**: State of the Art, Classisfication, Principle of Operation, Analysis and Design.	

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

CO1	:	Explain the various power quality problems and identify the causes of PQ disturbances in a system.
CO2	:	Model and Simulate Active series, shunt, unified compensators and power filters.
CO3	:	Analyze and design controllers for various compensators and power Filters.
CO4	:	Compute the level of PQ disturbance and design a suitable compensator and filter for a system.

Reference Books

1. Power Quality Problems and Mitigation Techniques, Bhim Singh, Ambrish Chandra, Kamal Al- Haddad, 1st Edition, 2015, John Wiley Publisher, ISBN: ISBN: 978-1-118-92205-7.

2. Understanding Power Quality Problems: Voltage Sags and Interruptions,Math H.J. Bollen, 1st Edition, 1999, Wiley India Pvt Ltd Publisher, ISBN-13: 978-8126530397.

3. Power Quality Enhancement Using Custom Power Devices, Arindam Ghosh and Gerard Ledwich, 1st Edition, 2002, Kluwer Academic Press, ISBN 1-4020-7180-9.

4. Power Quality, C. Sankaran , CRC Press, 1st Edition, 2002, ISBN: 0-8493-1040-7.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1A4T	**SMART GRID AND CHALLANGES**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective A (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani			

UNIT - I **8 Hrs**

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 **8 Hrs**

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, HighEfficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT - III **8 Hrs**

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 Hrs**

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 Hrs**

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	:	To understand The concepts and design of Smart grid.
CO2	:	To understand the various communication and measurement technologies in smart grid.
CO3	:	To understand the analysis and stability of smart grid.
CO4	:	To learn the 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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1B1T	**MIRCROCONTROLLER AND APPLICATIONS IN POWER ELECTRONICS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. M.N. Dinesh			

UNIT - I	**8 Hrs**
Introduction to Embedded Systems Definition, Embedded System vs. general Computing System, Application Areas of Embedded Systems, Use Cases, Characteristics of Embedding Computing Applications, Concept of Real time Systems, **Typical Embedded System** Core of the Embedded System, Memory, Sensors and Actuators, Communication Interfaces, Embedded Firmware, Other System Components **Microcontrollers** Block Diagram, Functional Units, Interrupts, Serial Interfaces, GPIOs, 8-bit,16-bit and 32-bit, ARM Cortex Family, M Series of ST Microcontrollers, Discovery boards	
UNIT - II	**8 Hrs**
Embedded System Development Environment Integrated Development Environment, Files Generated on Compilation, Linking, Disassembler, Simulators, Emulators, Debugger, Target Hardware Debugging, Working with STMCubeMX, CMSIS Embedded Programming Constructs Bare Metal Programs, OS based Programs, Programming Languages, Variables, Structures, Functions, Accessing Memory and Registers, Arithmetic Operators, Logical Operators, Pointers, Programming Examples	
UNIT - III	**8 Hrs**
Designing with Analog and Digital IO Introduction to analog sensors, Analog to Digital Conversion, SAR ADC, Flash ADC, Programming ADC using STMCubeMX, Typical Applications Digital to Analog Conversion, DAC Types, Programming DAC using STMCubeMX, Typical Applications GPIOs, Programming GPIOs with STMCubeMX	
UNIT - IV	**9 Hrs**
T**imer and Pulse Width Modulation (PWM) - Interrupts and Events** Introduction, Main Features, Functional Description, Programming, Typical Applications, Watchdog Timer, PWM, Programming and Generation, Typical Applications. NVIC, Features, Vector Table, Programming ISR.	
UNIT - V	**9 Hrs**
RTOS and IDE for Embedded System Design: Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, How to choose an RTOS, Integration and testing of Embedded hardware and firmware. Typical power Electronics Applications Model Based Design using Simulink, Advantages, PID tuning, Typical examples	

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

CO1	:	Describe High-level programming API as a prototype tool for rapid development of embedded applications
CO2	:	Demonstrate how microcontroller peripherals can be controlled through STMCubeMX API, using digital and analog I/O, interrupts, pulse-width modulation, and timers
CO3	:	Design the embedded controllers for many applications using auto code generators and modelling tools.
CO4	:	Interpret the use of microcontrollers to smart control of many devices irrespective to different domains.

Reference Books

1. Introduction to Embedded Systems, Shibu K V, 1st edition, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790.

2. Embedded Software Primer, David E.Simon, Addison Wesley, 2nd edition, John Weily, 2002, ISBN-13: 978-0201615692.

3. Embedded System Design: A Unified Hardware/Software Approach, Frank Vahid and Tony Givargis, Wiley India, student edition, 2006, ISBN: 9788126508372.

4. Embedded and Real-Time Operating Systems, K.C. Wang, 1st Edition, 2017, ISBN: 978-3319515168.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1B2T	**VLSI AND APPLICATIONS IN POWER ELECTRONICS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. K.M. Ajay				

UNIT - I	**8 Hrs**
VLSI Design Flow : Specification, Design entry, Functional simulation, planning placement and routing, timing simulation. MOS Transistor:Introduction, Ideal I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Junction Leakage, Body effect, Tunneling. Scaling of MOS **Circuits:** Scaling models and factors, Limits on scaling. **DC Transfer Characteristics:** Static CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin.	
UNIT - II	**8 Hrs**
CMOS Processing Technology: CMOS Technologies, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization. Lambda Design Rules, Stick diagram, Layout diagrams, Propagation delays, Power dissipation.	
UNIT - III	**8 Hrs**
Combinational Circuit Design: CMOS Logic, Inverter, NAND Gate, NOR Gate CMOS, Logic Gates, The Compound Gates, Pass Transistors and Transmission Gates, Tristate buffer, Multiplexers. CMOS Logic Structures:CMOS Complementary Logic, Bi CMOS Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic.	
UNIT - IV	**9 Hrs**
Sequential MOS Logic Circuitry: Behavioural of Bi stable element, SR Latch Circuitry, Clocked latch and Flip Flop Circuitry. Introduction to Verilog Programming: Introduction, general structure of Verilog program for describing digital circuit, operators, architectural models and simple examples. Verilog code for combinational and Sequential Logic Circuits.	
UNIT - V	**9 Hrs**
Sub system Design: A parity generator, Bus arbitration logic, Multiplexers, Memory cell Read/Write operation, Decoder, and Sub array Architectures, Embedded DRAM, Programmable ROMs, NAND ROMs.	

Course Outcomes:

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

CO1	:	Understand transistor circuits and its impact on VLSI circuits design.
CO2	:	Analyse the design rules for parameters such as speed, area & power.
CO3	:	Design and write Verilog code for fundamental combinational and sequential circuits.
CO4	:	Apply the VLSI blocks using various architectures.

Reference Books

1. Neil H.E. Waste, David Harris, Ayan Banerjee,“CMOS VLSI Design”, Pearson Education, 3rd Edition, 2006, ISBN: 0321149017

2. Sung MO Kang, Youssef Leblebici,“CMOS Digital Integrated Circuits”, Tata McGrawHill, 3rd Edition, 2003, ISBN: 0-7923-7246-8

3. Douglas. A. Pucknell, Kamaran , Eshraghian, “Basic VLSI Design”,PHI,3rd Edition, 2010, ISBN: 0-321-26977-2

4. John P. Uyemura,“Introduction to VLSI Circuits & Systems”, Wiley India Edition, 2007, ISBN: 978-81-265-0915-7

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1B3T	**ADVANCED CONTROL SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. D.G. Abhilash Krishna				

UNIT - I	**8 Hrs**
Introduction to Digital control system: Review of difference equations and Z - transforms, sampled data systems: ideal sampler, sample and hold operations, Z- transfer function (Pulse transfer function), pulse transfer functions and different configurations for closed loop discrete-time control systems. Z - Transforms analysis of sampled data systems.	
UNIT - II	**8 Hrs**
Mapping between the s-plane and the z-plane, stability analysis of closed loop systems in the zplane Stability analysis (Jury's Stability Test and Bilinear Transformation), State model for continuous time and discrete time systems, Solutions of state equations(for both continuous and discrete systems), discretization of continuous time state equations	
UNIT - III	**8 Hrs**
Concepts of controllability and observability (for both continuous and discrete systems): design of state feedback controllers via pole placement, design of full and reduced order state observers and design of servo systems using pole placement technique. (for both continuous and discrete systems), full order and reduced order observers (for both continuous and discrete systems), dead beat control by state feedback	
UNIT - IV	**9 Hrs**
Optimal control problems using state variable approach: state regulator and output regulator, Linear regulator problem: matrix Riccati equation and its solution, concepts of model reference control systems, adaptive control systems and design. Design of Discrete-time Control Systems: Introduction, Stability analysis of closed-loop systems in the z-plane, Transient and steady state response analysis, Design based on the root-locus method, Design based on the frequencyresponse method.	
UNIT - V	**9 Hrs**
Non Linear Control Systems: Characteristics of nonlinear systems, Singular points, stability of nonlinear systems - phase plane analysis and describing function analysis, Lyapunov's stability criterion, Popov's criterion.	

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

CO1	:	Understand, formulate and obtain transfer function models, solve discrete control engineering problems, use the techniques, tools and skills related to discrete signals to solve complex control engineering problems.
CO2	:	Analyse the concepts of state space, controllability and observability, pole placement technique, optimal & adaptive control and Liapunov stability.

CO3	:	Design the state space models, solution of state equation, state feedback controllers and observers, stability of linear nonlinear systems using phase plane and linear & nonlinear Liapunov method.
CO4	:	Evaluate the performance of state feedback controllers and observers, using pole placement for continuous and discrete systems.

Reference Books

1. Digital Control & State Variable Methods, M. Gopal, 4th Edition, 2012, McGraw Hill Education, ISBN: 9780071333276.

2. Modern Control Engineering, Ogata. K., 5th Edition, 2010, PHI, ISBN: 9788120340107.

3. Discrete Time Control Systems, Ogata K, 2nd Edition, 2011, PHI, ISBN: 9788120327603.

4. Control Systems Engineering, Nagarath and Gopal, 7th Edition, 2012, New Age International Publishers, ISBN: 9788122420081.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: I						
Course Code	:	22MPE1B4T	**SWITCHING TECHNIQUES FOR POWER CONVERTERS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective B (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. D.G. Abhilash Krishna			

UNIT - I	**8 Hrs**
Introduction - Switching Converters Overview of converters and control methods. 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	
UNIT - II	**8 Hrs**
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, Voltage and frequency control of single phase and three-phase inverters.	
UNIT - III	**8 Hrs**
Performance Analysis Analysis of 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 **Analysis of current ripple:** Analysis of 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. **Analysis of torque ripple:** Evaluation of harmonic torques and rms torque ripple, hybrid PWM for reduced torque ripple **Analysis for inverter's loss:** Simplifying assumptions in evaluation of inverter loss, dependence of inverter loss on line 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 on line voltages, dependence on power factor and modulation method, compensation of dead-time effect.	
UNIT - IV	**9 Hrs**
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.	
UNIT - V	**9 Hrs**
Commercial PWM Control ICs and their Applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 resonant mode power supply controller.	

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

CO1	:	understand and explain the basic concepts of swiching techniques for power converters.
CO2	:	Analyze 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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	**22IM21T**	**RESEARCH METHODOLOGY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Common Course to all M.Tech Programs*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Rajeswara Rao K V S			

UNIT - I	8 Hrs
Research Problem: Problem Solving – General Problem Solving, Logical Approach, Soft System Approach, Creative Approach, Group Problem Solving Techniques for Idea Generation. Formulation of Research Problems – Approaches to Research Problem, Exploration for Problem Identification, Hypothesis Generation and Formulation of the problem.	
UNIT - II	9 Hrs
Research Design: Experimental Design – Principles of Experiment, Laboratory Experiment, Experimental Design, Quasi Experimental Design, Action. Research, Validity and Reliability of Experiment and Quasi Experiments. Ex Post Facto Research – Exploratory Research, Historical Research, Descriptive Research, Field Studies, Survey Research, Qualitative Research Methods.	
UNIT - III	8 Hrs
Research Design for Data Acquisition: Measurement Design – Primary types of Measurement scales, Validity and Reliability Measurement, Sample Design – Non-Probability Sampling, Probability Sampling. Data Collection Procedures – Sources of secondary data, Primary data collection methods, Validity and Reliability of data collection procedures.	
UNIT - IV	9 Hrs
Data Analysis: Exploratory Data Analysis, Statistical Estimation, Hypothesis Testing, Parametric Tests, Non-Parametric Tests, Multiple Regression, Factor Analysis, Cluster Analysis	
UNIT - V	8 Hrs
Research Proposal: Purpose, Types, Development of Proposal, Evaluation of Research Proposal. Report Writing: Pre-writing consideration, Format of Reporting, Briefing, Best practices for Journal writing.	

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

CO1	:	Recognize the principles and concepts of research types, data types and analysis procedures.
CO2	:	Apply appropriate method for data collection and analyze the data using statistical principles.
CO3	:	Express research output in a structured report as per the technical and ethical standards.
CO4	:	Develop a research design for the given engineering and management problem context.

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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	22MPE22TL	**ADVANCED POWER CONVERTERS AND APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3-0-1	*(Theory & Practice)*	SEE Marks	:	100
Hours	:	42L + 28P	*(Professional Core - 3)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Hemalatha J N			

UNIT - I	**8 Hrs**
Non isolated dc-dc converters: Comparison of linear and switch mode power converter. Analysis and Design Buck, Boost, Buck-boost, Cuk and SEPIC converters in continuous and discontinuous modes.	
UNIT - II	**8 Hrs**
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 - III	**8 Hrs**
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 - IV	**9 Hrs**
Design of magnetics: Design of inductors and transformers. Closed loop Control of DC-DC converters: Basic control techniques: Voltage control, current control, Design of type 2 and type 3 error amplifiers. Stability analysis of converters	
UNIT - V	**9 Hrs**
Advanced Converters for renewable energy integration and battery charging applications: Interleaved converters. High boost converter, Z source converter, Converters with multiple inputs and multiple outputs, Matrix converters, Bidirectional converters.	
LABORATORY	**28 Hrs**
1. Design and Simulation of DC-DC Converters buck, boost, buck-boost, cuk, SEPIC converters for continuous & discontinuous current mode. 2. Design ,Simulation and testing of load for continuous & discontinuous current mode(Cuk, SEPIC) in open loop and closed loop 3. Design, Simulation and testing of isolated converter for RL load for continuous & discontinuous current mode) in open loop and closed loop. 4. Design, simulation and testing of series resonant converter. 5. Development of Converter for renewable Energy source (Using PV and wind Emulator) 6. Development of converter for EV charging applications.	

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

CO1	:	Understand the basic concepts of various converters, choppers inverters, multi-level inverters, matrix converters and ac regulators.
CO2	:	Analyze the operations of various converters, choppers, inverters, multi-level inverters and ac regulators. Also choose appropriate control techniques and converters.
CO3	:	Design of power converter to meet desired specifications
CO4	:	Evaluate the control techniques for converters.

Reference Books

1. Daniel w Hart , Power Electronics, McGrawHill Education, 1st Edition, 2014, ISBN-13: 978- 007338067.
2. Ned Mohan, Tore M. Undeland, William P Robbins, Power Electronics Converters, Applications, and Design, Wiley India Pvt Ltd, 3rd Edition, 2011, ISBN: 978-0-471-22693-2.
3. Islam, Md Rabiul & Shah, Rakibuzzaman & Ali, Mohd Hasan, Emerging Power Converters for Renewable Energy and Electric Vehicles: Modeling, Design, and Control, CRC Press, 1st Edition, 2021, ISBN:978-0367528034.
4. L Umanand, Power Electronics Essentials & Applications, Willey Publisher, 1st Editon, 2013, ISBN: SBN-978-81-265-1945-3.

Scheme of Continuous Internal Evaluation (CIE): 10 + 30 + 30 + 30 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The average of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 30 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (10), Video based seminar /presentation /demonstration (20) adding upto 30 marks.

Laboratory: Conduction of laboratory exercises, Lab report & observation & analysis (30 Marks), Lab Test (10 Marks) & Innovative Experiment/Concept Design & Implementation (10 Marks) adding up to 50 Marks. The final marks will be reduced to 30 Marks.

Scheme of Semester End Examination (SEE) for 100 marks: Each unit consists of TWO Questions of 16 Marks each. Answer FIVE full questions selecting one from each unit (from 1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.

Rubric for CIE & SEE for Integrated Theory courses with Laboratory

RUBRIC of CIE			***RUBRIC of SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	10	Each unit consists of TWO questions of 16 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5). Question No. 11 is compulsory (Laboratory component) for 20 Marks.		
2	Tests - T1 & T2	30			
3	Experiential Learning - EL1 & EL2	30	1 & 2	Unit-1: Question 1 or 2	16
4	Laboratory	30	3 & 4	Unit-2: Question 3 or 4	16
	Total Marks	100	5 & 6	Unit-3: Question 5 or 6	16
NO SEE for Laboratory			7 & 8	Unit-4: Question 7 or 8	16
			9 & 10	Unit-5: Question 9 or 10	16
			11	Laboratory Component (Compulsory)	20
				Total Marks	100

SEMESTER: II						
Course Code	:	22MPE23T	**PLC AND SCADA SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*(Professional Core - 4)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Suresh C			

UNIT - I	**8 Hrs**

Programmable Logic Controllers An Overview:
Programmable Logic Controllers , Parts of a PLC ,Principles of Operation, Modifying the Operation , PLCs versus Computers, PLC Size and Application.
PLC Hardware Components:
The I/O Section, Discrete, Analog and Special I/O Modules, Typical Discrete and Analog I/O Module Specifications, The Central Processing Unit(CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).

UNIT - II	**8 Hrs**

Fundamentals of Logic:
The Binary Concept , AND, OR, NOT and XOR Function, Boolean Algebra , Developing Logic Gate circuits, from Boolean Expressions, Producing the Boolean Equation for a Given Logic Gate Circuit, Hardwired Logic versus Programmed Logic, Programming Word Level Logic Instructions,
Basics of PLC Programming:
Processor Memory Organization, Program Files, Data Files, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of Operation.

UNIT - III	**8 Hrs**

Fundamental PLC Wiring Diagrams and Ladder Logic Programs :
Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Output Control Devices, Seal-In Circuits, Latching Relays, Converting Relay Schematics into PLC, Ladder Programs, Writing a Ladder Logic Program, Directly from a Narrative Description
Programming Timers:
Mechanical Timing Relays, Timer Instructions, On-Delay Timer Instruction, Off-Delay Timer Instruction, Retentive Timer, Cascading Timers. **Interfacing with different sensors:** Proximity sensors Inductive, capacitive sensors, Photoelectric Sensors and Switches, Encoders, Temperature sensors, position and displacement sensors, pressure sensors,Hydrolic and Pnematic valves.

UNIT - IV	**9 Hrs**

Programming Counters: Counter Instructions, Up-Counter, One-Shot Instruction, Down-Counter, Cascading Counters, Incremental Encoder-Counter, Applications, Combining Counter and Timer Functions **Program Control Instructions:** Master Control Reset Instruction, Jump Instruction, Subroutine Functions, Immediate Input and Immediate Output Instructions, Forcing External I/O Addresses, Safety Circuitry, Selectable Timed Interrupt , Fault Routine, Temporary End Instruction, Suspend instruction.
Data Manipulation Instructions: Data Manipulation, Data Transfer Operations, Data Compare Instructions, Data Manipulation Programs Closed-Loop Control, Math Instructions, Addition Instruction, Subtraction Instruction, Multiplication Instruction Division Instruction.

UNIT - V	**9 Hrs**

SCADA System:
History of Critical Infrastructure Directives, SCADA System Evolution, Definitions and Basic Architecture, SCADA Evolution, SCADA Definition, SCADA System Architecture, SCADA Applications, Redundancy as a Component of SCADA Security, SCADA System Desirable Properties. **SCADA Systems and its application:** Employment of SCADA Systems for various applications. (The Basic Refining Process, Nuclear Power Generation,Conventional Electric Power Generation) **SCADA Protocols:**
Evolution of SCADA Protocols, Overview of the OSI Model, TCP/IP Model. MODBUS Model,IEC61850 Standards, Controller Area Network, Ethernet/IP, Profibus.

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

CO1	:	Understand the basic concepts of PLC and SCADA systems.
CO2	:	Assess the control needs of a process industry and evaluate various options of using PLC or SCADA
CO3	:	Design and program the PLC to meet a specified control objective
CO4	:	Develop a complete control system through integration of sensor with PLC.

Reference Books

1. Frank D. Petruzella , "Programmable Logic Controllers", McGraw-Hill Book Company, 4th Edition, 2010, ISBN 13: 9780073510880.

2. John R. Hackworth and Frederick D. Hackworth, Jr., "Programmable Logic Controllers: Programming Methods and Applications", Pearson/Prentice Hall, 1st Edition, 2004, ISBN-9780130607188.

3. W.Bolton, "Programmable Logic Controllers", Elsevier, 4th Edition, 2006, ISBN-13: 978-0-7506-8112-4.

4. Ronald L. Krutz, "Securing SCADA System", Wiley Publications, 1st Edition, 2007, ISBN: 978-0-764-59787-9.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	22MPE2C1T	**EMI AND EMC IN POWER ELECTRONICS**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Anitha G.S.			

UNIT - I	**8 Hrs**
EMI/EMC CONCEPTS EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards	
UNIT - II	**8 Hrs**
EMI COUPLING PRINCIPLES Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling.	
UNIT - III	**8 Hrs**
EMI Filter Design: EMI Filter Design for Insertion Loss, Calculation of Worst – case Insertion Loss, Design Method for Mismatched Impedance Condition, Design Method for EMI Filters with Common – Mode Choke Coils, Damped EMI Filters and Lossy Filter Elements, HF Characteristics of Noise Filter Circuit Elements, EMI Filter Layout.	
UNIT - IV	**9 Hrs**
EMC DESIGN OF PCBS Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; Vias connection; Terminations.	
UNIT - V	**9 Hrs**
EMI MEASUREMENTS AND STANDARDS Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Standard for EMI/EMC- MILSTD461/462, IEEE/ANSI, CISPR/IEC, FCC regulations, British and Japan standard, VDE standard, EURO norms and Comparison of Standards.	

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

CO1	:	Understanding the EMI/EMC concepts to practical electronic design.
CO2	:	Analyse EMI / EMCmeasurements and standards
CO3	:	Design the various EMIcoupling techniques
CO4	:	Apply the concept for EMI/EMC design of PCBs

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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	22MPE2C2T	**FACTS AND CUSTOM POWER DEVICES**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani			

UNIT - I	**8 Hrs**
Basics of Transmission systems and FACTS Reactive power flow control in Power Systems. Control of dynamic power un-balances in power system. Power flow control. Constraints of maximum transmission line loading. Benefits of FACTS Transmission line compensation. Uncompensated line. Shunt compensation. Series compensation. Phase angle control. Reactive power compensation. Shunt and Series compensation principles. Reactive compensation at transmission and distribution level.	
UNIT - II	**8 Hrs**
SVC AND STATCOM Static versus passive VAR compensator. Static shunt compensators: SVC and STATCOM. Operation and control of TSC, TCR and STATCOM. Compensator control. Comparison between SVC and STATCOM.	
UNIT - III	**8 Hrs**
Series Compensation TSSC, SSSC -Static Voltage and phase angle regulators. TCVR and TCPAR Operation and Control Applications. Static series compensation – GCSC, TSSC, TCSC and their Control.	
UNIT - IV	**9 Hrs**
Unified Power Flow Controller SSR and its damping Unified Power Flow Controller. Circuit Arrangement, Operation and control of UPFC. Basic Principle of P and Q control. Independent real and reactive power flow control, Applications.	
UNIT - V	**9 Hrs**
Interline Power Flow Controller Introduction to interline power flow controller. Modelling and analysis of FACTS Controllers. Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering - shunt, series and hybrid and their control. **Power Quality Issues** Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.	

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

CO1	:	understand the basic concepts of FACT devices
CO2	:	analyse and compare the performance FACTS devices
CO3	:	Design the series and shunt compensators
CO4	:	Evaluate the power quality issues of FACTS devices

Reference Books

1. K R Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International Publishers, 2nd Edition, 2016, ISBN: 978-81-224-2541-3.

2. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 1st Edition, 2001, ISBN:978-8126530403.

3. T. J. E. Miller, “Static Reactive Power Compensation”, John Wiley and Sons, New York, 1st Edition, 1982, ISBN: 978-8126525201

4. K.S.Suresh Kumar, S.Ashok, “FACTS Controllers & Applications”, E-book edition, Nalanda Digital Library, NIT Calicut, 2003.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	22MPE2C3T	**INTELLIGENT CONTROL TECHNIQUES IN DRIVES**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani			

UNIT - I	**8 Hrs**
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	**8 Hrs**
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	**8 Hrs**
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 Hrs**
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 Hrs**
Hybrid algorithms: Neuro-fuzzy systems, ANFIS and extreme-ANFIS, derivative free optimization methods, **Genetic algorithms :** introduction, principle of natural selection, Flow chart of simple genetic algorithm, GA operators and parameters. particle swarm optimization, Solution of typical control problems. Case studies on Application to Electrical Drives.	

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

CO1	:	Explain the concepts ANN and Fuzzy Logic
CO2	:	Analyze the techniques involved in ANN and fuzzy logic applications
CO3	:	Design and model hybrid system with ANN and FL or independent system
CO4	:	Apply techniques in modern industrial drives and power electronics system

Reference Books

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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II						
Course Code	:	22MPE2C4T	**IoT APPLICATIONS IN SMART GRID**	CIE Marks	:	100
Credits L-T-P	:	3 - 0 - 0		SEE Marks	:	100
Hours	:	42L	*Elective C (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani/Indusrty Expert			

UNIT - I	**8 Hrs**
Introduction to IoT: Introduction, Definition of IoT, Proposed architecture and Reference Models, Enabling technologies, challenges. Organizational Implementation and Management Challenges in the Internet of things: Introduction, IoT in Organizations, Managing IoT Systems.	
UNIT - II	**8 Hrs**
The Smart-Grid Concept: Introduction, Actors in the Smart-grid Environment: Grid operator, Grid users, Energy market place, Technology providers, Influencers. **Challenges of Smart-grid:** Inadequacies in Grid Infra Structure, Cyber Security, Storage Concern, Data Management, Communication Issues. **Edge Computing for Smart Grid:** An Overview on Architectures and Solutions: Introduction, IoT Applications, Requirement and Architecture, Information processing in Smart-Grid, Edge Computing in Internet of Things, Edge Computing Model for Smart Grid, A Use-Case for Home Appliance Management.	
UNIT - III	**8 Hrs**
Communication Protocols for the IoT-Based Smart Grid: Introduction, IoT Application types, IoT based Smart-Grid review, Current IoT Based Smart Grid Technology Enablers. **Smart Grid Hardware Security:** Introduction, Smart Grid Architecture Patterns, Hardware Device Authentication, Confidentiality of Power Usage, Integrity of Data, Software and Hardware.	
UNIT - IV	**9 Hrs**
Solar Energy Forecasting in the Era of IoT Enabled Smart Grids: Introduction, The Future Role of Forecasting, Summary of Solar Forecasting Methods, Example of a Detailed, Short-Term Forecasting Method. **The Internet of Things in Electric Distribution Networks:** Introduction, Current Control and Communication Provision in DNOs, AuRA-NMS-Based Electric IoT Architecture, Communication Standards, Protocols, and Requirements of Electric IoT.	
UNIT - V	**9 Hrs**
Intelligence in IoT-enabled Smart Cities: Energy Consumption monitoring in IoT based smart cities, Smart homes in the crowd of IoT based cities, Smart meters for the smart city's grid, Intelligent parking solutions in IoT based smart cities. **Satellite-Based Internet of Things Infrastructure for Management of Large-Scale Electric Distribution Networks:** Introduction, Distributed Control Approach for Smart Distribution Grid, LEO Network Characteristics and Modelling, Communication Performance Assessment.	

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

CO1	:	Discuss the concepts, organizational implementation and challenges of Internet of Things. Understand
CO2	:	Explain the fundamental components for realizing IoT platforms targeting the smart-grid domain. Understand
CO3	:	Design the various applications of IoT in Smart grid and Smart cities.
CO4	:	Evaluate the IOT applications in distribution networks

Reference Books

1. Qusay F. Hassan, Atta ur Rehman Khan, Sajjad A. Madani, "Internet of Things: Challenges, Advances, and Applications", CRC Press (Taylor and Francis group), 1st Edition, 2019, ISBN: 978-1498778510.

2. Kostas Siozios, Dimitrios Anagnostos, Dimitrios Soudris, Elias Kosmatopoulos, "IoT for Smart Grids: Design Challenges and Paradigms", Springer, 1st Edition, 2019, ISBN: 978-3030031695.

3. Fadi Al-Turjman, "Intelligence in IoT-enabled Smart Cities", CRC Press, 1 st Edition, 2018, ISBN: 978-0367656713.

4. James A. Momoh, "Smart Grid: Fundamentals of Design and Analysis", Wiley India, 1st Edition, 2012 ISBN: 978-0470889398

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II

Course Code	:	22BT2D01T	**BIOINSPIRED ENGINEERING**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hr
Faculty Coordinator:		Dr Nagashree Rao and Dr Ashwani Sharma				

UNIT - I **8 Hrs**

Introduction to Bio-inspired Engineering: Macromolecules, Stem cells; types and applications. Synthetic Biology; Bottom-up' and 'top-down' engineering approaches. Synthetic/ artificial life. Biological Clock, Genetic Algorithms.

UNIT - II **9 Hrs**

Principles of bioinspired materials: Biological and synthetic materials, Self-assembly, hierarchy and evolution. Biopolymers, Bio-steel, Bio-composites, multi-functional biological materials. Thermal Properties. Antireflection and photo-thermal biomaterials, Microfluidics in biology, Invasive and non-invasive thermal detection inspired by skin

UNIT - III **9 Hrs**

Lessons from Nature:Bioinspired Materials and mechanism: Firefly-Bioluminescence, Cockleburs –Velcro, Lotus leaf - Self-cleaning materials, Gecko - Gecko tape, Whale fins - Turbine blades, Box Fish / Bone - Bionic car, Shark skin - Friction reducing swim suits, Kingfisher beak - Bullet train, Coral - Calera cement, Forest floor / Ecosystem functioning - Flooring tiles, Morpho butterfly- Structural color, Namib beetle- Water collecting, Termite mound passive cooling, Birds/Insects-flights/ aerodynamics, Mosquito inspired micro needle.

UNIT - IV **8 Hrs**

Biomedical Inspiration-Concept and 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 eye/ bionic eye.

UNIT - V **8 Hrs**

Biomimetics: Inventions in nature for Human Innovation: Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. Bio-ink and 3D-Bioprinting. Cellular automata. Biosensors: Artificial tongue and nose. Biomimetic echolation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bees and Honeycomb Structure. Artificial Intelligence, Neural Networking and bio-robotics.

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

CO1	:	Elucidate the concepts and phenomenon of natural processes
CO2	:	Apply the basic principles for design and development of bioinspired structures
CO3	:	Analyse and append the concept of bio-mimetics for diverse applications
CO4	:	Designing technical solutions by utilization of bio-inspiration modules.

Reference Books:

1. D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, 1st edition, MIT Press, 2008, ISBN: 9780262062718

2. Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. 1st edition, John Wiley, 2018, ISBN: 978-1-119-3903362

3. M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials, 1st edition, Cambridge University Press, 2014, ISBN 978-1-107-01045.

4. Tao Deng. Bioinspired Engineering of Thermal Materials, 1st edtion, Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II							
Course Code	:	22BT2D02T	**HEALTH INFORMATICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr A H Manjunatha Reddy				

UNIT - I	**8 Hrs**
Introduction, Healthcare data, information and knowledge: Data types, data conversion, clinical data warehouse, data analytics, challenges, role of informatics in analytics, future trends	
UNIT - II	**8 Hrs**
Electronic health records: Introduction, scope for the e health records, challenges, examples, logical steps to selecting and implementing EHR	
UNIT - III	**8 Hrs**
Data standards and medical coding: Introduction, medical content standards, termonology standards, transport standards, medical coding and reimbursement, future trends,	
UNIT - IV	**9 Hrs**
Healthcare Enterprise: Overview of Health Informatics: Introduction, Key players in HI, organizations involved, barriers, programs, organizations and career, HI Resoruces	
UNIT - V	**9 Hrs**
Health Information privacy and security: Introduction, basic security principles, authentication and identity management, data security in the cloud and client/server management	

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

CO1	:	Understand the basic principles of Health informatics
CO2	:	Data capture to data transformation and to analysis
CO3	:	Creation of E health records, identify the challenges
CO4	:	Improvise the significant factors as per the spatio-temporal requirements

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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II						
Course Code	:	22CS2D03T	**BUSINESS ANALYTICS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Azra Nasreen and Dr. Badarinath K				

UNIT - I	**9 Hrs**
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling.	
UNIT - II	**9 Hrs**
Trendiness and Regression Analysis Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	
UNIT - III	**8 Hrs**
Organization Structures of Business analytics Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, Predictive Analytics, Predicative Modelling, Predictive analytics analysis.	
UNIT - IV	**8 Hrs**
Forecasting Techniques Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.	
UNIT - V	**8 Hrs**
Decision Analysis Formulating Decision Problems, Decision Strategies with and without Outcome, Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	

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

CO1	:	Apply the concepts and methods of business analytics to solve business problems
CO2	:	Analyse, model and solve decision problems in different settings
CO3	:	Interpret results/solutions and identify appropriate courses of action for a given business scenario
CO4	:	Demonstrate skills like investigation, effective communication, working in team/Individual and following ethical practices by implementing solutions to decision making problems

Reference Books:

1. Business analytics Principles, Concepts, and Applications FT Press Analytics, Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 1st Edition, 2014, ISBN-13: 978-0133989403, ISBN-10: 0133989402
2. The Value of Business Analytics: Identifying the Path to Profitability, Evan Stubs , John Wiley & Sons, |DOI:10.1002/9781118983881,1st Edition 2014, ISBN:978111898388
3. Business Analytics, James Evans, Pearsons Education 2nd Edition, ISBN-13: 978-0321997821 ISBN-10: 0321997824
4. Predictive Business Analytics Forward Looking Capabilities to Improve Business, Gary Cokins and Lawrence Maisel, Wiley; 1st Edition, 2013, ISBN: 978-1-118-17556-9 .

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.
Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes – Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests – T1 & T2	40			
3	Experiential Learning – EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22CV2D04T	**INDUSTRIAL AND OCCUPATIONAL HEALTH AND SAFETY**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr.V.AnanthaRam				

UNIT - I **08Hrs**

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT - II **09Hrs**

Occupational health and safety: Introduction, Health, Occupational health: definition, Interaction between work and health, Health hazards, workplace, economy and sustainable development, Work as a factor in health promotion. Health protection and promotion Activities in the workplace: National governments, Management, Workers, Workers' representatives and unions, Communities, Occupational health professionals. 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 **09Hrs**

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 **08 Hrs**

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - V **08 Hrs**

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, over hauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

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	:	Characterize the different type materials, with respect to safety and health hazards of it.
CO4	:	Analyze the different processes with regards to safety and health and the maintenance required in the industries to avoid accidents.

Reference Books:

1.Maintenance Engineering Handbook, Higgins & Morrow, SBN 10: 0070432015 / ISBN 13: 9780070432017, Published by McGraw-Hill Education. Da Information Services.

2. H. P. Garg, Maintenance Engineering Principles, Practices & Management, 2009,S. Chand and Company, New Delhi, ISBN:9788121926447

3.Fundamental Principles of Occupational Health and Safety, Benjamin O. ALLI, Second edition,2008 International Labour Office – Geneva: ILO, ISBN 978-92-2-120454-1

4.Foundation Engineering Handbook, 2008, Winterkorn, Hans, Chapman & Hall London. ISBN:8788111925428.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22CV2D05T	**INTELLIGENT TRANSPORT SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr.Sunil S			

UNIT - I **8 Hrs**

Introduction: –Historical Background, Definition, Future prospectus, ITS training and educational needs.
Fundamentals of Traffic Flow and Control- Traffic flow elements, Traffic flow models, Shock waves in Traffic streams, Traffic signalization and control principles, Ramp metering, Traffic simulation

UNIT - II **9 Hrs**

ITS User services-User services bundles, Travel and Traffic management, Public Transportation Operations, Electronic Payment, Commercial Vehicles Operations, Emergency Management, Advanced Vehicle Control and safety systems, Information Management, Maintenance and construction Management. ITS Architecture-Regional and Project ITS Architecture, Need of ITS architecture, concept of Operations, National ITS Architecture, Architecture development tool

UNIT - III **9 Hrs**

Technology Building Blocks for ITS-Introduction, Data acquisition, Communication Tools, Data Analysis, and Traveller Information. Various detection, identification and collection methods for ITS. ITS Applications and their benefits-Freeway and incident management systems, Advanced arterial traffic control systems, Advanced Public Transportation Systems, Multimodal Traveller Information systems

UNIT - IV **8 Hrs**

ITS Planning-Transportation planning and ITS, Planning and the National ITS Architecture, Planning for ITS, Integrating ITS into Transportation Planning, relevant case studies. ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing

UNIT - V **8 Hrs**

ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines, Challenges and Opportunities. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options and ITS 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 implimentions

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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22EC2D06T	**ELECTRONIC SYSTEM DESIGN**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof. Ravishankar Holla				

UNIT - I **9 Hrs**

Design Process & its Fundamentals: Life Cycle of Electronic Products, Design and Development Process, Guidance for Product Planning, Design and Development, Technical Drawings, Circuit Diagrams, Computer-Aided Design (CAD)

UNIT - II **9 Hrs**

System Architecture and Protection Requirements: Introduction - Terminology, Functions and Structures, Systems Design Architecture, Electronic System Levels, System Protection
Experiential Learning: (4 quizzes on the below mentioned topics other than CIE) Reliability Analysis: Introduction, Calculation Principles, Exponential Distribution, Failure of Electronic, Components, Failure of Electronic Systems, Reliability Analysis of Electronic Systems, Recommendations for Improving Reliability of Electronic Systems

UNIT - III **8 Hrs**

Thermal Management and Cooling: Introduction - Terminology, Temperatures and Power Dissipation, Calculation Principles, Heat Transfer, Methods to Increase Heat Transfer, Application Examples in Electronic Systems, Recommendations for Thermal Management of Electronic Systems, Cooling systems, liquid, air and non cooling systems.

UNIT - IV **8 Hrs**

Electromagnetic Compatibility (EMC):
Introduction, Coupling Between System Components, Grounding Electronic Systems, Shielding from Fields, Electrostatic Discharge (ESD), Recommendations for EMC-compliant Systems Design

UNIT - V **8 Hrs**

Recycling Requirements and Design for Environmental Compliance: Introduction - Motivation and the Circular Economy, Manufacture, Use, and Disposal of Electronic Systems in the Circular Economy, Product Recycling in the Disposal Process, Material Recycling in the Disposal Process, Design and Development for Disassembly, Material Suitability in Design and Development, Recommendations for Environmentally Compliant Systems

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

CO1	:	Realize the fundamentals of Design, Architecture, thermal management, EMC and Recycling requirements of Electronic System Design
CO2	:	Analyze the various application wise design requirements in Electronic systems along with the related concepts of implementations, standards and Compliances.
CO3	:	Use modern open source tools to realize the various concepts of Electronic system design
CO4	:	Engage in self-study through assignments, simulations, case studies and projects

Reference Books:

1. Fundamentals of Electronic Systems Design, Jens Lienig, Hans Brümmer 2017, Springer International Publishing, ISBN 978-3-319-55839-4, DOI:10.1007/978-3-319-55840-0
2. “Embedded System Design”, Marwedel, Peter, Springer Nature, 10.1007/978-3-030-60910-8
3. “Electromagnetic Compatibility Engineering”, Henry W. Ott, WILEY Publication, ISBN: 978-0-470-18930-6
4. "Handbook of Electronic Systems Design" by Charles A. Harper, McGraw-Hill Inc.,US , 0070266832, 978-0070266834

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
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TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes – Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests – T1 & T2	40			
3	Experiential Learning – EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II							
Course Code	:	22EC2D07T	**EVOLUTION OF WIRELESS TECHNOLOGIES**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Mahesh A				

UNIT - I	**9 Hrs**
Introduction to cellular systems: Overview of Cellular Systems and evolution 2G/3G/4G/5G, Cellular Concepts – Frequency reuse, Co channel and Adjacent channel Interference, C/I, Handoff, Blocking, Erlang Capacity, Bluetooth, WiFi, WWAN and PAN.	
UNIT - II	**9 Hrs**
Fundamentals of wireless communication: Wireless Channel, Wireless propagation, Link budget, Free-space path loss, Noise figure of receiver, Multipath fading, Shadowing, Fading margin, Shadowing margin, Wireless Channel Capacity, OFDM and LTE, Large Scale Propagation effects and Channel Models	
UNIT - III	**8 Hrs**
Fundamentals of 5G architecture: Difference between 4G and 5G, 5G Architecture, Planning of 5G Network, Quality of Service, Radio Network, Requirements, Security, SIM in 5G Era, Specifications, Standardization, Terminal States	
UNIT - IV	**8 Hrs**
mmWave and Visible Light Communications: Back ground and concept of mmWave Communications, Frequency bands, propagation characteristics, channel models, applications and challenges in 5G	
UNIT - V	**8 Hrs**
Future Generations: Future Generations(where is the 6G?), Health Considerations, Identifiers, Interfaces, ,Key Derivation, Location Based Services, Massive Internet of Things, Measurements, Network Functions Virtualization, Network Slicing, Open Source, , User Equipment, Vehicle-to-Vehicle communications (V2V),Virtual Reality (VR/AR/XR). Case study- Bharath Stack	

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

CO1	:	Demonstrate their understanding on functioning of wireless communication system and evolution of different wireless communication systems and standards
CO2	:	Compare different technologies used for wireless communication systems.
CO3	:	Demonstrate an ability explain recent techniques for Wireless Communication systems
CO4	:	Update the latest trends in wireless communications

Reference Books:

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, Pearson, 2nd Edition.
2. Aditya K Jagannatham, “Principles of Modern Wireless Communications”, McGraw Hill, 2017
3. Robin Chataut, Robert Akl, “Massive MIMO Systems for 5G and beyond Networks—Overview, Recent Trends, Challenges, and Future Research Direction” Sensors, May 2020
4. A. N. Uwaechia and N. M. Mahyuddin, A Comprehensive Survey on Millimeter Wave, Communications for Fifth-Generation Wireless Networks: Feasibility and Challenges, in IEEE, Access, vol. 8, pp. 62367-62414, 2020

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes – Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests – T1 & T2	40			
3	Experiential Learning – EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II							
Course Code	:	22ET2D08T	**TRACKING AND NAVIGATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Prof. Shambulinga .M, Dr. B. Roja Reddy			

UNIT - I	**9 Hrs**
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	**8 Hrs**
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	**8 Hrs**
Satellite-based navigation systems: Global Navigation satellite systems (GNSS), GNSS receivers.	
UNIT - IV	**9 Hrs**
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	**8 Hrs**
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

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.
Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II							
Course Code	:	22IM2D09T	**PROJECT MANAGEMENT**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Vikram N Bahadurdesai				

UNIT - I	**8 Hrs**
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	**8 Hrs**
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 Hrs**
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	**8 Hrs**
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 Hrs**
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, 8th Edition, 2010, ISBN 0-07-007793-2.
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: 9812-53-121-1

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22IS2D10T	**DATABASE AND INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof.Smitha G R				

UNIT - I **8 Hrs**

Advanced Database Models, Systems, and Applications : Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases . Distributed Database Concepts : Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases

UNIT - II **8 Hrs**

Introduction to Information Retrieval and Web Search : Information Retrieval (IR) Concepts Retrieval Models, Types of Queries in IR Systems , Text Preprocessing , Inverted Indexing, Evaluation Measures of Search Relevance ,Web Search and Analysis, Trends in Information Retrieval .

UNIT - III **8 Hrs**

Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues, Ethical and Social issues in Information Systems: Understanding ethical and Social issues related to Information Systems, Ethics in an information society, The moral dimensions of information society. A Case study on business planning.

UNIT - IV **9 Hrs**

Achieving Operational Excellence and Customer Intimacy: Enterprise systems, Supply chain management(SCM) systems, Customer relationship management(CRM) systems, Enterprise application. E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, The mobile digital platform and mobile E-commerce, Building and E-commerce web site. A Case study on ERP.

UNIT - V **9 Hrs**

Managing Knowledge:
The knowledge management landscape, Enterprise-wide knowledge management system, Knowledge work systems, Intelligent techniques. Enhancing Decision Making: Decision making and information systems, Business intelligence in the enterprise. Business intelligence constituencies. Building Information Systems: Systems as planned organizational change, Overview of systems development.

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

CO1	:	Understand the different models for Infromation Retrieval.
CO2	:	Appricieate the technology of Information Retrieval and Web Search
CO3	:	To understand the basic principles and working of information technology.
CO4	:	Describe the role of information technology and information systems in business.

Reference Books:

1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.
2. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7th Edition, 2016, Published by Pearson, Copyright © , ISBN-10: 0133970779
3. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110.
4. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2003, McGraw-Hill, ISBN: 9780071231510

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			RUBRIC for SEE		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22IS2D11T	**MANAGEMENT INFORMATION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Prof. Vanishree K				

UNIT - I **8 Hrs**

Overview: Introduction:
Professional Software Development, Software Engineering Ethics, Case studies. Software Processes: Models, Process activities, Coping with Change, Process improvement. The Rational Unified Process. Computer Aided Software Engineering. Agile Software Development: Introduction to agile methods, Agile development techniques, Agile project management and scaling agile methods. Information Systems in Global Business Today: The role of information systems in business today, Perspectives on information systems, Contemporary approaches to information systems

UNIT - II **9 Hrs**

Requirements Engineering and System Modeling:
Software Requirements: Functional and Non-functional requirements. Requirements Elicitation, Specification, Validation and Change. System Modeling: Context models, Interaction models, Structural models, Behavioural models, Model driven architecture. Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues

UNIT - III **9 Hrs**

Development and Testing:
Design and implementation: Object oriented design using UML, Design patterns, Implementation issues, Open-source development. Software Testing: Development testing, Test-driven development, Release testing, User testing.
Securing Information Systems: System vulnerability and abuse, Business value of security and control, Establishing framework for security and control, Technology and tools for protecting information resources. A case study on cybercrime.

UNIT - IV **8 Hrs**

Advanced Software Engineering:
Dependable systems: Dependability properties, Sociotechnical systems, dependable processes, formal methods and dependability, A15 Availability and reliability, reliability requirements, Reliability measurements E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, A Case study on ERP.

UNIT - V **8 Hrs**

Software Management:
Project Management: Risk Management, Managing People, Teamwork, Project Planning: Software Pricing, Plan driven development, Project Scheduling, Agile planning, Estimation Techniques, COCOMO cost modeling. Building Information Systems: Systems as planned organizational change, Overview of systems development.

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

CO1	:	Understand and apply the fundamental concepts of software engineering for information systems.
CO2	:	Develop the knowledge about software engineering for management of information systems.
CO3	:	Interpret and recommend the use information technology to solve business problems.
CO4	:	Apply a framework and process for aligning organization's IT objectives with business strategy.

Reference Books:

1. Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global edition, 2016, ISBN:9781292094007.
2. Ian Sommerville,— Software Engineering, 9th Edition, Pearson Education, 2013, ISBN: 9788131762165
3. W.S. Jawadekar: Management Information Systems, Tata McGraw Hill, 2006, ISBN: 9780070616349.
4. James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100
QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.
TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.
EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			RUBRIC for SEE		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II

Course Code	:	22MAT2D12T	**STATISTICAL AND OPTIMIZATION METHODS**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. PRAKASH R			

UNIT - I **9 Hrs**

Random Vectors:
Probability models of N random variables, Vector notation, Marginal probability functions, Independence of random variables and random vectors, Functions of random vectors, Expected value vector and Correlation matrix, Gaussian random vectors, Expected values of sums, Probability density function of the sum of two random variables, Moment Generating Functions (MGF), MGF of the sum of independent random variables, Characteristic function and Probability generating function.

UNIT - II **8 Hrs**

Estimation: Point estimation, Estimator and estimate, Criteria for good estimates - unbiasedness, consistency, efficiency and sufficiency, Variance of a point estimator, Methods of point estimation - Method of moments and Method of maximum likelihood, Bayesian estimation of parameters.

UNIT - III **9 Hrs**

Inferential Statistics: Principles of Statistical Inference, Formulation of the problems with examples. Test of hypothesis - Null and alternative hypothesis, Procedure for statistical testing, Type I and Type II errors: level of significance, Rejection regions and power, Standard Normal null distribution (Z-test), Z-tests for means and proportions, Duality: two-sided tests and two-sided confidence intervals, P-value, Inference about variances, Special tests of significance for large and small samples (F, Chi – square, Z, t – test).

UNIT - IV **8 Hrs**

Fuzzy Optimization:
Basic concepts of fuzzy sets - Operations on fuzzy sets, Fuzzy relation equations, Fuzzy logic control, Fuzzification, Defuzzificatiuon, Knowledge base, Decision making logic, Membership functions, Rule base.
Artificial Neural Networks: Introduction - Neuron model, Multilayer perceptions - Back propagation algorithm and its variants, Loss functions in artificial neural networks, Stochastic gradient descent method.

UNIT - V **8 Hrs**

Machine Learning Algorithms:
Data mining, Hierarchy Clustering, k-Means Clustering, Distance Metric, Data mining for Big data, Characteristics of Big data, Statistical nature of Big data, Support Vector Machines, Statistical Learning Theory, Linear Support Vector Machine, Kernel functions and Nonlinear Support Vector Machines.

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

CO1	:	Illustrate the fundamental concepts of statistics, random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms.
CO2	:	Derive the solution by applying the acquired knowledge of random variables, estimation, inferential statistics, fuzzy optimization and machine learning algorithms to the problems of engineering applications.
CO3	:	Evaluate the solution of the problems using appropriate statistical and probability techniques to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of statistics, probability distributions and estimation, tests of hypothesis and optimization gained to engage in life – long learning.

Reference Books:

1. Roy D. Yates, David J. Goodman, “Probability and Stochastic Processes”, 3rd Edition, An Indian Adaptation, Wiley, 2021, ISBN: 9789354243455.

2. Douglas C. Montgomery and George C. Runger, “Applied Statistics and Probability for Engineers”, 7th Edition, John Wiley & Sons, 2019, ISBN: 9781119570615.

3. Trevor Hastie Robert Tibshirani Jerome Friedman, “The Elements of Statistical Learning - Data Mining, Inference, and Prediction”, 2nd Edition, Springer, 2009 (Reprint 2017), ISBN-10: 0387848576, ISBN-13: 9780387848570.

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

5. 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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: II

Course Code	:	22ME2D13T	**INDUSTRY 4.0**	CIE Marks	:	100
Credits L-T-P	:	3-0-0		SEE Marks	:	100
Hours	:	42L	*Elective D (Global Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:		Dr. Gopalakrishna H D				

UNIT - I **8 Hrs**

Fundamentals of Industry 4.0
Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS) Industry 4.0 across the Sectors Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications), Fundamentals of Industry 4.0, Introduction, Industry 4.0, RAMI 4.0 (Reference Architecture Model Industry 4.0), Servitization, Product Service-System (PSS)
Industry 4.0 across the Sectors
Introduction, Transportation 4.0: Multimodal Transportation Systems, Rail 4.0, Digital Transformation of Railways, Logistics 4.0 (Implications)

UNIT - II **8 Hrs**

The Concept of the IIoT: Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.

UNIT - III **8 Hrs**

Data Analytics in Manufacturing: Introduction, Power Consumption in manufacturing, Anomaly Detection in Air Conditioning, Smart Remote Machinery Maintenance Systems with Komatsu, Quality Prediction in Steel Manufacturing.
Internet of Things and New Value Proposition, Introduction, Internet of Things Examples, IoTs Value Creation Barriers: Standards, Security and Privacy Concerns.
Advances in Robotics in the Era of Industry 4.0, Introduction, Recent Technological Components of Robots, Advanced Sensor Technologies, Artificial Intelligence, Internet of Robotic Things, Cloud Robotics.

UNIT - IV **9 Hrs**

Additive Manufacturing Technologies and Applications: Introduction, Additive Manufacturing (AM) Technologies, Stereo lithography, 3DP, Fused Deposition Modeling, Selective Laser Sintering, Laminated Object Manufacturing, Laser Engineered Net Shaping, Advantages of Additive Manufacturing, Disadvantages of Additive Manufacturing.
Advances in Virtual Factory Research and Applications, The State of Art, The Virtual Factory Software , Limitations of the Commercial Software.

UNIT - V **9 Hrs**

Augmented Reality: Definitions and application of AR, VR, MR, Limitations of AR, VR, Hardware devices and Software systems, Technical issues and challenges in AR, Industrial applications, IoT and the Need for Data Rationalization
Internet of Things (IoT), Internet of Things Vision, Internet of Things (IoT) Frameworks, Architecture of Internet of Things (IoT), Visualizing the Internet of Things (IoT), Essential Technologies of the Internet of Things (IoT), Key Technologies Involved in Internet of Things, Enablers of IoT, Collaborative Operations , Training.
Smart Factories: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward.
A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.

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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE			***RUBRIC for SEE***		
Sl.No	**Content**	**Marks**	**Q. No**	**Contents**	**Marks**
1	Quizzes - Q1 & Q2	20	Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
2	Tests - T1 & T2	40			
3	Experiential Learning - EL1 & EL2	40	1 & 2	Unit-1: Question 1 or 2	20
	Total Marks	100	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
				Total Marks	100

SEMESTER: II						
Course Code	:	22MPE24L	**EMBEDDED SYSTEMS LAB**	CIE Marks	:	50
Credits L-T-P	:	1 - 0 - 1		SEE Marks	:	50
Hours	:	14L + 28P	*(Coding / Skill Laboratory)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			**Sri C. Suresh**			

Content	**28 Hrs**
1. Experiments with ARM7- Cortex (STM 32F4 Discovery):-Interfacing with Sensor and Accelerometer. 2. Experiments with ARM7- Cortex (STM 32F4 Discovery):- Interfacing with Bluetooth, Working with SPI and I2C 3.Measurement of current and voltage USING ADC OF F28335 ,Altair Embed Software 4. Time period measurement using capture module, Altair embed software 5.generation of PWM signals using f28335, Altair embed software 6.control of PWM signals based on adc values f 28335, Altair embed software 7. Program to control the speed of a 9v permanent magnet dc motor using f28335, Altair embed software 8. Mini Project using ARM cortex processor	

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

CO1	:	Acquire a basic knowledge about fundamentals of ARM 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. Introduction to Embedded Systems, Shibu K V, 1st edition, Tata McGraw Hill Education Private Limited, 2009, ISBN: 10: 0070678790.
2. Embedded System Design: A Unified Hardware/Software Approach, Frank Vahid and Tony Givargis, Wiley India, student edition, 2006, ISBN: 9788126508372.
3. Embedded Software Primer, David E.Simon, Addison Wesley, 2nd edition, John Weily, 2002, ISBN-13: 978-0201615692.
4. Embedded Systems Fundamentals with Arm Cortex-M Based Microcontrollers, A Practical Approach Nucleo-F091RC Edition , ISBN: 9781911531265, 1911531263

Scheme of Continuous Internal Evaluation (CIE- Laboratory) : Only LAB Course 30 + 10 + 10 = 50. The Laboratory session is held every week as per the timetable and the performance of the student is evaluated in every session. The average of marks over number of experiments conducted over the weeks is considered for 30 Marks i.e (Lab Report, Observation & Analysis). The students are encouraged to implement additional innovative experiments in the lab (10 marks). At the end of the semester a test is conducted for 10 Marks (Lab Test). This adds to 50 Marks.

Scheme of Semester End Examination (SEE- Laboratory) : Only LAB Course 40 + 10 =50. Students will be evaluated for Write-up, Experimental Setup, Experiment Conduction with Results, Analysis & Discussions for 40 Marks and Viva will be conducted for 10 Marks adding to 50 Marks.

Only LAB Courses with 50 Marks

RUBRIC FOR CIE			RUBRIC FOR SEE	
Sl.No	Content	Marks	Content	Marks
1	Write Up, Setup, Conduction Results, Analysis & Discussions	30	1. Write Up, Setup, Conduction 2. Results, Analysis & Discussions	40
2	Innovative Experiment/Concept Design & Implementation	10		
3	Laboratory Internal	10	Viva Voce	10
	Total Marks	50	Total Marks	50

SEMESTER: II						
Course Code	:	**22HSS25T**	**PROFESSIONAL SKILL DEVELOPMENT- I**	CIE Marks	:	50
Credits L-T-P	:	2-0-0		SEE Marks	:	50
Hours	:	28L	*Common Course to all M.Tech Programs*	SEE Durations	:	2 Hrs
Faculty Coordinator:			Dr. C.Bindu Ashwini			

UNIT - I	4 Hrs
Communication Skills: Basics of Communication, Personal Skills & Presentation Skills – Introduction, Application, Simulation, Attitudinal Development, Self Confidence, SWOC analysis. Resume Writing: Understanding the basic essentials for a resume, Resume writing tips Guidelines for better presentation of facts. Theory and Applications.	
UNIT - II	8 Hrs
Quantitative Aptitude and Data Analysis: Number Systems, Math Vocabulary, fraction decimals, digit places etc. Simple equations – Linear equations, Elimination Method, Substitution method, Inequalities. Reasoning – a. Verbal - Blood Relation, Sense of Direction, Arithmetic & Alphabet. b. Non- Verbal reasoning - Visual Sequence, Visual analogy and classification. Analytical Reasoning - Single & Multiple comparisons, Linear Sequencing. Logical Aptitude, - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. Verbal Analogies/Aptitude – introduction to different question types – analogies, Grammar review, sentence completions, sentence corrections, antonyms/synonyms, vocabulary building etc. Reading Comprehension, Problem Solving,	
UNIT - III	6 Hrs
Interview Skills: Questions asked & how to handle them, Body language in interview, and Etiquette – Conversational and Professional, Dress code in interview, Professional attire and Grooming, Behavioral and technical interviews, Mock interviews - Mock interviews with different Panels. Practice on Stress Interviews, Technical Interviews, and General HR interviews	
UNIT - IV	5 Hrs
Interpersonal and Managerial Skills: Optimal co-existence, cultural sensitivity, gender sensitivity; capability and maturity model, decision making ability and analysis for brain storming; Group discussion(Assertiveness) and presentation skills;	
UNIT - V	5 Hrs
Motivation: Self-motivation, group motivation, Behavioral Management, Inspirational and motivational speech with conclusion. (Examples to be cited). Leadership Skills: Ethics and Integrity, Goal Setting, leadership ability.	

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

CO1	:	Develop professional skill to suit the industry requirement.
CO2	:	Analyze problems using quantitative and reasoning skills
CO3	:	Develop leadership and inter personal working skills.
CO4	:	Demonstrate verbal communication skills with appropriate body language.

Reference Books:

1. The 7 Habits of Highly Effective People, Stephen R Covey Free Press, 2004 Edition, ISBN: 0743272455
2. How to win friends and influence people, Dale Carnegie General Press, 1st Edition, 2016, ISBN: 9789380914787
3. Crucial Conversation: Tools for Talking When Stakes are High, Kerry Patterson, Joseph Grenny, Ron Mcmillan 2012 Edition, McGraw-Hill Publication ISBN: 9780071772204
4. Ethnus, Aptimithra: Best Aptitude Book ,2014 Edition, Tata McGraw Hill ISBN: 9781259058738

Phase *	Activity
I	Test 1 is conducted after completion 9 of hours of training program (3 Class) for 50 marks Part A- Quiz for 15 Marks and Part B for 50 Marks (Descriptive answers). Part B – 50 Marks is consolidated to 35 and total marks on 50 is 15 + 35 = 50 Marks.
II	Test 2 is conducted after completion 18 hours of training program (6 Class) for 50 marks Part A- Quiz for 15 Marks and Part B for 50 Marks (Descriptive answers). Part B – 50 Marks is consolidated to 35 and total marks on 50 is 15 + 35 = 50 Marks.
	Average of 2 tests is considered as final CIE marks.
Semester End Examination: SEE is conducted for 50 Marks for a duration of 2 hours.	

SEMESTER: III						
Course Code	:	22MPE31T	**MODELLING OF POWER ELECTRONIC CIRCUITS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	***Professional Core - 5***	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. M.N. Dinesh			

UNIT - I	**8 Hrs**
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, block diagrams **MNA and ST approaches:** Nodal analysis, Modified Nodal analysis, the sparse tableau approach. Non linear circuits The Newton-Raphson Method, computation time, convergence issues, nonlinear circuit equations, Practical limit.	
UNIT - II	**8 Hrs**
Transient simulation: Introduction , Discretization of time, 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	**8 Hrs**
Steady state analysis: Direct method for SSW computation, simulation examples, computational efficiency. **Method in DC DC converters**: Simple DC to DC converter, switched mode power converters, more versatile power converters, discontinuous mode of operation in DC to DC converters.	
UNIT - IV	**9 Hrs**
Dynamic performance of switched mode power converters: Introduction, PWM converter, Average model of the converter, Circuit Averaged model of the converter. **Closed loop control of switching converters:** Introduction, Close loop control, closed loop performance functions	
UNIT - V	**9 Hrs**
Bond Graphs:Standard elements, One ports, two ports, steps in obtaining system Model, Bond graph construction, state equation extraction. **case study:** Modelling and simulation of power electronic systems using a bond graph formalism. Case study : on modelling and simulation of SMPS.	

Course Outcomes:

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

CO1	:	Understand the necessity of modelling and challanges in computer simulation
CO2	:	Solve 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 modeliing SMPS with case stufdies

Reference Books

1.Power Electronics Essentials and Applications, L.Umanand, 1st Edition, 2009, John Wiley & Sons, ISBN: 978-81-265-1945-3

2. Power Electronics Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, 2011, Wiley India Pvt Ltd, ISBN : 978-81-265-1090-0

3.Simulation of Power Electronic Circuits, M.B.Patil, V.Ramanarayanan, V.T.Ranganathan, 1st Edition, 2013, Narosa Publishing House, ISBN: 978-81-7319-989-9

4. Power Electronics : Devices, Circuits And Matlab Simulations, Alok Jain, 1st Edition, 2011,Penram International Publishing, ISBN-13: 978-8187972389

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPE3E1T	**EMBEDDED SYSTEMS FOR EV APPLICATIONS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr.K. M. Ajay			

UNIT - I	**8 Hrs**
Automotive Embedded System Oview Automotive Embedded System Technology, Overview of Embedded System Categories, Various Embedded Sub Systems like Chassis, Body, Driveline, Engine, Fuel, Emission, Brakes, Suspension, Emission, Brakes, Suspension, Doors, Safety & Security, Comfort & Multimedia, Communication & Lighting and Future Trends in Automotive Embedded Systems: DRIVE by Wire technologies.	
UNIT - II	**8 Hrs**
Automotive Hardware Module Concept to Market: Understanding Automotive Product Design Cycle, Microcontroller, architecture, Memory map, I/O map, Building Blocks of Automotive Electronic Product: Actuators, Sensors, Semiconductor Components, Devices, Integrated Circuits (ICs), Relay, Stepper motor, PCBs etc.	
UNIT - III	**8 Hrs**
Automotive Sensors Automotive Sensors and Transducers: Temperature, Force, Oxygen Sensor, LAMBDA Sensor, Proximity Distance Sensors, Speed, Engine Knock Sensor, Resistive Potentiometer & Flow. Typical Sensors Specifications & Microcontroller Interfacing, Signal Processing circuit, Sensor Calibration.	
UNIT - IV	**9 Hrs**
Automotive Software Structure of embedded program, infinite loop, and compiling, linking and locating, downloading and debugging, Intra processor Communication Protocols: I2C & I2S, SPI & USB, LIN and CAN. Coding Standards and Guidelines: MISHRA C & Automotive Operating System: AUTOSAR.	
UNIT - V	**9 Hrs**
Verfication & Validation The Validation and Verification Process, Introduction to NI Lab VIEW for Automotive, Test Categories like Functional Test, Black Box Test, Boundary level Test & Test Case Development, Reliability and Certifications Tests: EMI / EMC Tests as per AIS 004 standard, Environmental Test, Vibration Tests, Protection against Dust, Water Ingress and IP Standards Vehicle Diagnostic Interface like OBD, OBD - II.	

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

CO1	:	Understand the overall knwoledge on embedded system technology in automotives, automotive sensors and automotive softwares.
CO2	:	Analyse the integration and working of various embedded systems in the automobiles.
CO3	:	Evaluate the perfromance of various embedded systems using different software platforms
CO4	:	Design of embedded automotive system.

Reference Books

1. Tom Denton, “Automotive Electricals / Electronics System and Components”, Routledge, 3rd Edition, 2004, ISBN:978-0415725774 .
2. Miroslaw Staron, “Automotive Software Architectures: An Introduction”, Springer, 1st Edition, 2017, ISBN: 978-3319586090.
3. Nicolas Navet and Francoise Simonot-Lion, “Automotive Embedded Systems Handbook”, CRC Press, 1st Edition, 2009, ISBN: 978-0-8493-8026-6.
4. Ronald K. Jurgen, “Distributed Automotive Embedded Systems”, SAE International, 1st Edition, 2007, ISBN:978-0768019667.

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QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPE3E2T	**COMMUNICATION SYSTEMS AND NETWORKING**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. S.G. Srivani			

UNIT - I	**8 Hrs**
Introduction to electronic communication : The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, The Electromagnetic Spectrum, Bandwidth. **Amplitude Modulation Fundamentals**: AM Concepts, Modulation Index and Percentage of Modulation, Sidebands and the frequency Domain, AM Power, Single sideband Modulation. **Fundamentals of Frequency Modulation**: Basic Principles of FM, Principles of Phase Modulation, Modulation Index and Sidebands, Noise Suppression Effects of FM, FM Versus AM.	
UNIT - II	**8 Hrs**
Digital Communication Techniques: Digital Transmission of Data, Parallel and serial Transmission, Data Conversion, Pulse Modulation Multiplexing and DE multiplexing: Multiplexing Principles, Frequency Division Multiplexing, Time Division Multiplexing, Pulse Code Modulation, Duplexing	
UNIT - III	**8 Hrs**
The Transmission of Binary data in Communication Systems: Digital Codes, Principles of Digital Transmission, Transmission Efficiency, Modem Concepts and Methods, Wideband Modulation, Broadband Modem Techniques, Error Detection and Correction, Protocols. **Optical Communication**: Optical principles, Optical Communication Systems, Fibber Optic Cables, Optical Transmitters and Receivers, Wavelength Division Multiplexing, Passive Optical Networks	
UNIT - IV	**9 Hrs**
Cell Phone Technologies: Cellular Telephone Systems, The Advanced Mobile Phone Systems (AMPS) Digital cell phone Systems. Computer Networks: Introduction :LAN, MAN, WAN, wireless networks, home networks, Internetwork	
UNIT - V	**9 Hrs**
Networking: Network software, OSI reference model and TCP/IP Reference model and comparison, Physical layer: communication satellites, Data link layer: Error Detection and correction The network layer: Network layer in the internet ,Transport layer: Internet transport protocol Application layer :Electronic mail Case studies : networking and protocol	

Course Outcomes:

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

CO1	:	Understand different analog modulation techniques and applications of AM & FM. Optical communication, computer networks , digital cell phone systems, Layers of OSI model.
CO2	:	Differentiate and evaluate parallel and serial transmission. Analyse different methods analog to digital data conversion.
CO3	:	Analysis of analog, digital communication techniques and multiplexing.
CO4	:	Development and design of communication circuits and networking topologies and protocols.

Reference Books

1. Principles of Electronic communication systems, Louis E. Frenzel, McGraw-Hill 3rd Edition, 2008, ISBN: 0070667551.

2. Simon Haykin, John Wiley, ”An Introduction to Analog and Digital communication “,2nd Edition, 2006,ISBN: 0-07-010829-3 6.

3. George Kennedy ,”Electronic Communication System”- The McGraw-Hill Companies.4th edition, 2006,ISBN-13: 978-0-07- 463682-4.

4. Computer Networks by Andrew S Tanenbaumb, PHI Ltd. Foutth edition.ISBN -978-81-203-2175-5.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

TESTS: Students will be evaluated in test, 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 upto 100 Marks. Final test marks will be reduced to 40 Marks.

EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPE3E3T	**HVDC POWER TRANSMISSION SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3 - 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. M.N. Dinesh			

UNIT - I	**8 Hrs**
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	**8 Hrs**
HVDC CONVERTER: Introduction to line commutated converter, analysis of six and twelve pulse converter without overlap. Effect of smooting 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	**8 Hrs**
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. **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 Hrs**
"**HARMONICS AND ITS SUPPRESSION IN HVDC SYSTEMS:** Importance of Harmonics Study, Generation of harmonics by converters, characteristic harmonics and non characteristic harmonics, Characteristic current harmonics. Design of AC and DC Filters to suppress harmonics. **SMOOTHING REACTOR AND DC LINE:** Smooting reactors, effects of corona loss, DC line insulators, Transient over voltages in DC line, DC breakers."	
UNIT - V	**9 Hrs**
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. **MULTI TERMINAL DC SYSTEM**: Introduction, types ,Parallel operation aspects of MTDC, control and protection.	

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

CO1	:	Understand the importance of 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. Kimbark E.W. ,"Direct current Transmission", Wiley Interscience, 1st Edition, 1971, ISBN:9780471475804.
2. Padiyar K R , "High Voltage Direct Current Power Transmission system- Technology and Systems Interactions" .,Wiley Eastern Ltd, 1st Edition, 1992, ISBN-13: 978-0470217061.
3. Arrillage , ' High voltage direct current transmission", Peter pregrinus , London , 1st Edition, 1983, ISBN: 9780906048979.
4. Adamson C Hingorani N G " High voltage direct current power transmission", Grraway ltd, London, 1st Edition, 1960, ISBN: .

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning and Program specific requirements (15), Video based seminar/presentation/demonstration (25) adding upto 40 marks.

Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER: III						
Course Code	:	22MPE3E4T	**POWER ELCTRONICS FOR RENEWABLE ENERGY SYSTEMS**	CIE Marks	:	100
Credits L-T-P	:	3- 1 - 0		SEE Marks	:	100
Hours	:	42L + 28T	*Elective E (Professional Elective)*	SEE Durations	:	3 Hrs
Faculty Coordinator:			Dr. Pandry Narendra Rao			

UNIT - I	**8 Hrs**
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.	
UNIT - II	**8 Hrs**
Electrical Machines for 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	**8 Hrs**
Power Converters Solar: Block diagram of solar photo voltaic system: Line commutated converters (inversion-mode) - Boost and buckboost 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 Hrs**
Analysis of Wind and PV Systems Stand alone 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.	
UNIT - V	**9 Hrs**
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 - Maximum Power Point Tracking (MPPT).	

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

CO1	:	Understand the 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 perfromance 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.

Scheme of Continuous Internal Evaluation (CIE): 20 + 40 + 40 = 100

QUIZZES: Quizzes will be conducted in online/offline mode. Two quizzes will be conducted & Each Quiz will be evaluated for 10 Marks. The sum of two quizzes will be the Final Quiz marks.

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Scheme of Semester End Examination (SEE) for 100 marks: The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

Rubric for CIE & SEE Theory courses

RUBRIC for CIE

Sl.No	Content	Marks
1	Quizzes - Q1 & Q2	20
2	Tests - T1 & T2	40
3	Experiential Learning - EL1 & EL2	40
	Total Marks	100

RUBRIC for SEE

Q. No	Contents	Marks
Each unit consists of TWO questions of 20 Marks each. Answer FIVE full questions selecting ONE from each unit (1 to 5).		
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
	Total Marks	100

SEMESTER III							
Course Code	:	22MPE32N	**INTERNSHIP**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. 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.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. 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. 6. 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 color for PG circuit Programs and Light Blue for Non-Circuit Programs.

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

CO1: Apply Engineering and Management principles to solve the problems
CO2: Analyze real-time problems and suggest alternate solutions
CO3: Communicate effectively and work in teams
CO4: Imbibe the practice of professional ethics and lifelong learning

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor. The committee shall assess the presentation and the progress reports.

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

Reviews	Activity	Weightage
I	Application of Engineering knowledge in industries, ability to comprehend the functioning of the Organization/ Departments.	40%
II	Importance of Resource Management, Environment and Sustainability. Demonstration and Presentation of Internship work with Report Submission	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.

SEMESTER III							
Course Code	:	22MPE33P	**MINOR PROJECT**	CIE Marks	:	50
Credits L-T-P	:	0 - 0 - 6		SEE Marks	:	50
Hours/Week	:	12		SEE Durations	:	3 Hrs

Guidelines:

1. Each project group will consist of maximum of two students.
2. Each student / group has to select a contemporary topic that will use the technical knowledge of their program of study after intensive literature survey.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The minor project would be performed in-house.
5. The implementation of the project must be preferably carried out using the resources available in the department/college.

Course Outcomes: After completing the course, the students will be able to

CO1: Conceptualize, design and implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply resource managements skills for projects.
CO4: Synthesize self-learning, team work and ethics.

Scheme of Continuous Internal Examination

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor.

Phase *	Activity	Weightage
I	Approval of the selected topic, formulation of Problem Statement and Objectives with Synopsis submission	20 %
II	Mid-term seminar to review the progress of the work with documentation	40 %
III	Oral presentation, demonstration and submission of project report	40 %

* Phase wise rubrics to be prepared by the respective departments

CIE Evaluation shall be done with weightage / distribution as follows:

• Selection of the topic & formulation of Problem Statement and Objectives	10 %
• Design and simulation/ Algorithm development/ Experimental setup	25 %
• Conducting experiments/ Implementation / Testing	25 %
• Demonstration & Presentation	25 %
• Report writing	15 %

Scheme of Semester End Examination (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

• Brief write up about the project 05%
• Methodology and Experimental Results & Discussion 20%
• Presentation / Demonstration of the Project 25%
• Report 20%
• Viva Voce 30%

SEMESTER IV							
Course Code	:	22MPE41P	**MAJOR PROJECT**	CIE Marks	:	100
Credits L-T-P	:	0 - 0 - 18		SEE Marks	:	100
Hours/Week	:	36		SEE Durations	:	3 Hrs

Guidelines:
1. Major Project is to be carried out for a duration of 18 weeks
2. Students must adhere to the Project Presentation Schedule, report to their guide on a weekly basis and get their Project diary signed by their guide 4. Students must execute the Major Project individually and not in teams.
5. It is mandatory for the students to present/publish their project work in National/International Conferences or Journals
6. 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 soft bound and in Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs

Course Outcomes: After completing the course, the students will be able to
CO1: Conceptualize, Design and Implement solutions for specific problems.
CO2: Communicate the solutions through presentations and technical reports.
CO3: Apply project and resource managements skills, professional ethics and societal concerns
CO4: Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination
Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor, Associate Professor/Assistant Professor.

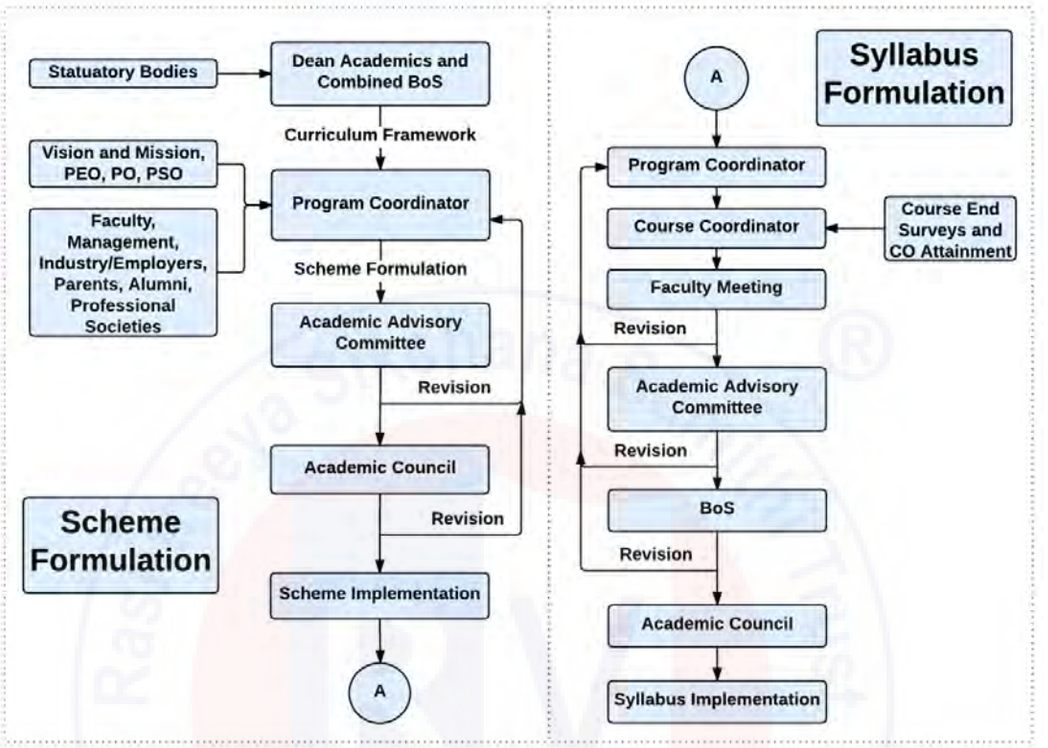
Phase *	Activity	Weightage
I	Selection of Project Title, Formulation of Problem Statement and Objectives	20 %
II	Design, Implementation and Testing	40 %
II	Experimental Result & Analysis, Conclusions and Future Scope of Work, Report Writing and Paper Publication	40 %

* Phase wise rubrics to be prepared by the respective departments

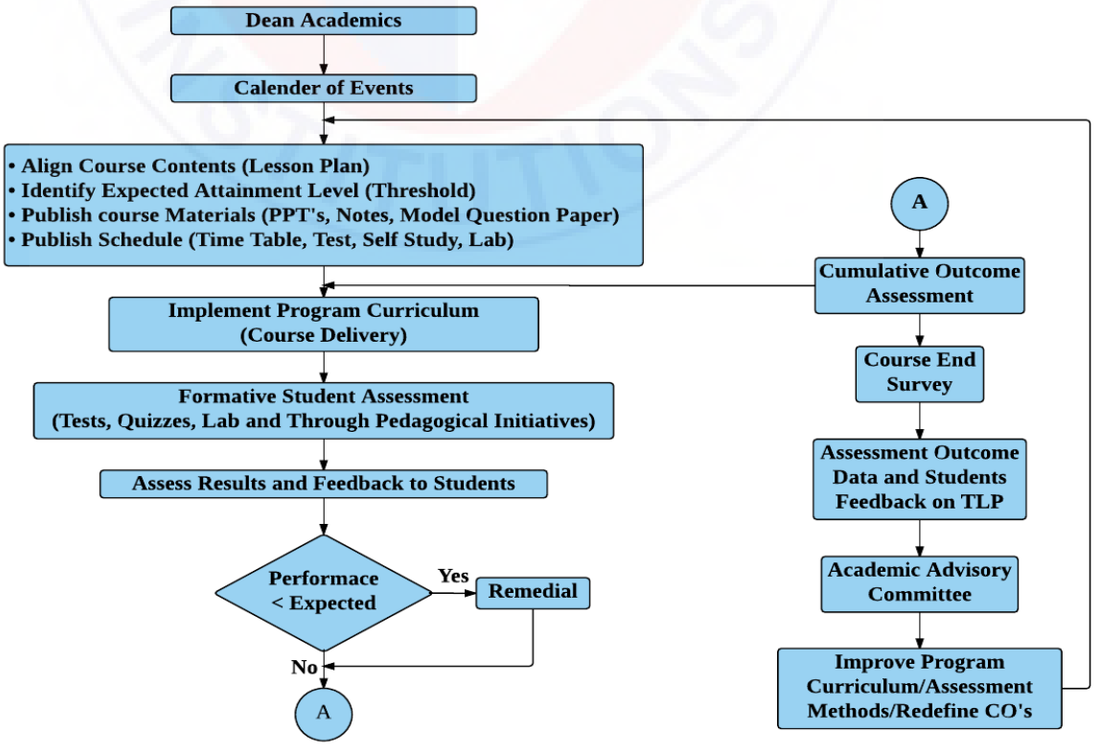
Scheme for Semester End Evaluation (SEE):
Major Project SEE evaluation shall be conducted in two stages. This is initiated after fulfilment of submission of Project Report and CIE marks.
Stage-1 Report Evaluation: Evaluation of Project Report shall be done by the Guide and an External examiner.
Stage-2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

SEE procedure is as follows:			
Report Evaluation	Internal Examiner: 100 Marks	**= 200**	
	External Examiner: 100 Marks	200 / 2 = **100**	**A**
Viva-Voce	Jointly evaluated by Internal Guide & External Evaluator	**= 100**	**B**
	Total Marks = (A + B) / 2 =	**100**	

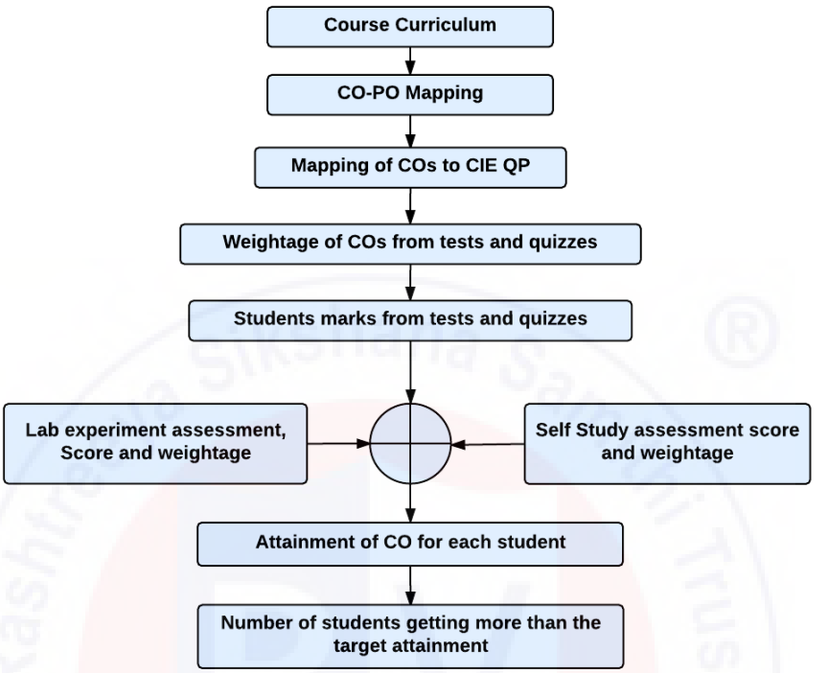
Curriculum Design Process



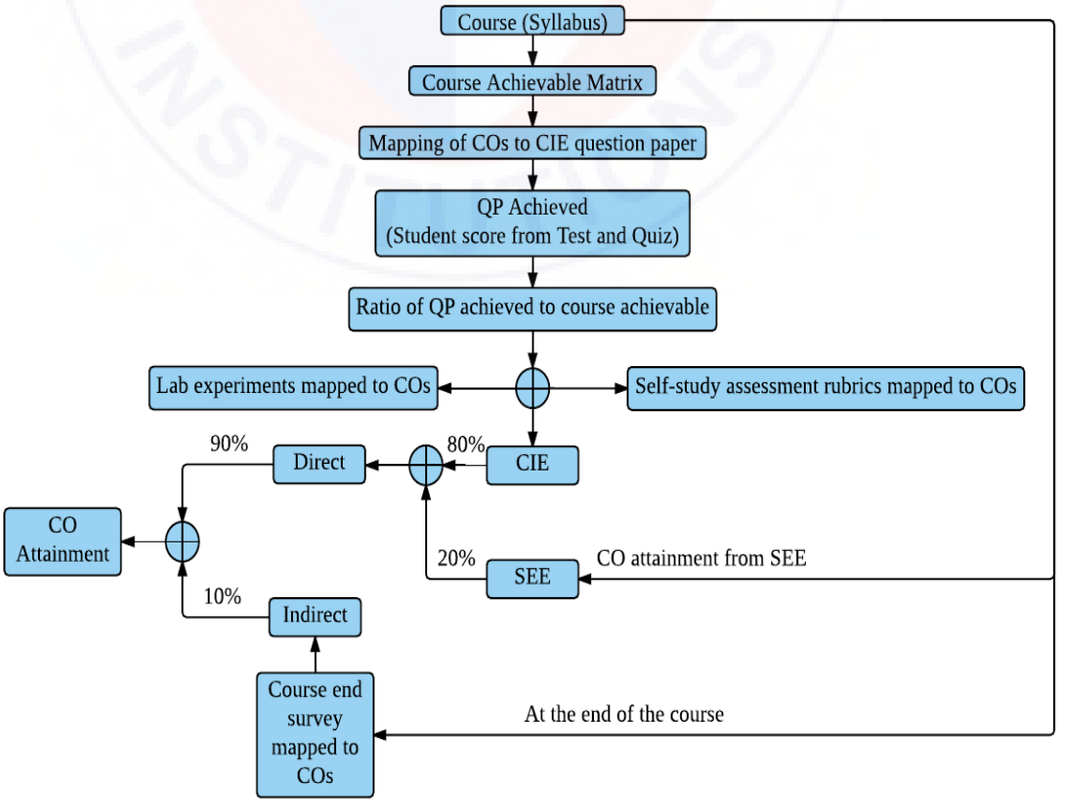
Academic Planning And Implementation



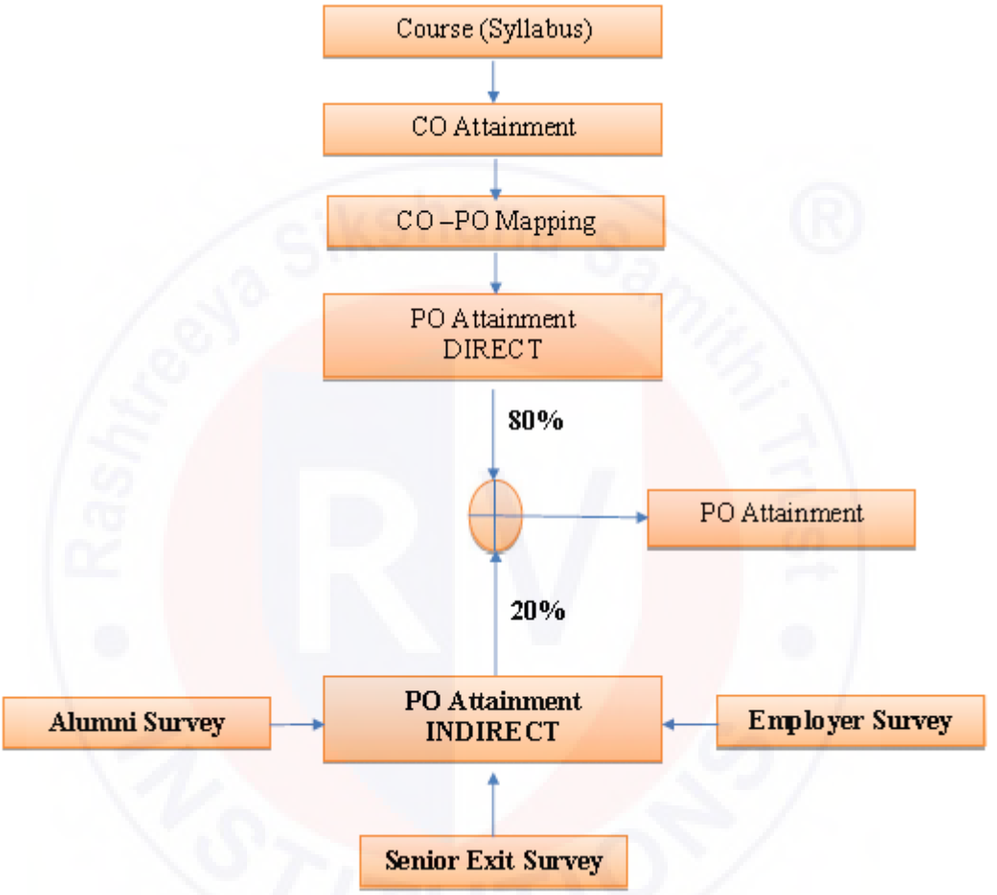
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Innovative Clubs of RVCE

1	**Ashwa Racing**	Ashwa Mobility Foundation (AMF) is a student R&D platform that designs and fabricates Formula theme race cars and future mobility solutions to tackle urban transportation problems.
2	**Astra Robitcs**	Team involved in the design, fabrication and building application specific robots.
3	**Coding Club**	To facilitate students the skills, confidence, and opportunity to change their world using coding and help them become successful in GSoC, ACM-ICPC, and other recognized coding competitions.
4	**Entrepreneurship Development Cell**	E-Cell is a student run body that aims to promote entrepreneurship by conducting workshops, speaker sessions and discussions on business and its aspects. We possess a mentor board to help startups grow.
5	**Frequency Club**	Team aims at contributing in both software and hardware domains mainly focusing on Artificial Intelligence, Machine Learning and it's advances.
6	**Garuda**	Design and development of supermileage urban concept electric car. Indigenous development of E-mobility products.
7	**Jatayu**	Build a low cost Unmanned Aerial Vehicle capable of Autonomous Navigation, Obstacle Avoidance, Object Detection, Localization, Classification and Air Drop of a package of optimum weight.
8	**Solar Car**	Build a roadworthy solar electric vehicle in order to build a green and sustainable environment.
9	**Team Antariksh**	Team Antariksh is a Space Technology Student Club whose goal is to understand, disseminate and apply the engineering skills for innovation in the field of Space technology. designing Nano-Satellite payload for ISRO PS4 Orbital platform, RVSAT-1 along with developing experimental rockets of various altitude.
10	**Team Chimera**	Building a Formula Electric Car through Research and Development in E-Mobility. Electrifying Formula Racing.
11	**Helios Racing**	Team involved in design, manufacturing and testing of All-Terrain Vehicles and other supportive tasks for the functioning of the team. Participating in BAJA competitions organized by SAE in India and the USA.
12	**Team Hydra**	Developing autonomous underwater vehicles and use it for various real world applications such as water purification, solid waste detection and disposal etc.
13	**Team Krushi**	Develop low cost equipments, which help farmers in cultivating and harvesting the crops. Use new technology applications to reduce the labour time hand cost for farmers. Aims at developing implants for Tractors.
14	**Team vyoma**	Design, fabrication and testing of radio controlled aircrafts and research on various types of unmanned aerial vehicles.
15	**Team Dhruva**	Organizing activities like quizzes based on astronomy.Stargazing and telescope handling sessions.Construction of a standard observatory. working on small projects with organizations like ICTS, IIA, ARIES etc.
16	**Ham club**	To popularize Amateur Radio as a hobby among students, alongside exploring technical innovations in the communications domain. Intended to provide human capital for service to the nation at times of natural calamities.

NCC

NCC

एकता और अनुशासन

NSS

राष्ट्रीय सेवा योजना

NATIONAL SERVICE SCHEME

"Not me but you"
" Education through Community Service & Community Service through education"

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 club)**

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 experiential learning 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

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