RV College of Engineering®

Mechanical Engineering

Bachelor of Engineering (B.E)

Scheme And Syllabus Of VII & VIII Semester
(2021 Scheme)

B.E. Programs : AI, AS, BT, CH, CS, CV, 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

2024

99TH
NIRF RANKING IN ENGINEERING (2024)

TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023
1501+
TIMES HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023 (ASIA)
501-600

EDUFUTURE EXCELLENCE AWARD
BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)
BY ZEE DIGITAL

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING INDIA
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

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

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

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

EXECUTED MORE THAN RS.40 CRORES WORTH SPONSORED RESEARCH PROJECTS & CONSULTANCY WORKS SINCE 3 YEARS

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2024

MECHANICAL ENGINEERING

DEPARTMENT VISION

Quality Education in Design, Materials, Thermal and Manufacturing with emphasis on Research, Sustainable technologies, and Entrepreneurship for Societal Symbiosis

DEPARTMENT MISSION

- Imparting knowledge in basic and applied areas of Mechanical Engineering
- Providing state-of-art laboratories and infrastructure for academics and research
- Facilitating faculty development through continuous improvement programs
- Promoting research, education and training in frontier areas of nanotechnology, advanced composites, surface technologies, MEMS and sustainable technology
- Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy
- Imbibing social and ethical values in students, staff and faculty through personality development programs

PROGRAM EDUCATIONAL OBJECTIVES

PEO1 Successful professional careers with sound fundamental knowledge in Mathematics, Physical Sciences and Mechanical Engineering leading to leadership, entrepreneurship or pursuing higher education.

PEO2 Expertise in specialized areas of Mechanical Engineering such as Materials, Design, Manufacturing and Thermal Engineering with a focus on research and innovation.

PEO3 Ability of problem solving by adopting analytical, numerical and experimental skills with awareness of societal impact.

PEO4 Sound communication skills, team working ability, professional ethics and zeal for life-long learning.

PROGRAM SPECIFIC OUTCOMES

PSO1 Project Innovation: Competency, creativity and innovativeness in Mechanical Engineering with Multidisciplinary approach.

PSO2 Research Innovation: Analytical, research and communication skills for placement in industries, research organizations and for pursuing higher education.

PSO3 Special Labs: Knowledge in cutting edge technologies and skills in modern simulation tools.

LEAD SOCIETY

American Society of Mechanical Engineers - ASME

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics
23.	AEC	Ability Enhancement Courses

RV COLLEGE OF ENGINEERING®, BENGALURU - 560 059

(Autonomous Institution Affiliated to VTU, Belagavi)

IV Year BE Programs of 2021 Scheme (Components and Credit Structure)

Mechanical Engineering [ME]

SEVENTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Sl. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**		**Theory**	**Lab**
1	HS	21HS71	Constitution of India and Professional Ethics	3	0	0	3	Theory	**100**	**----**	**3**	**100**	**----**
2	ME	21ME72	Control Engineering	3	1	0	4	Theory	**100**	**----**	**3**	**100**	**----**
3	ME	21ME73GX	Professional Core Elective-III **(Group – G)**	3	0	0	3	Theory	**100**	**----**	**3**	**100**	**----**
4	ME	21ME74HX	Professional Core Elective-IV **(Group- H)**	3	0	0	3	Theory	**100**	**----**	**3**	**100**	**----**
5	XX	21XX75IX	Institutional Electives – II **(Group I)**	3	0	0	3	Theory	**100**	**----**	**3**	**100**	**----**
6	ME	21ME76I	Summer Internship - III	0	0	2	2	Internship	**----**	**50**	**3**	**----**	**50**
7	ME	21ME77P	Minor Project	0	0	2	2	Project	**----**	**50**	**3**	**----**	**50**
8	ME	21ME78	Robust Design	3	0	0	3	Theory	**100**	**----**	**3**	**100**	**----**
			Total				**23**						

RV COLLEGE OF ENGINEERING®, BENGALURU - 560 059

(Autonomous Institution Affiliated to VTU, Belagavi)

IV Year BE Programs of 2021 Scheme (Components and Credit Structure)

Mechanical Engineering [ME]

EIGHTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Sl. No.	BoS	Course Code	Course Title	L	T	P	Credits	Category	Theory	Lab		Theory	Lab
1	ME	21ME81P	Major Project	0	0	12	12	Project	----	100	3	----	100
						Total	12						

INDEX

Semester: VII						
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS **Category: Professional Core** **(Theory)**						
Course Code	**:**	21HS71		**CIE**	**:**	**100**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100**
Total Hours	**:**	45 L		**SEE Duration**	**:**	**3 Hrs**

Unit-I	**09 Hrs**
Salient features of Indian Constitution; Preamble to the Constitution of India; Provisions Relating to Citizenship in India-Modes of Acquisition and Termination of Citizenship of India. Scope & Extent of Fundamental Rights-Articles 14-32 with case studies; Right to Information Act, 2005 with Case studies.	
Unit – II	**09Hrs**
Significance of Directive Principles of State Policy; Fundamental Duties in the Constitution of India; Union Executive- President and State Executive- Governor; Parliament & State Legislature; Council of Ministers; Union and State Judiciary; Emergency provisions; Elections commission. Human Rights & Human Rights Commission.	
Unit –III	**09 Hrs**
Consumer Protection Law - Definition and Need of Consumer Protection; Consumer Rights under the Consumer Protection Act, 2019; Unfair Trade Practice, Defect in goods, Deficiency in services; Product liability and **Penal Consequences, False and Misleading Advertisement, E-Commerce, Alternate dispute Redress mechanism;** Redresses Mechanisms under the Consumer Protection Act, 2019.	
Unit –IV	**09 Hrs**
Introduction to Labour and Industrial Law, Theory and Concept of Industrial Relations, Industrial Relations Code 2020, Code on Social Security 2020, Code on Occupational Safety, Health and Working Conditions 2020, Code on Wages 2020, Industrial Disputes Act ,**The Factories Act, 1948** ,Analysis of Recent Amendments made in Labour Laws	
Unit –V	**09 Hrs**
Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering.Corporate Social Responsibility, Statutory Provision regarding prohibition and prevention of Ragging, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Equips with a comprehensive understanding of the legal and political framework of India, preparing them to engage with complex legal, social, and political issues both as professionals and responsible citizens.
CO2	Effectively advocate for consumer rights, navigate regulatory frameworks, and address emerging challenges in the marketplace & empowers them with the legal knowledge and practical skills necessary to protect consumers and promote fair business practices.
CO3	Equipping with the knowledge and skills to navigate legal, ethical, and social issues in their professional and personal lives & Cultivate a sense of professional integrity and responsibility, emphasizing the importance of ethical behavior in engineering.
CO4	Apply the knowledge to solve practical problems with regard to personal issues & business enterprises

Reference Books	
1.	Dr. J. N Pandey, Constitutional Law of India, Central Law Agency, 2023 Edition
2.	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5th Edition, 2015, ISBN: 9789351452461.
3.	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 8th Kindle Edition 2023, ASIN : B0C5CCJX63

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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 up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar / presentation / demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE(THEORY)	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
CONTROL ENGINEERING **Category: Professional Core** **(Theory)**						
Course Code	**:**	21ME72		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L + 30 T		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction to Control Systems: Open-loop and closed-loop systems, typical Block Diagram Analysis for understanding system behavior and stability. Applications of Control Systems across engineering, automation, aerospace, and robotics. Differential Equation Model for describing system dynamics. Electrical Circuits representation and analysis in control systems. F-V and F-I Analogy application in control system design. Translational and Rotational Mechanical Systems modeling for control applications. Problem Solving exercises	
Unit – II	**09 Hrs**
Block Diagram Algebra and Signal Flow Graphs: Fundamental concepts of block diagram representation, including techniques for constructing block diagrams to model various systems. Applications of block diagrams in representing complex systems or processes and analysing system interactions. Signal flow graphs as an alternative system representation and their analysis to understand signal paths. Problem-solving exercises. **Control System Components**: DC and AC servomotors, tachometers, amplidynes, hydraulic and pneumatic systems, and stepper motors	
Unit –III	**09 Hrs**
Root Locus : R-H criterion, angle and magnitude criterion, Properties of Root Loci, Drawing Root Locus Diagrams, Determination of Damping Ratio, Gain Margin, and Phase Margin from Root Locus, stability analysis. Simple problems **Frequency Response: Nyquist and Bode Diagrams**: Nyquist criteria, sketching and obtaining gain and phase margin through Nyquist diagram, Bode plots: Magnitude vs Phase plots, understanding the relationship between magnitude and phase in logarithmic scale plots. Simple problems	
Unit –IV	**09 Hrs**
State Space Analysis of Control Systems: Introduction to State Space Analysis covering the transition from classical to modern control theory. Understanding the Generalized State Equation as a fundamental representation of dynamic systems. Techniques for Deriving System State-Space Equations from differential equations or transfer functions. Conversion of State Equations to Transfer Functions for analysis and design. Solution of State Vector and exploration of the State Transition Matrix. Exploring Controllability and Observability concepts.	
Unit-V	**09 Hrs**
Types of Controllers: Overview of control actions including Proportional (P), Integral (I), and Derivative (D) pneumatic controllers. Understanding the combination of these controllers in PD, PI, and PID configurations for various control applications **MATLAB in Control System Design**: Utilizing MATLAB's Control System Toolbox for system analysis, design, and tuning. Hands-on experience in control system design and tuning processes. Exploration of automated PID tuning techniques and Graphical Bode Design methods. Practical application through solving simple control system problems using MATLAB.	

Experiential Learning

Students must do four exercises from the following. (Each exercise carries 10 marks)

1. Programmable Logic Controller (PLC) Based Level Control System

2. Flow Control Characteristics Investigation using Flow Control Trainer

3. Temperature Control Performance Analysis with Temperature Control Trainer

4. PID Controller Tuning and Response Evaluation on PID Controller Trainer
5. Dynamic Response Study of DC Position Servo Mechanism using Demo Unit
6. Characterization of Inductive Transducer for Position Sensing Applications
7 Modal Testing of MS Cantilever Beam for Modal Parameter Estimation using FFT Analyzer
8 Modal Testing of Aluminum Plate in Free-Free Condition for Modal Parameter Estimation
9 Characterization of Step, Ramp, and Impulse Responses of First and Second Order Systems
10 Time Domain Specification Analysis of Under-Damped Second Order System
11 Stability Analysis of Control Systems using Routh-Hurwitz and Root Locus Methods
12 Frequency Response Analysis of Control Systems using Bode and Nyquist Plots

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand fundamental principles of control engineering, including concepts of feedback, stability, and control system design methodologies
CO2	Apply mathematical modeling techniques to analyze and design control systems for various engineering applications
CO3	Demonstrate proficiency in utilizing control system tools and software for simulation, analysis, and implementation of control strategies.
CO4	Develop the ability to evaluate and optimize control systems' performance through analysis of system dynamics, controller design, and tuning methodologies

Reference Books	
1.	Modern Control Engineering", Katsuhiko Ogata, Pearson Education, 2010, ISBN: 978-0136156734
2.	Feedback Control of Dynamic Systems", Gene F. Franklin, J. Da Powell, and Abbas Emami-Naeini, Pearson Education, 2019, ISBN: 978-0133496598
3.	Automatic Control Systems", Benjamin C. Kuo and Farid Golnaraghi, Wiley, 2008, ISBN: 978-0470048962

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
AI FOR MECHANICAL ENGINEERS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME73GA**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Introduction to Artificial Intelligence: Definition and scope of Artificial Intelligence (AI), Distinction between narrow AI and general AI, Overview of Artificial Intelligence and its subfields, Historical development and Milestones in AI, Applications of AI in Mechanical Engineering, Ethical considerations and societal impacts of AI.	
Unit – II	**09 Hrs**
Machine Learning Fundamentals: Introduction to machine learning: supervised, unsupervised, and reinforcement learning, Data preprocessing and feature engineering, Regression analysis and predictive modelling, Classification algorithms: decision trees, support vector machines, and neural networks	
Unit – III	**09 Hrs**
AI Applications in Design and Optimization: Genetic algorithms and evolutionary computation, Swarm intelligence and particle swarm optimization, Optimization techniques for engineering design problems, Case studies: Design optimization using AI techniques	
Unit – IV	**09 Hrs**
AI for Predictive Maintenance and Fault Detection: Introduction to predictive maintenance, Sensor data analysis and anomaly detection, Prognostics and health management (PHM) systems, Condition-based monitoring using AI algorithms, Real-world applications in mechanical systems maintenance.	
Unit – V	**09 Hrs**
Autonomous Systems and Robotics: Introduction to autonomous systems and robotics, Perception and decision-making in autonomous systems, Control architectures: reactive, deliberative, and hybrid, Reinforcement learning for robotic control, Applications of AI in autonomous vehicles, drones, and manufacturing robots.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Describing fundamental concepts of AI within the theme.
CO2	Designing and Analyzing AI Components for problem solving.
CO3	Identifying, formulating and Solving Mechanical Engineering problems using AI.
CO4	Determining and applying AI principles in Mechanical Engineering applications.

Reference Books	
1	"Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, Pearson publisher, 2020, ISBN-13: 978-0134610993
2.	"Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy, The MIT Press, 2012, ISBN-13: 978-0262018029
3.	"Introduction to Autonomous Robots" by Nikolaus Correll, Bradley Hayes, et al., MIT Press, 2019, ISBN-13:978-0262038621
4	"Predictive Maintenance of Industrial Control Systems" by Fan Yang and Andrew Kusiak, Wiley-IEEE Press, 2019, ISBN-13: 978-1119387853

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
	1. Machine Learning Applications in Mechanical Systems Optimization 2. Neural Network Modeling for Predictive Maintenance in Machinery 3. Robotics and Automation: Hands-on Experience with AI-driven Systems 4. Natural Language Processing for Human-Machine Interaction in Manufacturing 5. Computer Vision Techniques for Quality Control in Production Processes 6. Reinforcement Learning for Autonomous Control of Mechanical Systems 7. Genetic Algorithms for Design Optimization in Engineering 8. Deep Learning Applications in Structural Health Monitoring 9. Fuzzy Logic Control Systems for Robotic Manipulation 10. Artificial Intelligence in Additive Manufacturing: Opportunities and Challenges	**40**

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
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2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
INDUSTRIAL AUTOMATION						
Course Code	**:**	**21ME73GB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Prerequisites: NIL

Unit-I	**09 hrs**

Introduction to Industrial Automation

Automation in production systems, principles and strategies, levels of automation, automation and artificial intelligence, Industrial automation circuits, process industries and discrete manufacturing industries, continuous vs discrete control, computer based industrial control and automation.

Unit-2	**10 hrs**

Robot Drives and Actuators

Classification of end effectors, mechanical, magnetic and vacuum grippers, Functions of drive systems, positive displacement pumps – gear, vane and piston types, hydraulic actuators, basic elements used in hydraulic circuits, positive displacement compressors, pneumatic actuators, electric motors – DC, AC, servo, stepper.

Unit - 3	**10 hrs**

Sensors and Robot vision systems

Encoders, LVDT, Wrist sensors, Proximity and range sensors, electro optical imaging sensors, Machine vision system functions, sensing and digitising, preprocessing – masking, neighbourhood averaging, median filtering (Numericals), higher level vision, applications of robot vision system.

Unit-4	**08 hrs**

Petrinet modelling for automated systems

Classical petrinets – preliminary definitions, transitional firing and reachability, representational power, properties of petrinets. Stochastic petrinets – exponential timed petrinets. Generalized stochastic petrinets – firing rules, analysis, computation of performance measures. (Problems), Developing simple petrinet models for automation applications.

Unit-5	**08 hrs**

Logical Design of Automation circuits

Postulates and theorems of Boolean algebra, Classical state diagrams, state diagrams with sensors, step by step transition due to discrete successive signal, state diagram with time relays, components state diagram method, state diagrams and minimum realisations, sequential automation systems, Applications – Bi directional lead screw movable worktable with two speeds, Palindromic movement of a worktable with memory**.**

Course Outcomes:	
CO1	Recall and Illustrate the application of sensors actuators, switching elements and inspection technologies in industrial automation.
CO2	Build the circuit diagrams for fluid power automation, robot vision and identify its application areas.
CO3	Evaluate the concepts of analytical modeling paradigms for automation using state diagrams and Petri Nets.
CO4	Develop a suitable industrial automated system integrating all of the above advanced automation concepts

Reference Books	
1	Automation, production systems and computer integrated manufacturing, Mikell P Groover, 4th edition, 2016. Pearson education –ISBN: 978-9332572492
2	Performance modelling of automated manufacturing systems, N Vishwanadham, Y Narahari, 2015. PHI learning pvt ltd, ISBN: 978-81-203-0870-1
3	Stamatios Manesis, George Nikolakopoulos, 'Introduction to Industrial Automation', CRC Press, 2018, ISBN - 978-1-4987-0540-0
4	Robotics and Flexible Automation, SR Deb, S Deb, 2nd edition, 2017, McGrawhill Education, - ISBN – 0-07-007791-6

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
AERODYNAMICS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME73GC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Concepts of fluid dynamics – Basic Governing Equations: Continuity, Momentum, Energy and Navier-Stokes equation, Angular velocity, Vorticity, Strain, Circulation, Stream Function, Velocity Potential, Coefficient of Pressure, Pressure distribution on Air foil	
Unit – II	**09 Hrs**
Potential Flows: Governing Equation: Laplace Equation, Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink, Doublet flow, Non-lifting flow over a circular cylinder, Vortex flow, Lifting flow over a circular cylinder, Kutta-Joukowski theorem and generation of Lift, D'Alembert's paradox.	
Unit – III	**09 Hrs**
Incompressible Flow over Airfoils – Airfoil characteristics, Vortex Sheet, The Kutta Condition, Kelvin's circulation theorem and the starting vortex, Classical thin airfoil theory for symmetric Airfoil and cambered airfoil, Effect of Airfoil Thickness, Camber on the Airfoil Aerodynamic Characteristics.	
Unit – IV	**09 Hrs**
Incompressible Flow Over Finite Wings – Downwash and induced drag on wings, Vortex Filament, Biot-Savart law and Helmholtz's theorems, Infinite and semi-infinite vortex filament, Prandtl's classical lifting line theory, Limitations of Prandtl's lifting line theory, Lifting surface theory.	
Unit – V	**09 Hrs**
Aerodynamic simulation – Flow Similarity, Principles of wind tunnel operation: Low speed, Transonic, supersonic and Hypersonic wind tunnels, Measurement Techniques in Wind Tunnels: Pressure Measurements, Force Balance, Hot wire anemometer.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Apply fundamental principles of fluid dynamics to analyze the aerodynamic behavior of airfoils and wings.
CO2	Analyze potential flows to assess the aerodynamic performance of different bodies.
CO3	Determine the characteristics of incompressible flow pertaining to airfoils and wings.
CO4	Evaluate and simulate aerodynamic performance using wind tunnel measurement techniques.

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**M**
	1. Wind Tunnel Testing: Design and conduct experiments to analyze airflow patterns and aerodynamic characteristics of various shapes and objects in a wind tunnel. 2. Flight Simulation: Utilize flight simulators to experience and understand the effects of aerodynamic forces on aircraft performance and handling. 3. Model Aircraft Design: Design, build, and test model aircraft to investigate aerodynamic principles such as lift, drag, and stability.	**40**

4. Glider Construction and Flight: Construct gliders and conduct flight experiments to explore aerodynamic concepts related to lift generation and glide performance. 5. Airfoil Analysis: Experiment with different airfoil shapes and angles of attack to study their aerodynamic properties and performance characteristics. 6. UAV (Drone) Design: Design and test unmanned aerial vehicles (UAVs) to analyze aerodynamic efficiency, stability, and maneuverability. 7. Fluid Dynamics Demonstrations: Conduct hands-on demonstrations of fluid flow phenomena to observe and analyze aerodynamic principles in action. 8. Computational Fluid Dynamics (CFD): Use CFD software to simulate and visualize airflow around objects, providing insights into aerodynamic behavior and performance. 9. Aerospace Engineering Projects: Engage in team-based projects such as designing and building rockets, airplanes, or hovercraft to apply aerodynamic principles in real-world applications. 10. Aerodynamics in Sports: Investigate the aerodynamics of sports equipment (e.g., soccer balls, cycling helmets) through experimental testing and analysis to optimize performance and efficiency.	

Reference Books	
1	Fundamentals of Aerodynamics, Anderson J.D., 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
2	Aerodynamics for Engineering Students, E. L. Houghton, P.W, Carpenter 5th Edition, 2010, Elsevier,New York. ISBN: 9780080493855.
3	Aerodynamics,Clancy L. J., Sterlingbook house, 5th Edition, 2006, New Delhi. ISBN: 9788175980570
4	Theoretical Aerodynamics, Louis M. Milne-Thomson, Imported Edition, 4th Edition, 2011, Dover Publications, USA, ISBN: 080-075961980.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
ACOUSTICS AND NOISE CONTROL **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME73GD**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Fundamentals of Acoustics - Sound, Acoustics, Noise Pollution, Wave propagation, The Equation of State, The Equation of Continuity, The Simple Force Equation Euler's Equation, The Linear Wave Equation, Speed of Sound in Fluids, Harmonic plane Waves, Energy Density, Acoustic Intensity, Specific Acoustic Impedance, Spherical waves, Decibel Scales, Cylindrical Waves	
Unit – II	**09 Hrs**
Reflection and Transmission in fluids – Change in Media, Transmission from one fluid to another; Normal incidence, Transmission though a Fluid Layer; Normal Incidence, Transmission from one fluid to another oblique incidence, Normal specific acoustic impedance. **Reflection and Transmission in solids –** Reflection from the surface of a solid, Transmission though a thin partition, Method of Images.	
Unit – III	**09 Hrs**
Acoustic Measurements – Sound Level Meters, Intensity Level Meters, Octave Band Filters, Acoustic analysers, Dosimeter, Measurement of Sound Power, Sound Power Measurement in a Reverberant Room, **Sound Power Measurement** – Anechoic or Semi-Anechoic Room, sound Power Survey Measurements, Measurement of the Directivity Factor, Noise Measurement Procedures, Problems.	
Unit – IV	**09 Hrs**
Noise Sources – Sound Transmission Indoors and Outdoors, Fan Noise, Electric Motor Noise, Pump Noise, Gas compressor Noise, Transformer Noise, Cooling Tower Noise, Noise from gas ventilation, Appliance and Equipment noise, Valve noise, Air Distribution system noise, Noise Control, Historical Background, Principles of Noise Control, Noise Control at the source, Noise Control in the transmission path, Noise control at the Receiver.	
Unit – V	**09 Hrs**
Noise Standards – ISO guidelines for Noise control, dB Arithmetics, Octave band frequency analysis, Noise rating, Acoustic mathematics, transmission loss, insertion loss.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Identify various sources of industrial noise and understand their impacts
CO2	Formulate mathematical models to characterize industrial noise source
CO3	Assess and implement control mechanisms to mitigate noise from diverse industrial sources
CO4	Implement ISO standards to ensure effective noise control practices in industrial settings

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1.	Sound Absorption Coefficients Measurement Using Impedance Tube Metho.	**40**
2.	Characterization of Room Acoustics Through Reverberation Time Measurements	
3.	Design and Construction of Acoustic Panels for Noise Reduction	
4.	Analysis of Sound Transmission Loss in Building Structures	
5.	Evaluation of Noise Levels in Different Industrial Environments	

6. Testing and Calibration of Sound Level Meters 7. Study of Active Noise Control Techniques Using Adaptive Filters 8. Acoustic Design of Auditoriums and Performance Spaces 9. Measurement and Analysis of Noise Pollution in Urban Environments 10. Implementation of Noise Control Strategies in HVAC Systems	

Reference Books	
1	M. L. Munjal, Noise and Vibration Control, 2014, World Scientific Press: Singapore, 1st Edition, ISBN 978-981-4434-737
2.	E. G. Williams, Fourier Acoustics: Sound Radiation and Near Field Acoustic Holography, 1999, Academic Press: New York, 1st Edition, ISBN: 13-978-0127539607
3.	R J Peteres, Acoustics and Noise Control, Taylor & Francis India, 2019, 3rd Edition, ISBN 13-9781138653504
4	Möser & Michael, Engineering Acoustics - An Introduction to Noise Control, 2019, 1st Edition, Springer Publications, ISBN: 13-978-3540927228

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
RELIABILITY & MAINTAINABILITY ENGINEERING **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME73GE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Probability Theory - Concepts and Definitions – Reliability, Maintainability and Availability, Reliability and quality, Basic elements of reliability, Achievement of reliability, Measurement of Reliability, Causes of failures and unreliability, Elementary properties of probability, Random Experiments, Events, Sample Space, Probability rules, Conditional Probability, Bayes' theorem, Theorem of total probability, independent events, Random variables, Discrete distributions, Continuous distributions, Mathematical expectation and variance of random variables	
Unit – II	**09 Hrs**
Failure Data Analysis – Failure density, failure rate, Reliability function, PDF, CDF, MTTF, MTBF, Hazard rate function, Bath Tub curve, Time dependent hazard models, Stress dependant hazard models, Conditional Reliability **Failure Models –** Constant Failure Rate Model – Exponential Reliability Function, Failure Modes, Applications, Two-Parameter Exponential Distribution, Poisson Process, Redundancy and the CFR Model,Time-Dependent Failure Model –Weibull distribution, Normal distribution and Lognormal distribution	
Unit – III	**09 Hrs**
Reliability of systems – Serial, parallel and combined configurations, System structure function, Minimal Cuts and Minimal Paths, Common Mode failures, Three-state devices – Series Structure, Parallel Structure, Low- Level Redundancy and High-Level Redundancy **Reliability of state-dependent systems –** Markov Analysis, Load-sharing system, Stand-by system – Identical Standby Units, Standby System with Switching Failure, Three-Component Standby system, Degraded system	
Unit – IV	**09 Hrs**
Design for reliability – Reliability analysis, Reliability design process, Reliability specification and system measurements – System Effectiveness, Economic Analysis and Life-Cycle Costs, Reliability allocation – Exponential case, Optimal Allocations, ARINC, AGREE method, Redundancies, Design methods – Parts and material selection, Derating, Redundancy Optimization, FMEA, FTA	
Unit – V	**09 Hrs**
Design for maintainability – Analysis of downtime, Repair-time distribution – Exponential Repair Times, Lognormal Repair Times, System repair time, Reliability under preventive maintenance, State- dependant systems with repair, Maintenance requirements – Measurement and Specifications, Maintenance Concepts and procedures, Component Reliability and maintainability, Design methods – Preventive and Predictive maintenance	

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1.	Filtering observations in Excel	**40**
2.	Distribution Sampling in Excel	
3.	Descriptive Statistics	
4.	Hypothesis testing	
5.	Exploratory Data Analysis	
6.	Modeling data	
7.	Time Series Analysis	
8.	Monte Carlo Simulations	
9.	Power Analysis	
10.	Statistical Process Control	
11.	Design of Experiments	
12.	Data management	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Identify statistical tools to characterize the reliability and maintainability.
CO2	Establish reliability and maintainability strategies for efficient running of the systems.
CO3	Formulate the statistical models to enhance system reliability.
CO4	Develop reliable and maintainable systems.

Reference Books	
1	Probability & Statistics for Engineers and Scientists, Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, 2012, Pearson Publication, ISBN 10: 0-321-62911-6 ISBN 13: 978-0-321-62911-1
2.	An Introduction to Reliability and Maintainability engineering; Charles E. Ebeling, 2004,Tata McGraw-Hill Publishing Company Limited, ISBN - 13 : 978-0-07-042138-7 ISBN - 10 : 0-07-042138-2
3.	Reliability Engineering, E Balagurusamy, 1984, Tata McGraw-Hill Publishing Company Limited, ISBN - 13 : 978-0-07-048339-2 ISBN - 10 : 0-07-048339-6
4	Reliability Engineering, L S Srinath, East-West Press Pvt. Ltd 2005, ISBN 13: 9788176710480

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
ADVANCED FINITE ELEMENT METHOD **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME73HA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
MATHEMATICAL PRELIMINARIES Set Notation, Function Notation, Vectors, Matrices, Tensors, Partial Differential Equations, Variational Calculus.Finite Element Basics. Weak Form of PDEs, Linear Time-Dependent Heat Equation, Finite Element Basis Functions, Time Integration.	
Unit – II	**09 Hrs**
BENDING OF PLATES AND SHELLS Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements –Degenerated shell elements- Application & Examples	
Unit – III	**09 Hrs**
NON-LINEAR PROBLEMS Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity Plasticity – Visco Plasticity – Geometric Non linearity – large displacement Formulation–Solution procedureApplication in Metal Forming Process and Contact Problems	
Unit – IV	**09 Hrs**
DYNAMIC PROBLEM Direct Formulation – Free, Transient and Forced Response – Solution Procedures – Eigen solution- Subspace Iterative Technique – Response analysis-Houbolt, Wilson, Newmark – Methods – Explicit & Implict Methods- Lanchzos, Reduced method for large size system equations.	
Unit – V	**09 Hrs**
DYNAMIC FRACTURE, Stochastic Finite Elements, Contact, Mesh Generation, Multi-scale Methods, Multi-physics Problems. Error Estimates And Adaptive Refinement Error norms and Convergence rates – h refinement with adaptivity – Adaptive refinement.	

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**M**
1.	"Exploring Mathematical Foundations in ANSYS: From Set Notation to Variational Calculus"	**40**
2.	"Mastering Finite Element Basics in ANSYS: Implementing Weak Form PDEs and Time Integration Techniques"	
3.	"Elasticity Equations and Finite Element Formulation for Plate and Shell Bending in ANSYS"	
4.	"Understanding Conforming and Non-Conforming Plate and Shell Elements in ANSYS: Applications and Case Studies"	
5.	"Exploring Iterative Techniques and Material Non-Linearity in ANSYS: Applications in Elasto-Plasticity and Visco-Plasticity"	
6.	"Addressing Geometric Non-Linearity and Large Displacement in ANSYS: Solution Procedures and Applications in Metal Forming and Contact Problems"	
7.	"Dynamic Problem Formulation in ANSYS: Eigen Solutions, Subspace Iterative Techniques, and Response Analysis"	
8.	"Analysis of Free, Transient, and Forced Dynamic Responses in ANSYS: Solution Procedures and Methodologies"	
9.	"Dynamic Fracture Analysis in ANSYS: Incorporating Stochastic Finite Elements and Contact Mechanics"	

10. "Multi-scale Methods and Multi-physics Problems in ANSYS: Error Estimates, Adaptive Refinement, and Mesh Generation Strategies"	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Explain the fundamentals of finite element methods
CO2	Develop the knowledge to analyses, structures under static and dynamic conditions.
CO3	Selection of numerical techniques for solving engineering problems
CO4	Explore the use of finite element method knowledge to implement industrial project

Reference Books	
1	Bathe K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall, ISBN: 0-13-301458-4, 1996
2.	T.J.R. Hughes (2000), The Finite Element Method: Linear Static and Dynamic Finite Mechanics, Butterworth-Heinemann.Element Analysis, Dover Publications. ISBN(13)-978-0486411811
3.	O. C. Zienkiewicz and R. L. Taylor (2000), The Finite Element Method: Volume 2 Solid Mechanics, Butterworth-Heinemann. ISBN: 0 7506 5055 9
4	Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, Concepts and Applications of Finite Element Analysis, 4th Edition, ISBN: 978-0-471-35605-9

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS (PART A)**	**MARKS**
1	Objective type questions covering entire syllabus	20
	PART B(Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
THEORY OF ELASTICITY AND PLASTICITY **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME74HB**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Mathematical Theory of Elasticity Elasticity, stress, strain, Hooke's law, two- dimensional idealisations, plane stress and plane strain problems, equations of equilibrium, strain- displacement relations, constitutive relations, compatibility conditions, displacement and traction boundary conditions. Two-dimensional problems in rectangular coordinates: Stress function, solution by polynomials, Saint Vénant's principle, bending of a cantilever, determination of displacements.	
Unit – II	**09 Hrs**
Two-dimensional problems in polar coordinates: General equations, problems of axisymmetric stress distribution, pure bending of curved bars, effect of circular hole on stress distribution in plates, concentrated force at a point on a straight boundary. Stress-strain Problems in Three Dimensions: Principal stresses, principal strains, three- dimensional problems	
Unit – III	**09 Hrs**
Introduction to Cartesian Tensors Transformation laws of cartesian tensors, special tensors and tensor operations, the Kronecker's delta, the permutation tensor, the e-δ identity, symmetry and skew- symmetry, contraction, derivatives and the comma notation, Gauss' theorem, the base vectors and some special vector operations, eigenvalue problem of a symmetric second order tensor, equations of elasticity using index notation. Constitutive Relations for linearly elastic materials: Elasticity tensor, Material symmetry, Isotropic materials, constitutive assumptions, work theorems, stored energy. Strong ellipticity, anisotropic materials	
Unit – IV	**09 Hrs**
Energy Theorems: Strain energy and complementary energy, Clapeyron's theorem, virtual work and potential energy principles, principle of complementary potential energy, Betti's reciprocal theorem, principle of linear superposition, uniqueness of elasticity solution. Torsion of straight bars: Elliptic and equilateral triangular cross-section, membrane analogy, narrow rectangular cross-section, torsion of rectangular bars, torsion of rolled profile sections, hollow shafts and thin tubes.	
Unit – V	**09 Hrs**
Introduction to Plasticity: One-dimensional elastic-plastic relations, isotropic and kinematic hardening, yield function, flow rule, hardening rule, incremental stress-strain relationship, governing equations of elastoplasticity.	

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1.	"Exploring Elasticity Theory with Python: Analyzing Stress, Strain, and Hooke's Law in Two-Dimensional Idealizations"	**40**
2.	"Python-Based Analysis of Two-Dimensional Elasticity Problems: Stress Function Solutions and Application of Saint Vénant's Principle"	
3.	"Analyzing Two-Dimensional Elasticity Problems in Polar Coordinates using Python: Axisymmetric Stress Distribution and Pure Bending of Curved Bars"	
4.	"Python-Based Stress-Strain Analysis in Three Dimensions: Principal Stresses, Principal Strains, and Three-Dimensional Problem Solving"	

5. "Understanding Cartesian Tensors with Python: Transformation Laws, Special Tensors, and Tensor Operations" 6. "Implementation of Constitutive Relations for Linearly Elastic Materials in Python: Elasticity Tensor, Material Symmetry, and Isotropic Assumptions" 7. "Exploring Energy Theorems in Elasticity with Python: Strain Energy, Complementary Energy, and Virtual Work Principles" 8. "Analysis of Torsion in Straight Bars using Python: Membrane Analogy, Torsion of Various Cross-Sections, and Hollow Shafts" 9. "Introduction to Plasticity: Exploring One-Dimensional Elastic-Plastic Relations and Incremental Stress-Strain Relationships with Python" 10. "Understanding Plasticity: Isotropic and Kinematic Hardening, Yield Function, and Governing Equations of Elastoplasticity in Python"	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand mathematical formulation of elasticity problem as a well-posed boundary value problem
CO2	Solve simple engineering problems with mathematical rigour. Such solutions can act as bench-mark solutions for testing computational methods and software.
CO3	Appreciate the Cartesian tensor notation; thereby understand modern technical literature well
CO4	Enable understanding of literature and advanced books on theory of plasticity

Reference Books	
1	Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, Mc Graw Hill, Singapore, 1982
2.	Ameen, M., Computational Elasticity–Theory of Elasticity, Finite and Boundary Element Methods, Narosa Publishing House, 2004.
3.	Leipholz, H., Theory of Elasticity, Noordhoff International Publishing, Layden, 1974.
4	Chakrabarty, J, Theory of Plasticity, Elsevier, London, 2006

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
MECHATRONICS SYSTEMS **Category: Professional Core Elective** **(Theory)**						
Course Code	:	**21ME74HC**		CIE	:	**100 Marks**
Credits: L:T:P	:	**3:0:0**		SEE	:	**100 Marks**
Total Hours	:	**45 L**		SEE Duration	:	**3 Hours**

Unit - I	09 Hrs
Introduction to Mechatronics: Traditional and mechatronic design of automatic washing machine, Applications - automatic door, and temperature control. Principle and working of hall sensor, LVDT, absolute and incremental encoders, photoelectric sensors, inductive and capacitive proximity sensors, Brushless DC, AC and servo motors, pulse width modulation by H bridge circuit, Stepper motor: variable reluctance and permanent magnet, signal conditioning - amplifiers (No derivation - only numericals and applications), filtering, digital signal processing - difference equations, data acquisition.	
Unit – II	09 Hrs
Digital circuits: Karnough maps – 3 variable and 4 variable, Combinational logic circuits- Multiplexers, BCD to 7 segment display, calender subsystem in a smartwatch, sequential logic - Digital lock, timing diagrams of logic gates, , design of logic networks, flip-flops - positive and negative edge triggered, Binary Counters. **Dynamic Responses of Systems:** Closed loop system, Terminology, transfer functions, step response of first order and second order systems, steady state errors and error constants, performance measures for first and second order systems, - Numericals	
Unit – III	09 Hrs
Microcontroller Interfacing: Input/output addressing, interface requirements, central heating system, peripheral interface adapters, MC6821 PIA, interfacing a stepper, serial communication interface, interfacing a seven-segment display, interfacing motors, windshield wiper motion, bathroom scales. **Microcontroller Programming:** Programming basics: data types, control structures, functions, Interrupts, and real-time operating systems (RTOS) for microcontrollers, Code optimization techniques for memory and speed constraints, Project: writing and debugging microcontroller programs for mechanical applications.	
Unit – IV	09 Hrs
Electrical/Electronic interfacing with Fluid power systems: Symbolic representations of hydraulic and pneumatic components, Drilling machine circuit, electrical control of regenerative circuit, pressure control circuit., Direct and indirect control, Latching, Multi cylinder sequencing circuits, cyclic operation with proximity sensors, box sorting system, circuit for stamping device.	
Unit – V	09 Hrs
Fundamentals of Ladder Diagram for PLC: Principle of operation, modifying the operation with ladder logic , basic PLC instructions, and concepts of ladder diagram, latching, timer instructions, counter instructions. Examples with ladder logic programs, simple programs using Boolean logic and narrative descriptions. Relay to ladder conversion examples. **PLC programming for mechanical applications:** Central heating system, valve sequencing, water level control, overhead garage door, sequential process, continuous filling operation, Fluid pumping with timers, conveyor belt control with time delay.	

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1."Exploring Fluid power systems: Introduction to hydraulic, pneumatic, electrical interfaces in powerpack" 2."Hands-On Introduction to Electropneumatics: Applications in machine tools"		40

3 "Microcontroller Interfacing for IoT Applications: Sensors, Actuators, and Analog-Digital Conversion" 4 "Hands-On Microcontroller Interfacing: Implementing ADC, DAC, and Serial Communication Protocols for Sensor Integration" 5 "Microcontroller Programming Essentials: Data Types, Control Structures, and Interrupt Handling" 6 "Advanced Microcontroller Programming Techniques: Real-Time Operating Systems, Code Optimization, and Project Development for Mechanical Applications" 7 "Introduction to Microcontroller-Based Control Systems: Feedback Control Theory and PID Implementation" 8 "Design and Implementation of Closed-Loop Control Systems using Microcontrollers: Case Studies in Mechanical Engineering Applications" 9 "Introduction to PLC Programming for Mechanical Applications: Understanding Ladder Diagrams and Basic Conventions" 10 "Hands-On PLC Programming: Applications in Mechanical Engineering Including Valve Sequencing, Water Level Control, and Sequential Processes"	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes.
CO2	Apply the electrical and digital logic concepts toinspect the functioning of mechatronic systems.
CO3	Evaluate a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, fluid power systems, microcontrollers and programmable logic controllers
CO4	Develop conceptual design for Mechatronics products based on potential customer requirements

Reference Books	
1	Bolton W., 'Mechatronics-Electronic Control System in Mechanical and Electrical Engineering', Pearson Education, 4th Edition, 2012; ISBN:9788131732533
2.	Tilak Thakur 'Mechatronics', Oxford University Press, I Edition, 2016, ISBN: 9780199459329
3.	Petruzella, Frank D, Programmable logic controllers, McGraw-Hill, 4th Edition, 2013, ISBN-13: 978-0-07-351088-0
4	Anthony Esposito, 'Fluid Power with Applications', 7th Edition, 2013, ISBN – 13; 9789332518544.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration	**40**

	(20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
DESIGN OF HEAT EXCHANGERS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME74HD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Introduction To Heat Exchanger Design: Classification of heat exchangers and their applications. Flow arrangements and temperature distributions in heat exchangers. Overview of Heat Exchanger Design Methodology, Heat Exchanger Variables and Thermal Circuit, Overall heat transfer coefficient, fouling factor, Concentric-Tube Heat Exchangers, Mean temperature difference Concept: - LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi-pass heat exchangers, Numericals.	
Unit – II	**09 Hrs**
Shell And Tube Heat Exchangers: Constructional features. Applications. Effectiveness-NTU method for heat exchanger design/analysis. Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow, Numerical **ByPass And Leakage Calculation Procedure For Shell And Tube Heat Exchanger** Heat balance equations: LMTD: reference temperature calculations: evaluation of fluid properties: flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops, Numericals	
Unit – III	**09 Hrs**
Steam Condensers - Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculation procedure for steam condensers, Numericals **Heat pipes and Micro scale heat exchangers -**Heat pipes, construction, working principle, application, and analysis. Special heat pipes. Micro-scale heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations	
Unit – IV	**09 Hrs**
Compact Heat Exchangers: Compact heat exchangers, Enhancement of heat transfer, Extended surface or Fin, fundamental of extende surface heat transfer, Fin tube heat exchanger. Plate Fin Heat Exchangers (PFHE), Types, Construction, Fabrication, Design, Application, Multi-stream PFHE.	
Unit – V	**09 Hrs**
Selection of Heat Exchangers and Their Components: Selection Criteria Based on Operating Parameters - Operating Pressures and Temperatures, Cost, Fouling and Cleanability, Fouling and Cleanability, Fluids and Material Compatibility, Fluid Type, General Selection-Guidelines for Major Exchanger Types, Some Quantitative Considerations - Screening Methods, Performance Evaluation Criteria, Evaluation Criteria Based on the Second Law of Thermodynamics.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Select appropriate heat exchangers for the given application.
CO2	Identify how to design common type of heat exchangers.
CO3	Analyze single and multiphase heat transfer systems and friction coefficient correlation.
CO4	Develop sizing of condenser and air-cooled heat exchangers.

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1.	"Design and Analysis of Concentric-Tube Heat Exchangers: Applying LMTD Concepts and Correction Factors"	**40**
2.	"Prototype Models for Heat Exchanger Design: Exploring Flow Arrangements, Thermal Circuits, and Overall Heat Transfer Coefficients"	
3.	"Design and Analysis of Shell and Tube Heat Exchangers: Effectiveness-NTU Method, Rating, and Sizing"	
4.	"Procedure for Bypass and Leakage Calculation in Shell and Tube Heat Exchangers: Heat Balance Equations, LMTD, and Pressure Drop Calculations"	
5.	"Design and Calculation Procedure for Steam Condensers: TEMA Standards, Flow Arrangements, and Numerical Analysis"	
6.	"Exploring Heat Pipes and Microscale Heat Exchangers: Construction, Working Principle, Applications, and Special Design Considerations"	
7.	"Design and Analysis of Fin Tube Heat Exchangers: Fundamental Concepts and Applications of Extended Surface Heat Transfer"	
8.	"Exploring Plate Fin Heat Exchangers (PFHE): Types, Construction, and Multi-stream Configurations for Enhanced Heat Transfer"	
9.	"Selection Criteria for Heat Exchangers: Operating Parameters, Cost, Fouling, and Material Compatibility"	
10.	"Guidelines for Heat Exchanger Selection: Screening Methods, Performance Evaluation, and Second Law of Thermodynamics Criteria"	

Reference Books	
1	Sadik Kakal and Hogtan Liu, "Heat Exchangers Selection, rating and Thermal Design", CRC Press, 2012, 3rd Edition, ISBN: 9781439849903
2.	T. Taborek, G.F. Hewitt and N. Afgan, Heat Exchangers - Theory and practice, McGraw Hill Book Co., 1st Edition, 1980, ISBN: 978-0070628069.
3.	Walkers, Industrial Heat Exchangers-A Basic Guide, McGraw Hill Book Co., 1st Edition, 1980, **ISBN: 10: 0891162305**
4	Arthur, P. Frass, Heat Exchanger Design, John Wiley and Sons, 2nd Edition, 1989, ISBN: 978-0-471-62868-2

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration	**40**

	(20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
VEHICLE DYNAMICS **Category: Professional Core Elective** **(Theory)**						
Course Code	**:**	**21ME74HE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Introduction: Vehicle Dynamics terminology, The Driver-Vehicle-Ground System, Vehicle Fixed Coordinate System (SAE) and Earth Fixed Coordinate System; **Mechanics Of Pneumatic Tires**: Functions, Tire construction – Bias-ply Tire and Radial-ply, Tire Forces And Moments – Tire (Wheel) Axis System, Rolling Resistance of Tires, Tractive (Braking) Effort And Longitudinal Slip (Skid), Cornering Properties of Tires – Slip Angle and Cornering Force, Slip Angle and Aligning Torque, Camber and Camber Thrust; **Front Wheels Alignment:** Need, Centre-Point Steering – Camber, King Pin Inclination, Negative Scrub Radius, Caster, Front-Wheel Toe-In or Toe-out, Toe-Out-On-Turns.	
Unit – II	**09 Hrs**
Performance Characteristics of Road Vehicles (two-axle vehicle): Equation of Motion and Maximum Tractive Effort – Front & Rear Wheel Drive (No Numerical Problems); **Vehicle body Aerodynamics:** Mechanics of Air Flow around a Vehicle, Pressure Distribution on a Vehicle, Aerodynamic Forces and moments, Factors influencing aerodynamic resistance coefficient (C_D) and lift coefficient (C_L) – Body shape, shape of the front and rear end, front and rear spoiler, angle of attack, ground clearance, load, operational factors. **Braking Performance**: Braking Characteristics of a Two-Axle Vehicle - analysis of maximum braking force that the tire-ground contact can support, Loss of directional stability due to lock-up of rear tires, Quantitative determination of the conditions under which the front or the rear tires will lock first. (No Numerical Problems); **Antilock Brake Systems**: Elements of an ABS, criteria employed in existing ABS, Various layouts of ABS for passenger cars, Electromechanical Brake system; **Traction Control Systems** - prime functions.	
Unit – III	**09 Hrs**
Handling Characteristics of Road Vehicles: Ackermann Steering Geometry, Error Curve of a Steering Linkage (No Numerical Problems); **Steady-State Handling Characteristics of A Two Axle Vehicle**: Simplified Steady-State Handling Model for a Two-Axle Vehicle. Neutralsteer, Understeer, Oversteer. (Numerical Problems) **Steady-State Response to Steering Input**: Yaw Velocity Response, Lateral Acceleration Response, Curvature Response (Numerical Problems); **Testing of Handling Characteristics:** Constant Radius Test, Constant Speed Test, Constant Steer Angle Test, Vehicle Stability Control.	
Unit – IV	**09 Hrs**
Vehicle Ride Characteristics: Human Response to Vibration - methods for assessing human tolerance to vibration; **Two-Degree-of-Freedom Vehicle Model** - Sprung and Unsprung Mass (Quarter car model), Aspects to evaluate the overall performance of a suspension system – Vibration isolation, suspension travel and road holding. **Two-Degree-of-Freedom Vehicle Model** - Pitch and Bounce (Numerical Problems); **Concept of Active and Semi-Active Suspension Systems –** Electrorheological Damper and Magnetorheological Damper.	
Unit – V	**09 Hrs**
Electric Vehicles (EV's): Electric and hybrid electric vehicle (HEV) components, Power transmission path in in ICE, EV and HEV, electric motor and engine ratings, Gear Ratio, Torque-speed characteristics, Planetary Gear Set; **Hybrids based on Architecture** – series and parallel, Series-Parallel, Series–Parallel 2 × 2 Hybrid; **Hybrids based on Transmission Assembly** – Pre- and Post-transmission Hybrids, P0–P4 Hybrid Architectures, 48V Hybrid Architectures, Hybrids based on degree of Hybridization, Plug-In Hybrid Electric Vehicle, Skateboard Chassis.**Hybrid Vehicle Control Strategy**: Vehicle Supervisory Controller**; Mode Selection Strategy** – **Mechanical power-split hybrid modes**- Electric Only, Engine Starting, Parallel Mode, Power-Split Mode,	

Engine Brake Mode and Regeneration Mode; **Series-parallel 2 × 2 hybrid modes**-Electric Only, Series Mode, Power-Split Mode and Parallel Mode; Plug-In Hybrid Electric Vehicle.

Experience Learning- LAB		
#	**Student Must do Four exercises from the following (each Carries 10 Marks)**	**MARKS**
1)	"Introduction to Vehicle Dynamics: Terminology and Driver-Vehicle-Ground System"	**40**
2)	"Mechanics of Pneumatic Tires: Construction, Forces, and Moments in Vehicle Dynamics"	
3)	"Front Wheels Alignment and Steering Geometry: Camber, Caster, Toe-In/Toe-Out, and Performance Effects"	
4)	"Performance Characteristics of Road Vehicles: Equation of Motion, Tractive Effort, Aerodynamics, Power Plant, and Transmission Analysis"	
5)	"Analysis of Braking Performance in Road Vehicles: Stopping Distance, Brake Fade, and Efficiency"	
6)	"Handling Characteristics and Steering Geometry in Road Vehicles: Pitching, Yawing, Ackermann Steering, and Error Curve Analysis"	
7)	"Analysis of Steady-State Handling Characteristics of Two-Axle Vehicles: Neutralsteer, Understeer, and Oversteer"	
8)	"Testing and Control of Vehicle Handling Characteristics: Steady-State Response, Directional Stability, and Vehicle Stability Control"	
9)	"Understanding Vehicle Vibration and Human Comfort: Analysis of Single and Two Degree-of-Freedom Models"	
10)	"Advanced Suspension Systems for Vehicle Vibration Control: Active and Semi-Active Systems, Electrorheological and Magnetorheological Dampers"	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the terminology related to vehicle dynamics.
CO2	Analyse and apply principles of mechanics of pneumatic tyres front wheel alignment to the two axle road vehicles
CO3	Understand and explain the performance characteristics, braking performance and handling characteristics of road vehicles.
CO4	Analyse vehicle vibrations and apply to the vehicle suspension systems of the two axle road

Reference Books	
1	**Theory of Ground Vehicles**, 3rd Edition, J.Y. Wong, John Willey and Sons, 2005, ISBN 978-8126565405.
2.	Automobile Mechanics, 8th Edition, N.K. Giri, Khanna Publishers, 2013, ISBN 81-7409-216-1.
3.	**Electric and Hybrid Vehicles Design Fundamentals, 3rd Edition, CRC Press, 2021, ISBN: 978-0-367-69393-0 (pbk).**

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
UNMANNED AERIAL VEHICLES **Category: Institutional Elective-II** **(Theory)**						
Course Code	**:**	**21AS75IA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08Hrs**
Introduction to Unmanned Aerial Vehicles (UAVs): History of UAVs, Need of unmanned aerial systems, Overview of UAV Systems-System Composition, Classes and Missions of UAVs-Classification of UAVs based on size, range and endurance, Applications, Examples of UAVs	
Unit – II	**11Hrs**
Aerodynamics & Propulsion aspects of UAVs: Basic Aerodynamic Equations, Air foils, lift, drag, moments, Aircraft Polar, The Real Wing and Airplane, Induced Drag, Total Air-Vehicle Drag, Flapping Wings, Rotary wings. **Propulsion:**Thrust Generation and basic thrust equation, Sources of Power for UAVs- Piston, Rotary, Gas turbine engines, electric or battery powered UAVs.	
Unit –III	**08Hrs**
Airframe of UAVs: Mechanic loading, basics of types of load calculation and structural engineering, Material used for UAV (general introduction), FRP and methods of usage in UAV, Testing of FRP specimens for UAV, selection criteria for structure, Types of structural elements used in UAV their significance and characteristics, Methods of manufacturing UAV structure.	
Unit –IV	**10Hrs**
Payloads for UAVs: Barometers, Accelerometer, Magnetometer, RADAR and range finder, Non-dispensable and dispensable Payloads-Optical, electrical, weapon, imaging payloads.	
Unit –V	**08Hrs**
Mission Planning and Control: Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Understand the role of UAVs in the current generation for diverse applications ranging from commercial to military purposes
CO2:	Apply the fundamental concepts of Aerospace Engineering to Design a UAV for a particular Mission and application
CO3:	Evaluate the performance of UAV with a perspective of Aerodynamics, Propulsion, Structures for a given Mission
CO4:	Critically appraise and optimize the performance of the UAV for a given Mission profile

Reference Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1st Edition, 2010, Wiley, ISBN 9780470058190.
2	Flight Stability and Automatic Control, Robert C. Nelson, 2nd Edition, October 1, 1997, McGraw-Hill, Inc, ISBN 978-0070462731.
3	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Kimon P. Valavanis, 1st Edition,2007, Springer ISBN 9781402061141
4	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4
5	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chaput, 3rd Edition, 2001, Lockheed Martin Aeronautics Company, ISBN: 978-1-60086-843-6

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
HEALTHCARE ANALYTICS **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	**21BT75IB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction to tools and databases: Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases, Applications of these databases, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method	
Unit – II	**09 Hrs**
Sequence Analysis: Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation.	
Unit –III	**09 Hrs**
Introduction to Next-Generation Sequencing (NGS) analysis: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads	
Unit –IV	**09 Hrs**
Structural analysis & Systems Biology: Gene prediction programs – ab initio and homology-based approaches.. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition, Prediction of secondary structure. Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology.	
Unit –V	**09 Hrs**
Drug Screening: Introduction to Computer-aided drug discovery, target selection, ligand preparation and enumeration, molecular docking, post-docking processing, molecular dynamics simulations, applications and test cases.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Comprehend Bioinformatics Tools: Understand and effectively utilize various bioinformatics tools and databases for sequence and structure analysis.
CO2	Investigate and apply innovative sequencing technologies and analytical methods to solve complex biological questions and advance research in genomics and molecular biology.
CO3	Analyze Next-Generation Sequencing: Proficiency in NGS technologies, including data quality assessment and read processing techniques and handle big data.
CO4	Apply bioinformatics tools to model and simulate various biological processes, leveraging gene prediction programs including both ab initio and homology-based approaches.

Reference Books	
1.	Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13.
2.	Buehler LK, Rashidi HH, editors. Bioinformatics basics: applications in biological science and medicine. CRC Press; 2005 Jun 23.
3.	Ghosh Z, Mallick BM. Bioinformatics principles and Applications. Oxford University Press; 2018 Jun 13.

4.	Low L, Tammi MT. Introduction to next generation sequencing technologies. Bioinformatics. WORLD SCIENTIFIC. 2017 Jul 26:1-21.
5.	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
6.	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
	COMPONENTS	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
SUSTAINABILITY AND LIFE CYCLE ANALYSIS **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	21CH75IC		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09Hrs**
Introduction to sustainability: Introduction to Sustainability Concepts and Life Cycle Analysis, Material flow and waste management, Chemicals and Health Effects, Character of Environmental Problems	
Unit – II	**09 Hrs**
Environmental Data Collection and LCA Methodology: Environmental Data Collection Issues, Statistical Analysis of Environmental Data, Common Analytical Instruments, Overview of LCA Methodology. – Goal, Definition.	
Unit –III	**09 Hrs**
Life Cycle Assessment: Life Cycle Impact Assessment, Life Cycle Interpretation, LCA Benefits and Drawbacks. **Wet Biomass Gasifiers:** Introduction, Classification of feedstock for biogas generation, Biomass conversion technologies: Photosynthesis, Biogas generation, Factors affecting bio-digestion, Classification of biogas plants, Floating drum plant and fixed dome plant their advantages and disadvantages.	
Unit –IV	**09 Hrs**
Design for Sustainability: Green Sustainable Materials, Environmental Design for Sustainability. **Dry Biomass Gasifiers:** Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems:	
Unit –V	**09Hrs**
Case Studies: Odor Removal for Organics Treatment Plant, Bio-methanation, Bioethanol production. Bio fuel from water hyacinth.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the sustainability challenges facing the current generation, and systems-based approaches required to create sustainable solutions for society.
CO2	Identify problems in sustainability and formulate appropriate solutions based on scientific research, applied science, social and economic issues.
CO3	Apply scientific method to a systems-based, trans-disciplinary approach to sustainability
CO4	Formulate appropriate solutions based on scientfic research, applied science, social and economic issues.

Reference Books	
1.	Sustainable Engineering Principles and Practice, Bavik R Bhakshi, 2019, Cambridge University Press, ISBN - 9781108333726.
2.	Environmental Life Cycle Assessment , Olivier Jolliet, Myriam Saade-Sbeih, Shanna Shaked, Alexandre Jolliet, Pierre Crettaz , 1st Edition, CRC Press, ISBN: 9781439887660 .
3.	Sustainable Engineering: Drivers, Metrics, Tools, and Applications, Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams, 2019, John Wiley & Sons , ISBN-9781119493938

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
ADVANCES IN CORROSION SCIENCE AND MANAGEMENT **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	21CM75ID		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42 L		**SEE Duration**	**:**	03 Hours

Unit-I	**08 Hrs**
Basics of corrosion: Introduction: Galvanic series, Pilling-Bedworth ratio, Types: Galvanic corrosion, crevice corrosion, pitting corrosion, intergranular corrosion, erosion corrosion, stress corrosion, season cracking, hydrogen embrittlement, bacterial corrosion. **Corrosion in different engineering materials**: Concrete structures, duplex, stainless steels, ceramics, composites.	
Unit-II	**08 Hrs**
Corrosion mechanism: Electrochemical theory of corrosion**,** Crevice corrosion-mechanism of differential aeration corrosion, mixed potential theory for understanding common corrosion of metals and alloys. **Thermodynamics of Corrosion:** Pourbaix diagram and its importance in metal corrosion and its calculation for Al, Cu, Ni and Fe.	
Unit – III	**08 Hrs**
Effects of corrosion: The direct and indirect effects of corrosion, economic losses, Indirect losses - Shutdown, contamination, loss of product, loss of efficiency, environmental damage, Importance of corrosion prevention in various industries, corrosion auditing in industries, corrosion map of India. Corrosion issues in specific industries-power generation, chemical processing industries, oil and gas Industries, corrosion effect in electronic industry.	
Unit –IV	**09 Hrs**
Corrosion Testing and monitoring: Introduction, classification. Purpose of corrosion testing, materials, specimen. Surface preparation, measuring and weighing. Types of testing, lab, pilot plant and field tests. Measurement of corrosion rate, weight loss method, CPR numericals, Electrochemical methods, Tafel extrapolation. Linear polarization method.	
Unit –V	**09 Hrs**
Corrosion Control: Principles of corrosion prevention, material selection, design considerations, control of environment- decrease in velocity, passivity, removal oxidizer, Inhibitors and passivators, coatings- organic, electroplating of Copper, Nickel and Chromium, physical vapor deposition-sputtering, Electroless plating of Nickel.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the causes and mechanism of various types of corrosion
CO2:	Apply the knowledge of chemistry in solving issues related to corrosion.
CO3:	Analyse and interpret corrosion with respect to practical situations.
CO4:	Develop practical solutions for problems related to corrosion.

Reference Books	
1	Corrosion Engineering, M.G, Fontana, 3rd Edition, 2005, Tata McGraw Hill, ISBN: 978-0070214637.
2	Principles and Prevention of Corrosion, D. A Jones, 2nd Edition, 1996, Prentice Hall, ISBN: 978-0133599930.

3	Design and corrosion prevention, Pludek, 1978, McMillan, ISBN: 978-1349027897
4	Introduction to metal corrosion, Raj Narain, 1983, Oxford &IBH, ISBN: 8120402995.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
PROMPT ENGINEERING **Category: Institutional Elective - II** **(Theory)**						
Course Code	**:**	21CM75IE		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42		**SEE Duration**	**:**	03 Hours

Unit-I	**08Hrs**
Introduction to Prompt Engineering Raise of Context Learning, Prompts, Prompt Engineering, LLM Settings, Basics of prompting, Elements of a Prompt, Settings for Prompting Language Model, General Tips for Designing Prompts, Designing Prompts for Different Tasks: few examples of common tasks using different prompts- Text Summarization, Information Extraction, Question Answering, Text Classification, Conversation/Role Playing, Code Generation, Reasoning	
Unit – II	**08 Hrs**
Techniques for Effective Prompts Techniques designed to improve performance on complex tasks - Zero-Shot Prompting, Few-shot prompting, Chain-of-thought (CoT) prompting, Zero-Shot CoT, Self-Consistency, Knowledge Generation Prompting, Program-aided Language Model (PAL), ReAct, Directional Stimulus Prompting	
Unit –III	**07 Hrs**
Best Practices in Prompt Engineering Tools & IDEs Capabilities include: Developing and experimenting with prompts, Evaluating prompts. Versioning and deploying prompts; Advanced prompting techniques: advanced applications with LLMs LLMs and external tools/APIs -- LLMs with External Tools; Data-augmented Generation – Steps, External Data, QA with sources, Summarization using sources	
Unit –IV	**08 Hrs**
Applications of Prompt Engineering: LLM Applications: Function Calling with LLMs - Getting Started with Function Calling, Function Calling with GPT-4, Function Calling with Open-Source LLMs, **Function Calling Use Cases:** Conversational Agents**,** Natural Language Understanding, Math Problem Solving, API Integration, Information Extraction	
Unit –V	**08 Hrs**
Opportunities and Future Directions Model safety, Prompt Injection, Prompt Leaking, Jail Breaking; Reinforcement Learning from Human Feedback (RLHF) -- Popular examples: aClaude (Anthropic), ChatGPT (OpenAI), **Future directions:** Augmented LMs, Emergent ability of LMs, Acting / Planning - Reinforcement Learning, Multimodal Prompting, Graph Prompting	

Course Outcomes: After completing the course, the students will be able to	
CO1	**Demonstrate an understanding of prompt engineering principles** including how prompt structure and phrasing impact the performance of AI models.
CO2	**Design and implement effective prompts-** to create and apply prompts for various natural language processing (NLP) tasks, such as text generation, summarization, and translation, using AI models.
CO3	**Critically evaluate the effectiveness of prompts -** assess the quality and performance of prompts in terms of accuracy, coherence, and relevance, identifying areas for improvement.
CO4	**Apply prompt engineering techniques in real-world scenarios -** use prompt engineering strategies to address practical problems in domains such as education, healthcare, and business, demonstrating the applicability of AI-driven solutions.

CO5	**Collaborate on projects involving prompt engineering -** work effectively in teams to design, implement, and evaluate prompt-based solutions, showcasing their ability to contribute to complex AI-related projects.

Reference Books	
1	Unlocking the Secrets of Prompt Engineering: Master the art of creative language generation to accelerate your journey from novice to pro , Gilbert Mizrahi, Jan 2024, 1st Edition, Packt Publishing, ISBN-13:978-1835083833
2.	Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, May 2024, O'Reilly Media, Inc.,ISBN: 9781098153434
3.	Prompt Engineering for LLMs, John Berryman, Albert Ziegler, O'Reilly Media, Inc. Dec 2024, ISBN: 9781098156152
4.	The Art of Asking ChatGPT for High-Quality Answers_ A Complete Guide to Prompt Engineering, Ibrahim John , Nzunda Technologies Limited, 2023, ISBN-13: 9781234567890
5	Programming Large Language Models with Azure Open AI: Conversational programming and prompt engineering with LLMs, Francesco Esposito, Microsoft Pr, 1st Edition, April 2024,ISBN-13: 978-0138280376

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Elective - II** **(Theory)**						
Course Code	**:**	21CV75IF		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration.	
Unit – II	**08 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence	
Unit –III	**08 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	
Unit –IV	**08 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	
Unit –V	**08 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Diagnose the distress in the structure understanding the causes and factors.
CO2	Understand safety aspects, components and materials used in Structural Health Monitoring.
CO3	Assess the health of structure using static field methods and dynamic field tests.
CO4	Analyse behavior of structures using remote structural health monitoring

Reference Books	
1	Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes,2006, John Wiley and Sons, ISBN: 978-1905209019
2	Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, 2007,John Wiley and Sons, ISBN:9780470033135
3	Structural Health Monitoring and Intelligent Infrastructure, J. P. Ou, H. Li and Z. D. Duan, Vol1,2006,Taylor and Francis Group, London, UK. ISBN: **978-0415396523**
4	Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, 2007,Academic Press Inc, ISBN: 9780128101612

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
WEARABLE ELECTRONICS **Category: Institutional Elective - II** **(Theory)**						
Course Code	**:**	21EC75IG		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	39L		**SEE Duration**	**:**	03 Hours

Unit-I	**07 Hrs**
Introduction: world of wearable (WOW), Role of wearable, The Emerging Concept of Big Data, The Ecosystem Enabling Digital Life, Smart Mobile Communication Devices, Attributes of Wearables, Taxonomy for Wearables, Advancements in Wearables, Textiles and Clothing, Applications of Wearables. [Ref 1: Chapter 1.1]	
Unit – II	**08 Hrs**
Wearable Bio and Chemical Sensors: Introduction, System Design, Microneedle Technology, Sampling Gases, Types of Sensors, Challenges in Chemical Biochemical Sensing, Sensor Stability, Interface with the Body, Textile Integration, Power Requirements, Applications: Personal Health, Sports Performance, Safety and Security, Case studies. [Ref 1: Chapter 2.1]	
Unit –III	**07 Hrs**
Wearable Textile: Conductive fibres for electronic textiles: an overview, Types of conductive fibre, Applications of conductive fibres, Bulk conductive polymer yarn, Bulk conductive polymer yarn, Techniques for processing CPYs, Wet-spinning technique, Electrospinning technique, case studies, Hands on project in wearable textile: Solar Backpack, LED Matrix wallet. [Ref 2: Chapter 1,2] &. [Ref 3: Chapter 6,9]	
Unit –IV	**08 Hrs**
Energy Harvesting Systems: Introduction, Energy Harvesting from Temperature Gradient, Thermoelectric Generators, Dc-Dc Converter Topologies, Dc-Dc Converter Design for Ultra-Low Input Voltages, Energy Harvesting from Foot Motion, Ac-Dc Converters, Wireless Energy Transmission, Energy Harvesting from Light, Case studies. [Ref 1: Chapter 4.1]	
Unit –V	**08 Hrs**
Wearable antennas for communication systems: Introduction, Background of textile antennas, Design rules for embroidered antennas, Integration of embroidered textile surfaces onto polymer substrates, Characterizations of embroidered conductive, textiles at radio frequencies, RF performance of embroidered textile antennas, Applications of embroidered antennas. [Ref 2: Chapter 10]	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the different types and wearable sensors, textile, energy harvesting systems and antenna
CO2:	Analysis measurable quantity and working of wearable electronic devices.
CO3:	Determine & interpret the outcome of the wearable devices and solve the design challenges
CO4:	Analyse and Evaluate the wearable device output parameter in real time scenario or given problem statement.

Reference Books	
1	Wearable Sensors: Fundamentals, Implementation and Applications, Edward Sazonov, Michael R. Neuman Academic Press, 1st Edition, 2014, ISBN-13: 978-0124186620.
2	Electronic Textiles: Smart Fabrics and Wearable Technology, Tilak Dias, Woodhead Publishing; 1 edition,**ISBN-13:** 978-0081002018.
3	Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, 1st Edition, ISBN-13: 978-1260116151.

4	Flexible and Wearable Electronics for Smart Clothing: Aimed to Smart Clothing, Gang Wang, Chengyi Hou, Hongzhi Wang , Wiley, 1st Edition, ISBN-13: 978-3527345342
5	Printed Batteries: Materials, Technologies and Applications, Senentxu Lanceros-Méndez, Carlos Miguel Costa, Wiley, 1 edition , ISBN-13: 978-1119287421

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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 up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10**)** Real time problem solving (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR THE SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: Question 3 or 4	16
5 & 6	Unit 3: Question 5 or 6	16
7 & 8	Unit 4: Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
E-MOBILITY **Category: Institutional Elective - II** **(Theory)**						
Course Code	**:**	21EE75IH		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**06 Hrs**
E-Mobility: A Brief History of the Electric Powertrain, Energy Sources for Propulsion and Emissions, The Advent of Regulations, Drive Cycles, BEV Fuel Consumption, Range, Carbon Emissions for Conventional and Electric Powertrains, An Overview of Conventional, Battery, Hybrid, and Fuel Cell Electric Systems, A Comparison of Automotive and Other Transportation Technologies. Vehicle Dynamics: Vehicle Load Forces, Vehicle Acceleration, Simple Drive Cycle for Vehicle Comparisons	
Unit – II	**09 Hrs**
Batteries: Batteries Types and Battery Pack, Lifetime and Sizing Considerations, Battery Charging, Protection, and Management Systems, Battery Models, Determining the Cell/Pack Voltage for a Given Output\Input Power, Cell Energy and Discharge Rate. **Battery Charging:** Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charging Standards and Technologies, SAE J1772, Wireless Charging, The Boost Converter for Power Factor Correction.	
Unit –III	**09 Hrs**
Battery Management System: BMS Definition, Li-Ion Cells, Li-Ion BMSs, Li-Ion Batteries, BMS Options: Functionality, CCCV Chargers, Regulators, Balancers, Protectors, Functionality Comparison, Technology, Topology. Measurement: Voltage, Temperature, Current, Management: Protection, Thermal Management, Balancing, Distributed Charging, Evaluation, External Communication: Dedicated analog and digital wires.	
Unit –IV	**09 Hrs**
Electric Drive train: Overview of Electric Machines, classification of electric machines used in automobile drivetrains, modelling of electric machines, Power Electronics, controlling electric machines, electric machine and power electronics integration Constraints. **Energy Management Strategies:** Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies and implementation issues of energy management strategies.	
Unit –V	**09 Hrs**
Charger Classification and standards: classification based on charging, levels (region-wise), modes, plug types, standards related to: connectors, communication, supply equipments, EMI/EMC. **Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems **Communications, Supporting Subsystems:** In vehicle networks- CAN	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and modelling.
CO 2	Discuss and implement different energy storage technologies used for electric vehicles and their management system.
CO 3	Analyze various electric drives and its integration techniques with Power electronic circuits suitable for electric vehicles.
CO 4	Design EV Simulator for performance evaluation and system optimization and understand the requirement for suitable EV infrastructure.

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
PROGRAMMABLE LOGIC CONTROLLER'S AND APPLICATIONS **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	21EI75IJ		**CIE**	**:**	100Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**09 Hrs**
Introduction: Introduction to Industrial Automation, Historical background, Different parts and types of Industrial automation, Block diagram of PLC, PLC Versus Other types of Controls, PLC Product Application Ranges, Fixed and Modular I/O Hardware PLC Operation: Binary Data representation, Input and output status files for modular PLC, Addressing concept.	
UNIT II	**09 Hrs**
PLC Hardware: The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications, Input and Output modules: Brief overview of Discrete and Analog input modules, Discrete and TTL/Relay output modules	
Unit –III	**09 Hrs**
Basics of PLC Programming: Processor memory organization, Program scan, PLC programming languages, Basic Relay Instruction, Bit or relay instructions, NO, NC, One Shot, Output latching software, negated Output and Internal Bit Type instructions, mode of operations	
Unit –IV	**09 Hrs**
Special programming Instructions: Timer and Counter Instructions: On delay and Off delay and retentive timer instructions, PLC Counter up and down instructions, combining counters and timers. **Program Control &Data manipulation Instructions**: Data handling instructions, Sequencer instructions, Programming sequence output instructions.	
UNIT V	**09 Hrs**
SCADA & DCS : Building Block of SCADA System, Hardware structure of Remote Terminal Unit, Block diagram of Distributive Control System **Case Studies**: Bottle filling system, Material Sorter. Elevator, Traffic control, Motor sequencers, Piston extraction and retraction using timers and counters.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the basic concepts of PLC's and SCADA techniques.
CO2	Apply the programming concepts to interface peripheral.
CO3	Analyze and evaluate the automation techniques for industrial applications.
CO4	Develop a system for automation application.

Reference Books	
1.	Programmable Logic controllers, Frank D. Petruzella, Mc Graw hill, 4th Edition, ISBN:9780073510880, 2017
2.	Introduction to Programmable Logic Controllers, Garry Dunning, CENGAGE Learning, 3rd Edition, 2017, ISBN: 978-8131503027
3.	Industrial Control and Instrumentation, Bolton W, Universities Press, 6th Edition, 2006. ISBN 978-0128029299
4.	Computer Based Industrial control, Krishna Kant, PHI Publishers, 2nd Edition, 2010. ISBN 978-8120339880.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	**21ET75IK**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
TotalHours	**:**	**45 L**		**SEE**	**:**	**3 Hours**

Unit-I	**9 Hrs**
Earth's environment: Atmosphere, ionosphere, Magnetosphere, VanAllen Radiation belts, Interplanetary medium, Solar wind, Solar- Earth Weather Relations. Launch Vehicles: Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.	
Unit– II	**9Hrs**
Satellite Technology: Structural, Mechanical, Thermal, Power control, Telemetry, Telecomm and Quality and Reliability, Payloads, Classification of satellites. Satellite structure: Satellite Communications, Transponders, Satellite antennas.	
Unit–III	**9Hrs**
Satellite Communications: LEO, MEO and GEO orbits, Altitude and orbit controls, Multiple Access Techniques**.** **Space applications:** Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Telemedicine, Satellite navigation, GPS.	
Unit–IV	**9Hrs**
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. Metrology: Weather forecast (Long term and short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using	
Unit–V	**9 Hrs**
Space Missions: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and international space Missions. **Advanced space systems:** Remote sensing cameras, planetary payloads, space shuttle, space station, Interspace communication systems.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain various Orbital Parameters, Satellite Link Parameters, Propagation considerations and Radar systems.
CO2	Apply the concepts to determine the parameters of satellite, performance of radar and navigation systems.
CO3	Analyze the design issues of satellite and its subsystems, radars and navigations ystems.
CO4	Evaluate the performance of the satellite systems and its parameters, radar and navigation Systems.

ReferenceBooks	
1.	Atmosphere, weather and climate, RGBarry, Routledge publications,2009, ISBN- 10:0415465702.
2.	Fundamentals of Satellite Communication, KN RajaRao, PHI,2012, ISBN: 978-8120324015
3.	Satellite Communication, Timothypratt, JohnWiley,1986ISBN: 978-0-471-37007 -9, ISBN10: 047137007X.
4	Remote sensing and applications, BCPanda, VIVAbooksPvt.Ltd.,2009, ISBN: 108176496308.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
MOBILE APPLICATION DEVELOPMENT **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	21IS75IL		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
TotalHours	**:**	45L		**SEE Duration**	**:**	03 Hours

Prerequisite: - Programming in Java.

Unit-I	**09 Hrs**
Introduction: Smart phone operating systems and smart phones applications. Introduction to Android, Installing Android Studio, creating an Android app project, deploying the app to the emulator and a device. UI Design: Building a layout with UI elements, Layouts, Views and Resources, Text and Scrolling Views. Activities and Intents, The Activity Lifecycle, Managing State, Activities and Implicit Intents, The Android Studio Debugger, Testing the Android app, The Android Support Library.	
Unit–II	**09 Hrs**
User experience: User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Testing app UI, Testing the User Interface	
Unit–III	**09 Hrs**
Working in the background: Async Task and Async Task Loader, Connect to the Internet, Broadcast Receivers and Services. Scheduling and optimizing background tasks – Notifications, Scheduling Alarms, and Transferring Data Efficiently	
Unit–IV	**09 Hrs**
All about data: Preferences and Settings, Storing Data, Shared Preferences. Storing data using SQLite, SQLite Database. Sharing data with content providers. Advanced Android Programming: Internet, Entertainment and Services. Displaying web pages and maps, communicating with SMS and emails, Sensors.	
Unit–V	**09 Hrs**
Hardware Support & devices: Permissions and Libraries, Performance and Security. Fire base and AdMob, Publish and Polish, Multiple Form Factors, Using Google Services.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic features of android platform and the application development process. Acquire familiarity with basic building blocks of Android application and its architecture.
CO2:	Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications.
CO3:	Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools.
CO4:	Create innovative applications, understand the economics and features of the app marketplace by offering the applications for download.

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4	Professional Android2ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012,ISBN-13:9788126525898

5	BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1
6	AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
PROJECT MANAGEMENT **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	**21IM75IM**		**CIE**	**:**	**100Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
Introduction: Project, Project management, relationships among portfolio management, program management, project management, and organizational project management, relationship between project management, operations management and organizational strategy, business value, role of the project manager, project management body of knowledge. **Generation and Screening of Project Ideas:** Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value.	
Unit – II	**09 Hrs**
Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope. **Organizational influences & Project life cycle:** Organizational influences on project management, project state holders & governance, project team, project life cycle.	
Unit –III	**09 Hrs**
Project Integration Management: Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase. **Project Quality management:** Plan quality management, perform quality assurance, control quality.	
Unit –IV	**09 Hrs**
Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk. **Project Scheduling:** Project implementation scheduling, Effective time management, Different scheduling techniques, Resources allocation method, PLM concepts. Project life cycle costing.	
Unit –V	**09 Hrs**
Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of project management and its relationship with organizational strategy, operations management, and business value.
CO 2	Apply techniques for generating, screening, and evaluating project ideas, considering factors such as net present value and project rating index.
CO 3	Create Work Breakdown Structures (WBS), utilization of PERT/CPM for developing project schedule, alongside requirement collection, scope definition, scope validation, and scope control.
CO 4	Develop skills in project integration, quality, risk management, and scheduling, enabling effective project planning, execution, monitoring, and control.

Reference Books	
1.	Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.

4	Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
SUPPLY CHAIN ANALYTICS **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	**21IM75IN**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hours**

Unit-I	**06 Hrs**
Introduction: Supply Chain, Supply Chain Management, Business Analytics, Supply Chain Analytics. Data-Driven Supply Chains: Data and its value in SCM, Data Source in Supply Chains, Big Data, Introduction to Python (Concepts only).	
Unit – II	**08 Hrs**
Data Manipulation: Data Manipulation, Data Loading and Writing, Data Indexing and Selection, Data Merging and Combination, Data Cleaning and Preparation, Data Computation and Aggregation, Working with Text and Datetime Data (Concepts only).	
Unit –III	**08 Hrs**
Customer Management: Customers in Supply Chains, Understanding Customers, Building a Customer-Centric SC, Cohort Analysis, RFM Analysis, Clustering Algorithms (Concepts only). Supply Management: Procurement in Supply Chains, Supplier Selection, Supplier Evaluation, Supplier Relationship Management, Supply Risk Management, Regression Algorithms (Concepts only).	
Unit –IV	**08 Hrs**
Warehouse and Inventory Management: Warehouse Management, Inventory Management, Warehouse Optimization, Classification Algorithms (Concepts only). Demand Management: Demand Management, Demand Forecasting, Time Series Forecasting, Machine Learning Methods (Concepts only).	
Unit –V	**06 Hrs**
Logistics Management: Logistics Management, Modes of Transport in Logistics, Logistics Service Providers, Global Logistics Management, Logistics Network Design, Route Optimization (Concepts only).	
Experiential Learning: Data Visualization: Data Visualization in Python, Creating a Figure in Python, Formatting a Figure, Plotting Simple Charts, Plotting with Seaborn, Geographic Mapping with Basemap, Visualizing Starbucks Locations. Python programming for various algorithms applied to supply chain processes and modelling included in the five units of the syllabus.	

Course Outcomes: After completing the course, the students will be able to know	
CO1:	Understand supply chain concepts, systemic and strategic role of SCM in global competitive environment.
CO2:	Evaluate alternative supply and distribution network structures using optimization models.
CO3:	Develop optimal sourcing and inventory policies in the supply chain context.
CO4:	Select appropriate information technology frameworks for managing supply chain processes.

Reference Books	
1.	Kurt Y. Liu, Supply Chain Analytics - Concepts, Techniques and Applications, Palgrave – Macmillan, Springer Nature Switzerland AG, 2022, ISBN 978-3-030-92224-5 (eBook)
2.	Işık Biçer, Supply Chain Analytics - An Uncertainty Modeling Approach, 2023, Springer Texts in Business and Economics, Springer Nature Switzerland AG, e-ISSN 2192-4341, e-ISBN 978-3-031-30347-0
3.	Supply Chain Management – Strategy, Planning & Operation, Sunil Chopra, Peter Meindl & D V Kalra, 6th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2.
4.	Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135–5

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
NUCLEAR ENGINEERING **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	**21ME75IO**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45**		**SEE Duration**	**:**	**3 Hours**

Prerequisites: Basic knowledge of Physics and Mathematics at the college level

Unit-I	**09 hrs**
Introduction to Nuclear Engineering : Historical Development of Nuclear Engineering, Overview of Nuclear Energy Applications, Nuclear Physics Fundamentals: Atomic Structure and Nuclear Models: Nuclear Forces and Interactions, Nuclear Reactions and Cross-sections, Types of Nuclear Reactions: Fission and Fusion Reactions, Neutron-Induced Reactions, Applications in Power Generation and Industry, Nuclear Power Generation: Basic Principles of Nuclear Reactors, Types of Nuclear Reactors, Radiation Basics, Types of Radiation (Alpha, Beta, Gamma), Radioactive Decay and Decay Chains, Units of Radioactivity and Radiation Measurement	
Unit-2	**10 hrs**
Nuclear Reactors : Types of Nuclear Reactors, Reactor Components and Their Functions, Nuclear Reactor Kinetics and Control, Neutron Interactions and Transport, Neutron Moderation and Absorption, Reactor Kinetics and Dynamics, Specific Types of Nuclear Reactor, Light Water Reactors: Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR), Heavy Water Reactors: Canada Deuterium Uranium (CANDU), Gas-Cooled Reactors: Gas-Cooled Reactor and Fast Breeder Reactor (and HTGR), Liquid Metal-Cooled Reactors (LMFR).	
Unit - 3	**10 hrs**
Nuclear Fuel Cycle : Introduction to the Nuclear Fuel Cycle: Importance of Fuel Cycle Management, Uranium Mining and Ore Processing, Types of Uranium Deposits, Mining Methods and Processing Techniques, Environmental and Health Considerations, Uranium Enrichment and Fuel Fabrication: Enrichment Technologies (Centrifugation, Gaseous Diffusion), Fuel Fabrication Processes, Quality Control and Safety Measures, Nuclear Reactors and Fuel Utilization: Fuel Assembly Design and Composition.	
Unit-4	**08 hrs**
Radiation Protection and Safety: Basics of Ionizing Radiation, Types of Ionizing Radiation, Interaction of Radiation with Matter, Units of Radiation Measurement, Biological Effects of Radiation, Deterministic and Stochastic Effects, Acute and Chronic Radiation Effects, Risk Assessment and Dose, Response Relationships, Radiation Dose Assessment: External and Internal Dosimetry, Radiation Monitoring Devices, Occupational and Public Dose Limits, Radiation Safety Measures:, Emergency Response and Contingency Planning: Emergency Procedures and Drills, Communication Strategies During Radiation Incidents.	
Unit-5	**08 hrs**
Environmental and Societal Aspects : Environmental Impact Assessment: Life Cycle Analysis of Nuclear Energy, Impact of Uranium Mining and Fuel Cycle Operations, Radioactive Waste Management and Environmental Considerations, Societal Perceptions and Attitudes, Factors Influencing Public Perception, Ethical Considerations: Principles of Ethics in Nuclear Engineering, Nuclear Energy and Social Justice, Ethical Dilemmas in Nuclear Technology, Nuclear Energy and Climate Change: Carbon Footprint of Nuclear Power.	

Course Outcomes:	
CO1	Understand nuclear physics: grasp atomic structure, nuclear models, and the forces driving nuclear interactions
CO2	Evaluate various reactor types and advanced concepts, applying kinetics and controls to ensure safe and efficient nuclear reactor analysis and design.
CO3	Examine the nuclear fuel cycle from mining to recycling, assess environmental impact and safety, and promote responsible, sustainable practices throughout.
CO4	Apply ionizing radiation principles for safety measures; integrate communication and regulatory compliance into emergency response plans effectively.

Reference Books	
1	Bodansky, D. (2007). "Nuclear Energy: Principles, Practices, and Prospects." Springer. ISBN-13: 978-0387261994.
2	Lamarsh, J. R., & Baratta, A. J. (2001). "Introduction to Nuclear Engineering." Prentice Hall. ISBN-13: 978-0201824988.
3	Duderstadt, J. J., & Hamilton, L. J. (1976). "Nuclear Reactor Analysis." John Wiley & Sons. ISBN-13: 978-0471223634.
4	Knoll, G. F. (2008). "Radiation Detection and Measurement." John Wiley & Sons. ISBN-13: 978-0470131480

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
COGNITIVE PSYCHOLOGY **Category: Institutional Elective II** **(Theory)**						
Course Code	**:**	21HS75IQ		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	03		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42 L		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Fundamentals & current trends in cognitive psychology: Definition, Emergence of cognitive psychology, Cognitive development theories and perspectives; Current status and trends in cognitive Psychology. Research methods in cognitive psychology- goals of research. Distinctive research method. Current areas of research in cognitive psychology, (Educational application, marketing and advertisement).	
Unit – II	**08 Hrs**
Basic cognitive processes: Sensation and Perception: Sensory receptors and Brain, The constancies, pattern recognition, Modularity, Imagery: Characteristics of Imagery, Cognitive maps. Attention and Information processing: Nature and Types, Theories and models of attention. Neuropsychological studies of Attention. Consciousness: – meaning, Modern Theories and Contemporary Research of Consciousness.	
Unit –III	**08 Hrs**
Reasoning, Creativity and Problem- Solving: Reasoning definition, types, influencing factors. Creativity-definition, steps involved in creative process, obstacles involved in creativity, enhancing techniques of creativity. Meta cognition: Problem solving, steps in problem solving, types, methods, obstacles and aids of problem Solving.	
Unit –IV	**08 Hrs**
Psycholinguistics: Definition, characteristics of language, theories - Chomsky. Structure of Language (Properties), Stages in Language Development, Neurological Language. Comprehension and Production. Bilingualism, Multilingualism and Learning disability.	
Unit –V	**09 Hrs**
Cognitive Neuroscience: Definition and emergence of cognitive neuroscience, Scope of Neuroscience, structure and functions of Brain, Brain Plasticity, Intelligence and Neuroscience.Meta-cognitive strategies. Artificial intelligence, Robotics, Models on Information Processing.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Describe the basic theories, principles, and concepts of cognitive psychology as they relate to behaviors and mental processes.
CO2	Define learning and compare and contrast the factors that cognitive, behavioural, and Humanistic theorists believe influence the learning process.
CO3	Develop understanding of psychological attributes such as reasoning, problem-solving creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4	Apply the theories to their own and others' lives to better understand their personalities and experiences.

Reference Books	
1	Sterberg R.J and Sternberg Karin(2012) Cognitive Psychology 6th Edition Woods worth Cenguage Learning
2	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.
3	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
4	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
PRINCIPLES AND PRACTICES OF CYBER LAW **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21HS75IR		**CIE**	**:**	100
Credits: L:T:P	**:**	03		**SEE**	**:**	100
Total Hours	**:**	45 L		**SEE Duration**	**:**	3 Hours

Unit-I	**08 Hrs**
Introduction - Origin and meaning of Cyberspace; Introduction to Indian Cyber Law, Distinction between Cyber Crime and Conventional Crime, Cyber Criminals and their Objectives, Kinds of Cyber Crime & Cyber Threats, challenges of cybercrimes, Overview of General Laws and Procedures in India. **Cyber Jurisdiction** - Concept of Jurisdiction, Jurisdiction in Cyberspace, Issues and concerns of Cyberspace Jurisdiction in India, International position of Cyberspace Jurisdiction, Judicial interpretation of Cyberspace Jurisdiction.Activities:Case Studies and Practical Applications	
Unit – II	**08 Hrs**
Information Technology Act: A brief overview of Information Technology Act 2000, IT Act 2000 vs. IT Amendment Act 2008, Relevant provisions from Indian Penal Code, Indian Evidence Act, Bankers Book Evidence Act, Reserve Bank of India Act, etc. **Electronic Signature and Digital Signature** - Meaning & Concept of Relevance of Signature, Handwritten signature vs Digital Signature, Technological Advancement and development of signature, Digital Signature: IT Act, 2000, Cryptography, Public Key and Private Key, Public Key Infrastructure Electronic Signature vs. Digital Signature, E-Commerce under IT Act 2000, Issues and challenges of E-Commerce.Activities:Case Studies and Practical Applications	
Unit –III	**08 Hrs**
Data Protection and Privacy Concerns in Cyberspace - Need to protect data in cyberspace, Types of data, Legal framework of data protection, Data protection bill -an overview, GDPR, Concept of privacy, Privacy concerns of cyberspace, Constitutional framework of privacy, Judicial interpretation of privacy in India. **Data Privacy and Data Security**- Defining data, meta-data, big data, non- personal data. Data protection, Data privacy and data security, Data protection regulations of other countries- General Data Protection Regulations (GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues. Activities:Case Studies and Practical Applications	
Unit –IV	**08 Hrs**
IP Protection Issues in Cyberspace **Copyright Issues in Cyberspace**- Copyright infringement in digital environment. Indian legal protection of copyright in cyberspace. **Trademark Issues in Cyberspace** - Domain Name Vs Trademark, Domain Name dispute and Related Laws, Different Form of Domain in Cyberspace. **Patent Issues in Cyberspace** - Legal position on Computer related Patents - Indian Position on Patents. Activities:Case Studies and Practical Applications	
Unit –V	**07 Hrs**
Digital Forensics - Computer Forensics, Mobile Forensics, Forensic Tools ,Anti-Forensics **Cyber Crime & Criminal Justice Agencies** - Cyber Crime Cells, Cyber Crime Appellate- Cyber Crime Investigation, Investigation Procedure - FIR - Charge Sheet	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the importance of professional practice, Law and Ethics in their personal lives and professional careers.
CO2	Build in Depth Knowledge of Information Technology Act and Legal Frame Work of Right to Privacy, Data Security and Data Protection.
CO3	Identify the bone of contentions of cybercrime investigation techniques, evaluate problem-solving strategies, and develop science-based solutions.
CO4	Develop an Understanding of the Relationship Between E-Commerce and Cyberspace.

Reference Books	
1	Cyber Law by Dr. Pavan Duggal Publisher: LexisNexis, ISBN-10: 8196241070, ISBN-13: 978-8196241070
2	Introduction to Information Security and Cyber Laws by Surya Prakash Tripathi, Ritendra Goel, Praveen Kumar Shukla ASIN: 9351194736, Publisher: Dreamtech Press, ISBN-10: 9789351194736, ISBN-13: 978-9351194736.
3	Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, 1st Edition, ISBN: 9788131250709.
4	Cyber Laws, Justice Yatindra Singh, 6th Edition, Vol. 1, ISBN : 9789351437338

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**M**
1	**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.**	**20**
2	**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 up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar / presentation / demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE HEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B(Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
SUMMER INTERNSHIP						
Course Code	**:**	**21ME76I**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours/Week	**:**	**04**		**SEE Duration**	**:**	**2 Hours**

GUIDELINES

1. The duration of the internship shall be for a period of 6/8 weeks on full time basis after VI semester final exams and before the commencement of VII 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 UG 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. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
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 Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7. The broad format of the internship final report shall be as follows
8. Cover Page
9. Certificate from College
10. Certificate from Industry / Organization
11. Acknowledgement
12. Synopsis
13. Table of Contents
14. Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
15. Chapter 2 - Activities of the Department
16. Chapter 3 - Tasks Performed: summary of the tasks performed during 8-week period
17. Chapter 4 – Reflections: Highlight specific technical and soft skills acquired during internship
18. References & Annexure

Course Outcomes:

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

CO1: Apply Engineering and Management principles

CO2: Analyze real-time problems and suggest alternate solutions

CO3: Communicate effectively and work in teams

CO4: Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews. The evaluation criteria shall be as per the rubrics given below:

Reviews	Activity	Weightage
Review-I	Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments.	25 Marks
Review - II	Importance of resource management, environment and sustainability, presentation skills and report writing	25 Marks

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.

Scheme of Evaluation for SEE	
Particulars	**%Marks**
Project Synopsis (Initial Writeup)	10%
Project Demo/Presentation	30%
Methodology and Results Discussion	30%
Project Work Report	10%
Viva-voce	20%
Total	100

Semester: VII						
MINOR PROJECT						
Course Code	**:**	**21ME77P**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours/Week	**:**	**04**		**SEE Duration**	**:**	**2 Hours**

GUIDELINES

1. The minor project is to be carried out individually or by a group of students. (maximum of 4 members and minimum of 3 students).

2. Each student in a team must contribute equally in the tasks mentioned below.

3. Each group has to select a current topic that will use the technical knowledge of their program of study after detailed literature survey.

4. The project should result in system/module which can be demonstrated, using the available resources in the college.

5. The CIE evaluation will be done by the committee constituted by the department. The committee shall consist of respective guide & two senior faculty members as examiners. The evaluation will be done for each student separately.

6. The final copy of the report should be submitted after incorporation of any modifications suggested by the evaluation committee.

The minor-project tasks would involve:

1. Carrying out the Literature Survey of the topic chosen.
2. Understand the requirements specification of the minor-project.
3. Detail the design concepts as applicable through appropriate functional block diagrams.
4. Commence implementation of the methodology after approval by the faculty.
5. Conduct thorough testing of all the modules developed and carry out integration testing.
6. Demonstrate the functioning of the minor project along with presentations of the same.
7. Prepare a project report covering all the above phases with proper inference to the results obtained.
8. Conclusion and Future Enhancements must also be included in the report.

The students are required to submit the report in the prescribed format provided by the department.

Course Outcomes:

After going through the minor project the student will be able to:

CO1: Interpreting and implementing the project in the chosen domain by applying the concepts learnt.

CO2: The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any of the domains in his / her future career.

CO3: Appling project life cycle effectively to develop an efficient product.

CO4: Produce students who would be equipped to pursue higher studies in a specialized area or carry out research work in an industrial environment.

Scheme of Continuous Internal Evaluation (CIE):

The evaluation committee shall consist of Guide, Professor/Associate Professor and Assistant Professor. The committee shall assess the presentation and the progress reports in three review phases. The evaluation criteria shall be as per the rubrics given below:

ReviewPhase	Activity	Weightage
Phase-I	Synopsis submission, approval of the selected topic, Problem definition, Literature review, formulation of objectives, methodology	10 Marks
Phase - II	Mid-term evaluation to review the progress of implementation, design, testing and result analysis along with documentation	15 Marks
Phase -III	Submission of report, Final presentation and demonstration	25 Marks

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.

Scheme of Evaluation for SEE	
Particulars	**%Marks**
Project Synopsis (Initial Writeup)	10%
Project Demo/Presentation	30%
Methodology and Results Discussion	30%
Project Work Report	10%
Viva-voce	20%
Total	100

Semester: VII						
ROBUST DESIGN **Category: Professional Core** **(Theory)**						
Course Code	**:**	**21ME78**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit - I	**09 Hrs**
Review of Statistics: Introduction, Normal Distribution, Distribution of Sample Means, t-Distribution, F-Distribution, Confidence Intervals, Hypotheses Testing **Fundamentals of Experimental Design:** Experimentation, Analysis of Variance, Basic Principles of Design, Terminology Used in Design of Experiments, Steps in Experimentation, Normal probability plots, problems	
Unit – II	**09 Hrs**
Single-Factor Experiments: Completely Randomized Design, Analysis of Variance, Randomized Complete Block Design, Balanced Incomplete Block Design (BIBD), Latin Square Design, problems **Multi-Factor Factorial Experiments**: Two-factor Experiments, Statistical Model for a Two-factor Experiment , Estimation of Model Parameters, Three-factor Factorial Experiment, Experiments with Random Factors, problems	
Unit – III	**09 Hrs**
Response Surface Methods: Designs for Fitting First-order Model, Central Composite Design (CCD), Box–Behnken Designs, Problems **Quality Loss Function**: Taguchi Quality Loss Function, Estimation of Quality Loss, S/N ratio, Robust Design, Basis of Taguchi methods, Steps in Experimentation, problems	
Unit – IV	**09 Hrs**
Orthogonal Arrays: Introduction, Assignment of Factors and Interactions, Linear Graph, Selection and Application of Orthogonal Arrays, problems **Data Analysis From Taguchi Experiments**: Variable Data with Main Factors Only, Variable Data with Interactions, Attribute Data Analysis, Confirmation experiments, Confidence intervals, Problems	
Unit – V	**09 Hrs**
Multi-response optimization problems: Introduction, Engineering Judgment, assignment of Weights, Data Envelopment Analysis based Ranking Method, Grey Relational Analysis, Problems **Metaheuristic Algorithms**: Principal Component Analysis (PCA), genetic algorithm, case studies on Automotive Disc Pad Manufacturing, Optimization of Flash Butt Welding Process	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Illustrate the basic concepts of operations research and management in manufacturing systems.
CO2	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained
CO3	Apply the concepts of purchase, stores and inventory management and analyse and evaluate material requirement decisions
CO4	Evaluate the concepts of analytical modeling paradigms for automation using queueing theory and scheduling algorithms.

Reference Books	
1	Applied Design Of Experiments And Taguchi Methods , K. Krishnaiah and P. Shahabudeen, PHI Learning Private Limited, ISBN-978-81-203-4527-0
2.	R.B Khanna, Production and Operations Management, 2nd Edition, 2015, ISBN: 9788120351219
3.	Panneerselvam, R. Operations Research, 3rd Edition, PHI, 2015, ISBN: 978-93-5443-789-2

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**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.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1: (Compulsory)	16
3 & 4	Unit 2: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VIII						
MAJOR PROJECT						
Course Code	**:**	**21ME81P**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**0:0:12**		**SEE**	**:**	**100 Marks**
Hours/Week	**:**	**24**		**SEE Duration**	**:**	**03 Hours**

GUIDELINES

- The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester.
- The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

- Students are free to choose their project partners from within the program or any other program.
- Each student in the team must contribute towards the successful completion of the project.
- The project may be carried out In-house / Industry / R & D Institution. The project work is to be carried out by a team of two to four students, in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process, the student can work independently.
- The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college.
- In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc.

Project Topic Selection:

The topics of the project work must be in the field of respective program areas or in line with CoE's(Centre of Excellence) identified by the college or List of project areas as given by industry/Faculty. The projects as far as possible should have societal relevance with focus on sustainability.

Students can select courses in NPTEL from the discipline of Humanities and Social Sciences, Management, Multidisciplinary and Design Engineering. The course chosen could be either of 4w/8w/12w duration. The students need to enrol for a course, register for the exam and submit the e-certificate to the department, as and when it is released by NPTEL. The same will be considered as one of the components during project evaluation of phase 2 and phase 5.

Project Evaluation:

- Continuous monitoring of project work will be carried out and cumulative evaluation will be done.
- The students are required to meet their internal guides once in a week to report their progress in project work.
- Weekly Activity Report (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly.
- In case of Industry project, during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period.

- For CIE assessment the project groups must give a final seminar with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.
- Before the final evaluations the project group is required to produce a No dues certificate from Industry, Central Library and Department.

Course Outcomes:

After going through the major project the student will be able to:

CO1: Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.

CO2: Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.

CO3: Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.

CO4: Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

Scheme of Continuous Internal Evaluation (CIE):

The following are the weightings given for the various stages of the project.

1.Selection of the topic and formulation of objectives	10%
2.Design and Development of Project methodology	25%
3.Execution of Project	25%
4.Presentation, Demonstration and Results Discussion	30%
5.Report Writing & Publication	10%

Scheme for Semester End Evaluation (SEE):

The following are the weightages given during Viva Examination.

1.Written presentation of synopsis	10%
2.Presentation/Demonstration of the project	30%
3.Methodology and Experimental Results &Discussion	30%
4.Report	10%
5.VivaVoce	20%

Calendar of Events for the Project Work:

Week	Event
Beginning of 7th Semester	Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment
II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	First visit of the internal guides to industry(In case of project being carried out In industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Submission of draft copy of the project report
XI and XII Week	Second visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

Evaluation & Scheme for CIE and SEE

Scheme of Evaluation for CIE		**Scheme of Evaluation for SEE**	
Particulars	**%Marks**	**Particulars**	**%Marks**
Project Evaluation I	10%	Project Synopsis(Initial Writeup)	10%
Project Evaluation II	25%	Project Demo/Presentation	30%
Project Evaluation III	25%	Methodology and Results Discussion	30%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification)	30%	Project Work Report	10%
Project Evaluation Phase-V (Project Final Internal Evaluation)	10%	Viva-voce	20%
Total	100	Total	100

Course Outcomes of Major Project:	
CO1	Apply knowledge of mathematics, science and engineering to solve respective engineering domain problems.
CO2	Design, develop, present and document innovative/multidisciplinary modules for a complete engineering system.
CO3	Use modern engineering tools, software and equipment to solve problem and engage in life-long learning to follow technological developments.
CO4	Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

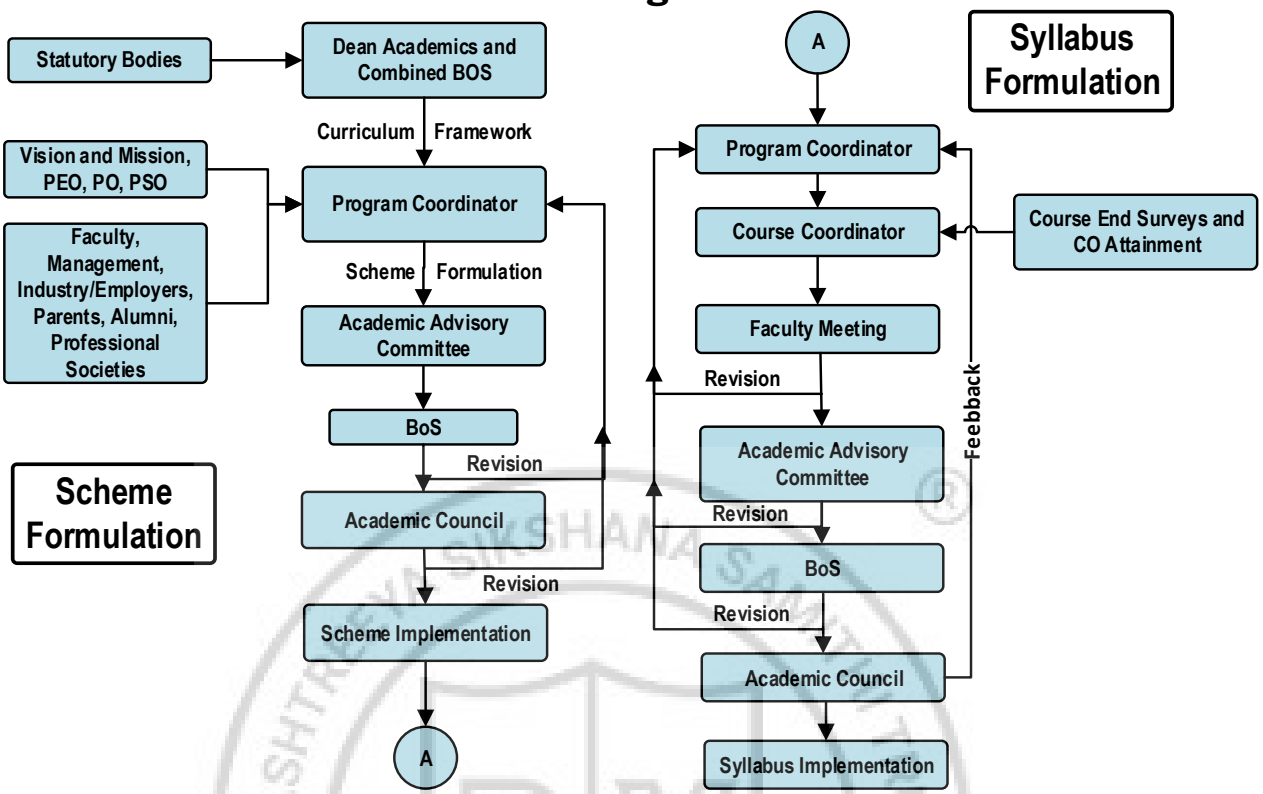
Calendar of Events for the Project Work:

Week	Event
Beginning of 7th Semester	Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment
II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	First visit of the internal guides to industry (In case of project being carried out in industry)
III to VI Week	Design and development of project methodology
VII to IX Week	Implementation of the project
X Week	Submission of draft copy of the project report
XI and XII Week	Second visit by guide to industry for demonstration. Final seminar by Department project Committee and guide for internal assessment. Finalization of CIE.

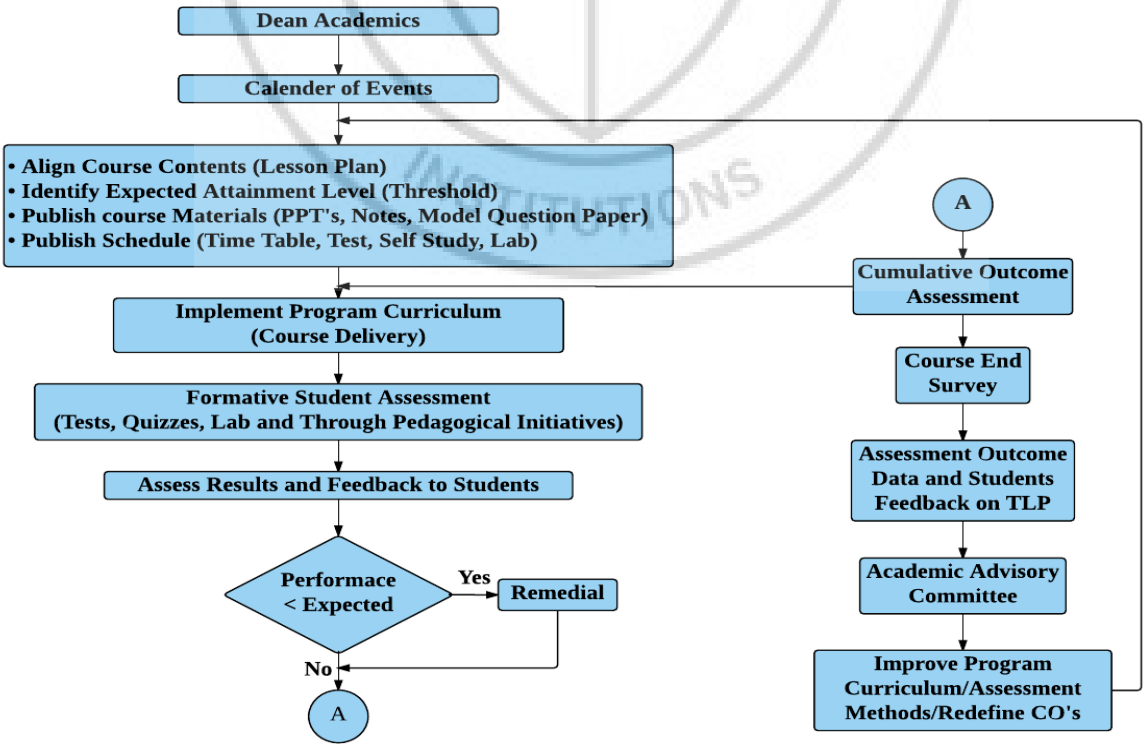
Evaluation Scheme for CIE and SEE

Scheme of Evaluation for CIE		Scheme of Evaluation for SEE	
Particulars	**%Marks**	**Particulars**	**%Marks**
Project Evaluation I	10%	Project Synopsis (Initial Write up)	10%
Project Evaluation II	25%	Project Demo / Presentation	30%
Project Evaluation III	25%	Methodology and Results Discussion	30%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification)	30%	Project Work Report	10%
Project Evaluation Phase-V (Project Final Internal Evaluation)	10%	Viva-voce	20%
Total	100	Total	100

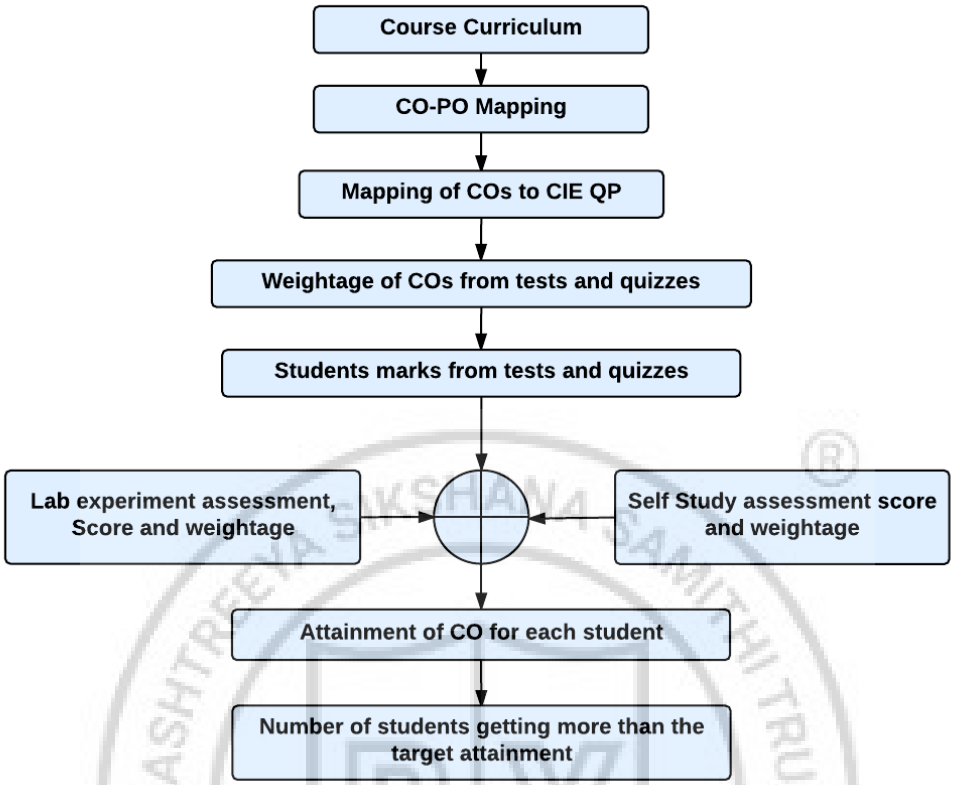
Curriculum Design Process



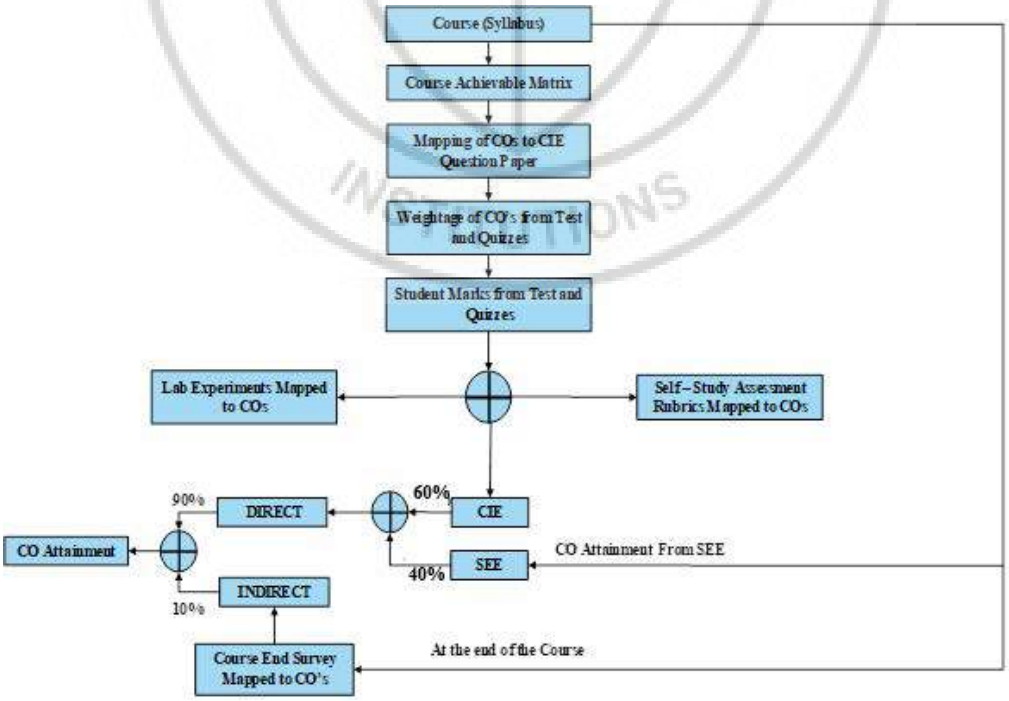
Academic Planning and Implementation



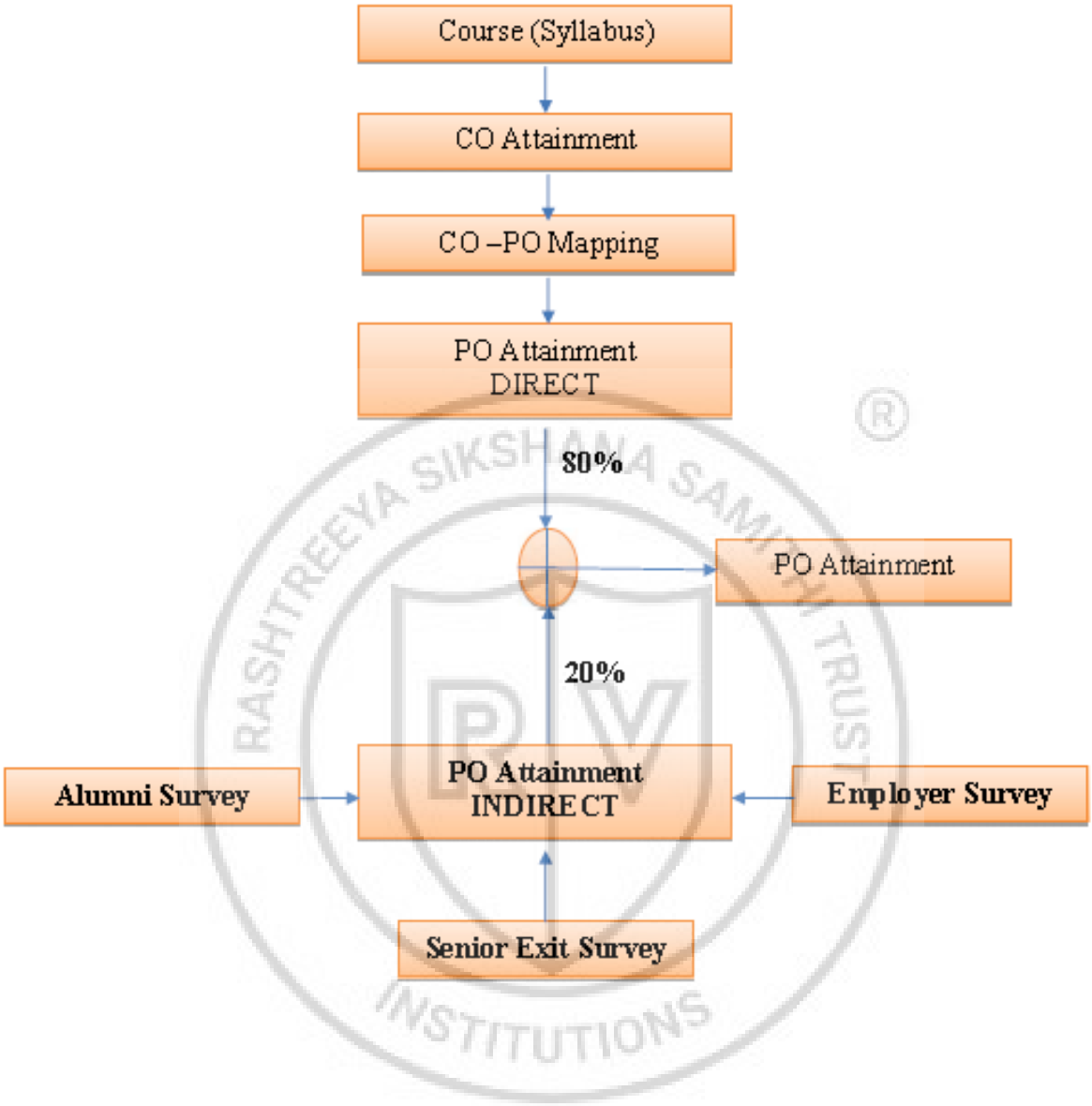
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



KNOWLEDGE & ATTITUDE PROFILE

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

PROGRAM OUTCOMES (POs)

- **PO1:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- **PO3:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- **PO5:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6**: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- **PO7:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- **PO8:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9:** Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- **PO10:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- **PO11:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation