



**RV College of
Engineering®**



Mechanical Engineering

Bachelor of Engineering (B.E)

Scheme And Syllabus Of VII & VIII Semester
(2022 Scheme)

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

M. Tech (13) MCA, M.Sc. (Engg.)

Ph.D. Programs : All Departments are recognized as Research Centres by VTU Except AI & AS

2025



**RV College of
Engineering®**

**NAAC
GRADE A+**
ACCREDITED INSTITUTION

**SINCE
1963**

SHAPING VISIONARIES, CRAFTING INNOVATORS



An autonomous institution affiliated with VTU, Belagavi, and approved by AICTE and UGC, New Delhi

- **RV SATELLITE-1 (RVSAT - 1)** India's First Microbiological Payload, launched by RVCE students in December 2024
- **NCC - Best Institution Award of Karnataka and Goa Directorate (2019, 2022, 2023 & 2025)**

₹50 Cr.

MoU with **TATA Technologies** to establish Centre for Invention, Innovation, Incubation & Training

Placements

₹92 LPA
Highest Package

250+
Recruitment Partners

92%
Placement Rate

₹10 LPA
Median Salary

Rankings

99th

NIRF Ranking 2024
in Engineering
Category

1501+

Times Higher
Education World
University
Rankings-2025

601+

Times Higher
Education Asia
University
Rankings-2025

NBA

UG and PG
programs
accredited
multiple times

IIRF 2025

Engineering ranking India
National -01
State -01
Zone -01

NPTEL

Local Chapter Ranking 2025
National-09
State – 01

Research and Centres

37 Skill Labs

General Skills, Domain Skills, Interdisciplinary Skills

- Bosch Rexroth
- Mercedes Benz
- Morris Garage
- Boston AI System
- Toyota Kirloskar
- Vision Astra EV Academy

Outcome Based Education (OBE) emphasizing on experiential learning, research-based learning and skill-based learning

20

Centres of
Excellence

8

Centres of
Competence

80

Patents
filed

65

Patents
published

46

Patents
granted

32

Innovative & Cultural
activity teams

₹30 Cr.

Research and
projects consultancy
(last 5 years)

16 Research Centres
in niche areas

- Autonomous Vehicles
- Nanomaterials and Devices
- Hydrogen and Green Technology
- Extended Reality
- Healthcare
- E-mobility
- IoT and Sensors
- Smart Antenna System
- Computational Genomics
- Quantum Computing

Programs and Faculty

- 13 UG Programs;
1420 (2025) annual sanctioned intake
- 13 PG Programs
390 (2025) annual sanctioned intake
- Ph.D. Programs in all departments
- 500+ Faculty Members and Staff

CET / KEA Code: **E005**
COMED-K Code: **E095**

PGCET Code (MTech): **T857**
PGCET Code (MCA): **C463**

State-of-the-Art infrastructure

- Innovation Center
- Gymnatorium
- Hostels
- Labs & Workshops

Alumni

36,000 +

Alumni across the globe

100+

RVCE alumni in civil service

RVCE Reconnect - USA edition, our first International Alumni Meet

NUMBER OF ATTENDEES

650
San Jose

120
Seattle

Mr. Suresh Katta, RVCE alumnus & Chairman Emeritus of Saama Group, USA and Mr. Anil Kumble, RVCE alumnus & former Indian cricketer, were the Guests of Honour at the alumni meets held in San Jose & Seattle, USA.

Collaborations with International universities



**Fachhochschule
Dortmund**
University of Applied Sciences and Arts

**Technische
Hochschule
Rosenheim**
Institute for Technik und
Management der
University of Applied Sciences

HTW D
HTW Berlin
HTW Brandenburg
HTW Cottbus

**The
UNIVERSITY
OF IOWA**

FIU
Florida
International
University

**Saint Peter's
UNIVERSITY**

**Kennesaw State
UNIVERSITY**

**RWTH AACHEN
UNIVERSITY**

125 MoUs with Industry, Institutions & Research Establishments



**RV College of
Engineering®**

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Bengaluru - 560059, Karnataka, India | +91-80-68188110 | www.rvce.edu.in

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2025



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

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	PE	Professional Core Elective
6.	IE	Institutional Elective
7.	HSS	Humanities and Social Sciences
8.	PY	Physics
9.	CM	Chemistry
10.	MA	Mathematics
11.	AS	Aerospace Engineering
12.	AI & ML	Artificial Intelligence & Machine Learning
13.	BT	Biotechnology
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	CV	Civil Engineering
17.	EC	Electronics & Communication Engineering
18.	EE	Electrical & Electronics Engineering
19.	EI	Electronics & Instrumentation Engineering
20.	ET	Electronics & Telecommunication Engineering
21.	IM	Industrial Engineering & Management
22.	IS	Information Science & Engineering
23.	ME	Mechanical Engineering
24.	CD	Computer Science & Engineering (Data Science)
25.	CY	Computer Science & Engineering (Cyber Security)
26.	CI	Computer Science & Engineering (Artificial Intelligence & Machine Learning)



**Bachelor of Engineering in
MECHANICAL ENGINEERING**

VII SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	HS271TA	Indian knowledge system	3	0	0	3	HS	Theory	1.5	100	****	3	100	****
2	ME372IA	Vibrations & Acoustics	3	0	1	4	ME	Theory + Lab	1.5	100	50	3	100	50
3	ME273TA	Product Life Cycle Management	3	1	0	4	ME	Theory	1.5	100	****	3	100	****
4	ME374TFX	Professional Core Elective-IV (Group F)	3	0	0	3	ME	Theory	1.5	100	****	3	100	****
5	XX375TGX	Institutional Elective-II (Group-G)	3	0	0	3	XX	Theory	1.5	100	****	3	100	****
6	ME376SI	Summer Internship	0	0	3	3	ME	Internship	****	****	100	2	****	100
										20				

VIII SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	ME481P	Major Project	0	0	12	12	ME	Project work	****	****	100	3	****	100
										12				



INDEX

VII Semester

Sl. No.	Course Code	Course Title	Page No.
1.	HS271TA	Indian knowledge system	1-2
2.	ME372IA	Vibrations & Acoustics	3-5
3.	ME273TA	Product Life Cycle Management	6-7
4.	ME374TFX	Professional Core Elective-IV (Group F)	8-17
5.	XX375TGX	Institutional Elective-II (Group-G)	18-57
6.	ME376SI	Summer Internship	58-59

Professional Electives (Group F)

Sl. No.	Course Code	Course Title	Page No.
1.	ME374TFA	Industrial Automation	8-9
2.	ME374TFB	Smart Manufacturing systems	10-11
3.	ME374TFC	Fracture Mechanics	12-13
4.	ME374TFD	Fluid power Engineering	14-15
5.	ME374TFE	Electric Vehicle dynamics	16-17

Institutional Electives-II (Group G)

Sl. No.	Course Code	Course Title	Page No.
1	AI375TGA	Data and Story Telling	18-19
2	AS375TGB	Aircraft Systems	20-21
3	BT375TGC	Health Care Technologies	22-23
4	CH375TGD	Green and Hydrogen Technology	24-25
5	CM375TGE	Chemistry of materials and molecular analysis	26-27
6	CS375TGF	Prompt Engineering	28-29
7	CV375TGG	Solid Waste Management and Statutory rules	30-31
8	CV375TGH	Freight Transportation Systems and Logistics	32-33
9	EC375TGI	IoT for smart systems	34-35
10	EE375TGJ	E Mobility	36-37
11	EI375TGK	Disease and Diagnostics an Engineering Perspective	38-39
12	ET375TGL	Space Technology and Applications	40-41
13	IM375TGM	Project Management	42-43
14	IM375TGN	Global Supply chain management	44-45
15	MA375TGO	Statistical methods for engineers	46-47
16	ME375TGP	Industry 5.0	48-49
17	PY375TGQ	Principles of Astrophysics	50-51
18	MA375TGR	Mathematics of Music	52-53
19	HS375TGS	Cognitive Psychology	54-55
20	HS375TGT	Principles & Practices of Cyber Law	56-57

VIII Semester

Sl. No.	Course Code	Course Title	Page No.
1.	ME481P	Major Project	60-61



Semester: VII				
INDIAN KNOWLEDGE SYSTEM				
Common Course				
Theory				
Course Code	: HS271TA		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 of Indian Knowledge Systems (IKS): Perception and prologue, Historicity of IKS, Indian Traditional Knowledge, Nature and scope, kinds of traditional knowledge, Transition from traditional to western knowledge. The IKS Corpus, Vedic Corpus, Indian Philosophical Systems.				
Unit - II				09 Hrs
Foundational Concepts of Mathematics and Science & Technology: Linguistics; Pānini's work on Sanskrit Grammar, Phoenetics, Ashtadhyayi's vyakarana. Number System and Units of Measurement: concept of zero, Piṅgala and the Binary system. Knowledge: Framework & Classifications: Prameya, Pramana, Samsaya.				
Unit - III				09 Hrs
Science, Engineering & Technology in IKS: Mathematics; Arithmetic, geometry, trigonometry and algebra, Chanda Sastra of Pingala. Astronomy: Elements of the Indian Calendar, Āryabhaṭṭa and the Siddhāntic Tradition, Panchanga, Astronomical Instruments (Yantras) and Jyotiḥśāstra. Engineering & Technology: Metals & Metal Working; Wootz Steel, Iron and Steel in India, Metals and Metal working Technology, Lost-wax casting of idols and artefacts, Dyes and Painting Technology, The art of making perfumes.				
Unit - IV				09 Hrs
Yoga and Ayurveda: Tridosas, Triguna System, Body-Mind-Intellect-Consciousness Complex, Sixty-four art forms and occupational skills (64 Kalas).				
Irrigation Systems and Water management Practices Town Planning & Architecture: Indian Architecture in India, Vāstu Śāstra; Eight limbs of Vāstu, Town Planning; Temple Architecture				
Unit - V				09 Hrs
Governance, Public Administration & Management: Rāmāyaṇa on great attributes, Arthaśāstra – Governance & Administration, Janapada, Durga, Kosa, Danda, Mitra. IKS & United Nations Sustainable development goals. Safeguarding traditional Indian Knowledge.				

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the nature, scope, and historical development of Indian Knowledge Systems and differentiate traditional knowledge from modern scientific paradigms
CO2	Analyze the foundational concepts of Indian contributions to linguistics, mathematics, and science, including works of Pānini, Piṅgala and others
CO3	Evaluate the applications of traditional Indian technologies in areas such as astronomy, metallurgy, architecture, and medicine.
CO4	Assess the relevance of Indian Knowledge Systems in the context of sustainable development goals and propose methods to safeguard and integrate IKS in contemporary society

Reference Books	
1.	Introduction to Indian Knowledge System Concepts & Applications, B Mahadevan, Vinayaka Rajat Bhat, R N Nagendra Pavana, PHI Learning publishers, ISBN-13: 978-9391818203
2.	Traditional Knowledge System in India, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230
3.	Knowledge Traditions and Practices of India, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
Suggested Web Links:	
1.	https://www.youtube.com/watch?v=LZP1StpYEPM
2.	http://nptel.ac.in/courses/121106003/



3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development-goals/?gclid=EAIAIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAVASAEgIm1vD_BwE

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				
VIBRATIONS & ACOUSTICS				
Professional Core Course				
(Theory and Practice)				
Course Code	: ME372IA		CIE	: 150 Marks
Credits: L:T:P	: 3:0:1		SEE	: 150 Marks
Total Hours	: 42L+28P		SEE Duration	: 3 + 3 Hours
PART-A				
Unit-I				
10 Hrs				
Free SDOF systems:				
Basic concept of vibration, Importance of the study of vibration, Classification of vibration, Natural frequency of simple systems, Free Vibration of Single Degree Freedom Systems – Free vibration of undamped systems, Equation of motion, Springs in series & parallel, Effect of mass of spring, problems				
Damped Free Vibration – Types of damping, over, critical and under damped systems, Logarithmic decrement, vibration energy and logarithmic decrement, problems				
Unit – II				
08 Hrs				
Forced SDOF Vibrations:				
Forced vibrations due to harmonic excitation, rotating unbalance, base excitation, transmissibility, problems. Whirling of shafts without damping, Vibration instruments-problems- vibrometer and accelerometer- FFT analyzer				
Unit – III				
08 Hrs				
Multi Degrees of Freedom:				
Influence coefficients, Determination of Natural frequencies and mode shapes, Matrix iteration method, Stodola's method, Dunkerley's method, problems				
Unit – IV				
08 Hrs				
Basics of Acoustics:				
Speed of Sound, Wavelength, Frequency, and Wave Number, Acoustic Pressure and Particle Velocity, Acoustic Intensity and Acoustic Energy Density, Spherical Wave propagation, Directivity Factor and Directivity Index, Levels and the Decibel, Addition and subtraction of Sound levels, Octave Bands, Weighted Sound Levels.				
Unit – V				
08 Hrs				
Noise Measurement and Control:				
Sound Level Meters, Intensity Level Meters, Octave Band Filters Acoustic analyzers, Dosimeter, Measurement of Sound Power, impact of noise on humans, A-Weighting, Noise control strategy, sound absorption and insulation.				

PART-B (Laboratory)		26 Hrs
Section – I (Vibrations)		16 Hrs
1	Modal testing of MS plate under cantilever condition using FFT Analyzer - Analyze the natural frequency and modal shapes	
2	Modal testing of MS plate under free-free condition using FFT Analyzer - Analyze the natural frequency and modal shapes	
3	Modal testing of a composite plate under free-free condition using FFT Analyzer - Analyze the natural	
4	Measurement of Frequency Response Function (FRF) using modally tuned shaker	
Section – II (Acoustics)		12 Hrs
5	Investigate Sound level meter operations and calibration	
6	Determination of Sound Pressure Level by Sound level meter at different locations	
7	Evaluating the effectiveness of Noise control measures	
8	Investigating the frequency response of A, B and C Weighing Networks	



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

CO1	Understand the fundamentals of vibration in single degree of freedom system
CO2	Analyze the undamped and damped mechanical systems & structures
CO3	Determine natural frequencies and mode shapes of millidegree freedom systems
CO4	Apply the knowledge of vibrations to acoustics and acoustic measurements

Reference Books

1	S S Rao, 'Mechanical Vibrations', Pearson Publisher, 6 th Edition, ISBN 978-0-13- 212819-3, 2018
2	C Sujatha, 'Vibration and Acoustics ', McGraw Hill Education, ISBN 978-007014878, 2017
3	Rao V Dukkipatti, 'Solving Vibration Analysis Problems using MATLAB', New Age, International Publishers, ISBN 978-81-224-2427-0, 2007
4	Ghosh M and Bhattacharya D., 'A Text Book of Oscillations, Waves and Acoustics', S. Chand Publication, ISBN: 9789385676154, 2021

RUBRICS 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
4.	LAB: Conduction of laboratory exercises, lab report, observation, and analysis (40 Marks) and lab test (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	50
MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)		150

**RUBRICS 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

RUBRICS FOR SEMESTER END EXAMINATION (LAB)

Student is required to perform Computer Simulation/ Develop a prototype or model as the case may be and present the results in the form of a **presentation**. Further, students have to submit a poster for exhibition and also a report.

Q.NO.	CONTENTS	MARKS
1	Design and development of the project	20
2	Presentation of the working model/simulation results/prototype building	20
3	Viva Voce	10
TOTAL		50



Semester: VII				
PRODUCT LIFE CYCLE MANAGEMENT				
Professional Core Course				
(Theory)				
Course Code	: ME273TA		CIE	: 100 Marks
Credits: L:T:P	: 3:1:0		SEE	: 100 Marks
Total Hours	: 42L+28T		SEE Duration	: 3 Hours
Unit-I				10 Hrs
Introduction: Overview, Need, Benefits, Concept of Product Life Cycle, Components / Elements of PLM. Emergence and Significance of P004CM, PLM implementation cases in various industry verticals.				
Unit – II				08 Hrs
PLM Strategy and Vision: Company's PLM vision, PLM Strategy, Principles for PLM strategy, preparing for the PLM strategy, Developing a PLM strategy, Strategy identification and selection, PLM business goals. Tools, Information systems and people involved in PLM. Product data and processes like New Product Development, Change Management, Concurrent Design & Process Management, product data linkages across the domain.				
Unit – III				08 Hrs
Typical Architectures in PLM Applications: N-tier architectures, Databases, File Vaults, Caching mechanisms				
Unit – IV				08 Hrs
PLM Solutions: Different phases of product lifecycle and corresponding technologies, Enterprise information, knowledge and IP, Change Process, Product Structure & Configuration, Bill of Material, Requirement, Portfolio, Program & Project, Engineering Process, Supplier Relationship, Manufacturing Process, Maintenance Repair & Overhaul process and Simulation Process Management.				
Unit – V				08 Hrs
Human resources in product lifecycle: Methods, Techniques, Practices, Methodologies, Processes, System components in lifecycle, slicing and dicing the systems, Interfaces, Information Standards, Vendors of PLM Systems and Components.				

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

CO1	Justify importance and need of various components/elements of PLM.
CO2	Able to demonstrate the benefits of PLM implementation/deployment.
CO3	Distinguish various tasks terminologies used in domain of PLM.
CO4	Implement and devise comprehensive strategies for the management of process and product data.

Reference Books	
1	Product Lifecycle Management , Grieves, Michael, , McGraw-Hill, 2006. ISBN 0071452303
2	Product Life Cycle Management , Antti Saaksvuori, Anselmilmmonen, - Springer, 1 st Edition (Nov.5, 2003)
3	Product Lifecycle Management , Stark, John. Paradigm for 21st Century Product Realization, Springer-Verlag, 2004. ISBN 1852338105
4	Product Design & Development , Kari Ulrich and Steven D. Eppinger, McGraw Hill International Edition, 1999.



RUBRICS 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

RUBRICS FOR 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				
INDUSTRIAL AUTOMATION				
Professional Core Elective (Group-F)				
(Theory)				
Course Code	:	ME374TFA	CIE	: 100 Marks
Credits: L:T:P	:	3:0:0	SEE	: 100 Marks
Total Hours	:	42 Hrs	SEE Duration	: 3 Hours
PREREQUISITES: Design Thinking, Manufacturing Technology				
Unit – I				06 Hrs
Introduction to Industrial Automation				
Definition, category, types of production systems and automation, specific industrial applications, Hierarchical structure of industrial automation, essential functions, supervisory control levels of automation, automation and artificial intelligence, examples of Industrial automation circuits, process industries and discrete manufacturing industries, continuous vs discrete control, computer based industrial control and automation.				
Unit -II				09 Hrs
Sensors and Machine vision systems				
Working and Industrial applications of Encoders, Limit switches, Reed switches, LVDT, Laser sensors, LiDAR sensor, inductive and capacitive proximity sensors, ultrasonic sensors, pneumatic back pressure sensors, electro optical imaging sensors. Machine vision system functions, sensing and digitizing, preprocessing – masking, neighborhood averaging, median filtering (Numericals), higher level vision, applications of robot vision system.				
Unit -III				09 Hrs
Industrial Automation Synthesis				
Latch principle and principle of command, step by step synthesis process, electrical and mechanical latch, automation circuit with motors, automation circuits with sensors, design regulations, application - machine operation control with multiple positions.				
Unit -IV				09 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 realizations, sequential automation systems, Applications – Bi directional lead screw movable worktable with two speeds, Palindromic movement of a worktable with memory.				
Unit - V				09 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. Developing simple petrinet models for automation applications				

Course Outcomes: After completing the course, the students will be able to	
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.	Stamatios Manesis, George Nikolakopoulos, 'Introduction to Industrial Automation', CRC Press, 2018, ISBN - 978-1-4987-0540-0
2.	Performance modelling of automated manufacturing systems, N Vishwanadham, Y Narahari, 2015. PHI learning pvt ltd, ISBN: 978-81-203-0870-1
3.	Automation, production systems and computer integrated manufacturing, Mikell P Groover, 4 th Edition, 2016. Pearson education –ISBN: 978-9332572492
4.	Robotics and Flexible Automation, SR Deb, S Deb, 2 nd Edition, 2017, McGraw-Hill Education, - ISBN – 0-07-007791-6

RUBRICS 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 50Marks , 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

RUBRICS FOR 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					
Smart Manufacturing Systems Professional Core Elective (Group-F) (Theory)					
Course Code : ME374TFB CIE : 100 Marks					
Credits: L:T:P	: 3:0:0	SEE	: 100 Marks		
Total Hours	: 42 Hrs	SEE Duration	: 3 Hours		
PREREQUISITES: Theory of Machines, Manufacturing Technology					
Unit - I					8 Hrs
AI and ML for Engineering Systems: Definition and scope of Artificial Intelligence (AI), Overview of AI and its subfields, Historical development and milestones in AI, Applications of AI in Mechanical Engineering, Introduction to Machine Learning: supervised, unsupervised, and reinforcement learning, Classification algorithms: Decision Trees, Support Vector Machines, Ethical considerations and societal impacts of AI.					
Unit - II					10 Hrs
Intelligent Design Optimization: Genetic algorithms, Evolutionary computation, Swarm intelligence, Particle swarm optimization, Optimization techniques for engineering design problems, Regression analysis, Predictive modelling, Case studies on design optimization using AI techniques.					
Unit - III					8 Hrs
AI in Predictive Maintenance: Introduction to predictive maintenance, Sensor data analysis, Anomaly detection, Prognostics and health management (PHM) systems, Condition-based monitoring using AI algorithms, Real-world applications in mechanical systems maintenance.					
Unit - IV					8 Hrs
Cognitive and Collaborative Robotics: Cognitive robotics, Human-robot interaction (HRI), Emotion-aware and socially assistive robots, Learning from demonstration (LfD), Imitation learning, multi-robot systems and swarm robotics, Robot collaboration and coordination, Trust and safety in human-robot teaming, Applications in healthcare, logistics, and service robotics.					
Unit - V					8 Hrs
Perception and Control in Robotics: Deep learning for visual perception, Sensor fusion and SLAM (Simultaneous Localization and Mapping), Vision-based control and visual servoing, Adaptive and robust control strategies, Reinforcement learning for motion planning and control, Real-time decision making and autonomous navigation, Explainable AI in robotics, Research case studies in autonomous and intelligent robotic systems.					

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the basic concepts of AI and ML and their applications in engineering systems.
CO2	Apply AI techniques such as genetic algorithms and swarm intelligence for engineering design optimization.
CO3	Analyze sensor data and detect faults using AI methods in predictive maintenance applications.
CO4	Evaluate the advanced AI techniques used in robotics for perception, control, and human-robot interaction.



Reference Books

1.	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" Pearson publisher, 2020, ISBN-13: 978-0134610993
2.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012, ISBN-13: 978-0262018029
3.	Nikolaus Correll, Bradley Hayes, et al., "Introduction to Autonomous Robots" MIT Press, 2019, ISBN-13: 978-0262038621
4.	Fan Yang and Andrew Kusiak, "Predictive Maintenance of Industrial Control Systems" Wiley-IEEE Press, 2019, ISBN-13: 978-1119387853
5.	Breazeal, C. <i>Designing Sociable Robots</i> , MIT Press, 1 st Edition, 2002, ISBN: 978-0262524600.

RUBRICS 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 50Marks , 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

RUBRICS FOR 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				
FRACTURE MECHANICS				
Professional Core Elective (Group-F)				
(Theory)				
Course Code	:	ME374TFC	CIE	: 100 Marks
Credits: L:T:P	:	3:0:0	SEE	: 100 Marks
Total Hours	:	42 Hrs	SEE Duration	: 3 Hours
PREREQUISITES: Solid Mechanics				
Unit – I				10 Hrs
Introduction: Historical Perspective, The Fracture Mechanics Approach to Design, Effect of Material Properties on Fracture, Differences between ductile and brittle fracture				
Linear Elastic Fracture Mechanics: stress concentration effect of flaws, Griffith Energy Balance, Energy Release Rate, Instability and the R Curve, Stress Analysis of Cracks, Relationship between K and G, K-Controlled Fracture (Simple Numericals)				
Unit -II				06 Hrs
Elastic-Plastic Fracture Mechanics: Effect of thickness on fracture, Plane Strain Fracture, Crack-Tip Plasticity, Plastic zone size, Crack-Tip-Opening Displacement, J Contour Integral, Relationships Between J and CTOD, Crack-Growth Resistance Curves, Stable and Unstable Crack Growth (simple Numericals)				
Unit -III				10 Hrs
Fracture Mechanisms in Metals: Ductile Fracture, Cleavage, Fractography, The Ductile-Brittle Transition, Intergranular Fracture				
Fracture Toughness Testing of Metals: General Considerations, Specimen standards, KIC Testing, K-R Curve Testing, J Testing of Metals, CTOD Testing, fracture Testing of Weldments (simple Numericals)				
Unit -IV				8 Hrs
Fatigue Crack Propagation: Similitude in Fatigue, Empirical Fatigue Crack Growth Equations, Crack Closure, The Fatigue Threshold, Variable Amplitude Loading and Retardation, Micro mechanisms of Fatigue, Fatigue Crack Growth Experiments (simple Numericals)				
Unit - V				8 Hrs
Environmentally Assisted Cracking in Metals: Environmental Cracking Overview, Stress Corrosion Cracking, Hydrogen Embrittlement, Corrosion Fatigue.				
Introduction to Computational Fracture Mechanics, FE applications in Fracture Mechanics				

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the fundamentals of how cracks initiate and propagate in different materials, including brittle and ductile materials.
CO2	Apply mathematical modelling and interpret the stress intensity factor (K), a key parameter in fracture mechanics, and its relationship to crack tip stress fields.
CO3	Demonstrate the ability to determine material fracture toughness, often using experimental methods like impact testing, and understand how it relates to material selection for specific applications.
CO4	Develop the ability to apply fracture mechanics principles for designing structures considering damage tolerance and to analyze failures to identify root causes.



Reference Books

1.	T. L. Anderson, "Fracture Mechanics, Fundamentals and Applications," 4 th Edition, CRC Press, Washington DC, 2017, ISBN: 978-1498728133
2.	Kumar, Prashant. "Elements of Fracture Mechanics". 1 st Edition, McGraw Hill Education (India) Private Limited. 2009., ISBN: 9780070656963
3.	David Broek, "Elementary Engineering Fracture Mechanics" Kluwer Academic Publishers; 2 nd Edition, 2011, ISBN: 978-94-010-8425-3
4	F. C. Campbell Fatigue and Fracture: Understanding the Basics, 2012, ASM International, ISBN: 978-1615039760

RUBRICS 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 50Marks , 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

RUBRICS FOR 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				
FLUID POWER ENGINEERING Professional Core Elective (Group-F) (Theory)				
Course Code : ME374TFD CIE : 100 Marks				
Credits: L:T:P	: 3:0:0	SEE	: 100 Marks	
Total Hours	: 42 Hrs	SEE Duration	: 3 Hours	
PREREQUISITES: Fluid Mechanics				
Unit – I				06 Hrs
Fundamentals of Fluid power systems: Pneumatic power system, hydraulic power system, combined representation of power transmission systems, Pascals law and its applications (simple Numericals), Positive vs non positive displacement pumps, working principle of gear pump, vane pump and piston pumps, linear hydraulic actuators (all types), basic hydraulic motors. Directional control valves (manual, electrical, pilot, mechanical/2 position and 3 position), pressure control valves (direct and pilot type relief, unloading, sequence, counterbalance, reducing) and flow control valves (Needle, pressure compensated), Accumulators.				
Unit -II				09 Hrs
Fluid power system performance: Volumetric displacement of gear, vane and piston pumps, theoretical and actual flow rate, pump and motor input and output power, motor torque, efficiency of hydraulic pumps and motor, hydrostatic transmission, cylinder thrust, input and output power. Summary of mathematical relations in hydraulic pumps, motors and cylinders (Numericals), cylinder mountings (Numericals), Beta rating of filters (Numericals), Numericals on selection of pneumatic cylinders, sizing of control valves, pressure losses in pipes, sizing of compressors, sizing of accumulators.				
Unit -III				09 Hrs
Hydraulic Circuit Design and Analysis Symbolic representations; control of bi-directional motors; clamping circuits using pressure-reducing valves and rotary chucks; pilot-operated DCV for surface grinder; Meter-IN and Meter-OUT feed circuits, unloading valve in punch press; pressure sequence valve for clamping and bending; milling circuit with three cylinders; drilling with regeneration; cylinder synchronization (Numericals); automatic reciprocation; accumulator circuits, Numericals on selected circuits, and analysis of open-ended hydraulic circuits with various components.				
Unit -IV				09 Hrs
Pneumatic Circuit Design and Analysis Symbolic representations, Memory control of double acting cylinder, logic design with AND, OR valves, MPL control of devices, applications of pneumatic pressure sequence valve and time delay valve, displacement – timing diagram, cascading principle and circuits for sequential operation using cascading with reversing valve, Use of Karnaugh – Veitch diagram for pneumatic circuit design, drawing open ended circuits based on the task given.				
Unit - V				09 Hrs
Electronic control of fluid power Single solenoid and dual solenoid valves, basic electric components - symbolic representations, Circuit diagram for gravity feed magazine, multi-track gravity feed magazine, conveyor belt control, rotary indexing table, diverting device, box sorting system, separating similar balls, multi cylinder sequencing, circuit for stamping device, electrical control of regenerative circuit.				



Course Outcomes: After completing the course, the students will be able to	
CO1	Apply fluid mechanics concepts to understand and analyze the behavior of hydraulic and pneumatic power systems including pumps, actuators, and control valves.
CO2	Calculate flow rate, power, torque, and efficiency of hydraulic and pneumatic components for effective system design.
CO3	Design and analyze hydraulic and pneumatic circuits for industrial applications.
CO4	Develop and interpret electro-pneumatic circuits using electrical control elements and logic gates for automation tasks.

Reference Books	
1.	Parambath, J. (2015). <i>Industrial Hydraulics</i> . Industrial press. 1 st Edition, ISBN: 9788193430907
2.	S. Ilango, V. Soundararajan, 'Introduction to Hydraulics and Pneumatics', PHI learning, 2 nd Edition, 2011, ISBN: 978812034406-8.
3.	Andrew Parr, 'Hydraulics and Pneumatics', Elsevier, 3 rd Edition, 2011, ISBN: 978008096674-8.
4.	Anthony Esposito, 'Fluid Power with Applications', 7 th Edition, 2013, ISBN – 13; 978-9332518544.
5.	R. Srinivasan, 'Hydraulic and Pneumatic controls', McGraw Hill Education, 2 nd Edition, 2010, ISBN: 978818209138-2.

RUBRICS 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 50Marks , 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

RUBRICS FOR 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				
ELECTRIC VEHICLE DYNAMICS Professional Core Elective (Group-F) (Theory)				
Course Code : ME374TFE CIE : 100 Marks Credits: L:T:P : 3:0:0 SEE : 100 Marks Total Hours : 45 Hrs SEE Duration : 3 Hours				
PREREQUISITES: Engineering Mechanics & Theory of Machines				
Unit – I				09 Hrs
Introduction to vehicle dynamics and electrical vehicles - Electric Vehicles (EV's): Power transmission path in ICE, EV and HEV; Hybrids-based on Architecture and Transmission Assembly; Vehicle dynamics - The Driver-Vehicle-Ground System, Vehicle Fixed (SAE) and Earth Fixed Coordinate System; Mechanics Of Pneumatic Tires: Bias-ply Tire and Radial-ply, Tire Forces And Moments – Tire (Wheel) Axis System, Rolling Resistance of Tires, Tractive and 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: Centre-Point Steering – Camber, King Pin Inclination, Negative Scrub Radius, Caster, Toe-In or Toe-out.				
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. 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); Elements of an ABS - criteria employed in existing ABS, Various layouts of ABS for passenger cars, Principles of Electromechanical Brake and Traction control Systems.				
Unit -III				09 Hrs
Handling Characteristics of Road Vehicles: Ackermann Steering Geometry, Error Curve of a Steering Linkage; Steady-State Handling Characteristics of A Two Axle Vehicle: Simplified Steady-State Handling Model for a Two-Axle Vehicle. Neutral steer, Understeer, Oversteer (Numerical Problems). Steady-State Response to Steering Input: Yaw Velocity Response, Lateral Acceleration Response, Curvature Response; 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
Hybrid Vehicle Control Strategy: Vehicle Supervisory Controller; Electric motor and engine ratings, Gear Ratio, Torque-speed characteristics, Planetary Gear Set. 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. Modal control strategies - Series & Parallel control, Series-Parallel - Mechanical Power-Split IC Engine Control, Series-Parallel 2x2 control, Energy storage System Control, Regeneration Control.				



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

CO1	Understand the basic principles of vehicle dynamics and electric/hybrid vehicle architectures including coordinate systems, tire mechanics, and wheel alignment parameters.
CO2	Analyze the dynamic performance and braking characteristics of road vehicles using governing equations, aerodynamic principles, and braking system concepts.
CO3	Evaluate the handling and ride characteristics of vehicles through steady-state handling models, suspension system analysis, and vibration models including pitch and bounce dynamics.
CO4	Apply hybrid vehicle control strategies to determine optimal operating modes and regeneration using vehicle supervisory control logic.

Reference Books

1.	J.Y. Wong, “ Theory of Ground Vehicles ”, 5 th Edition, 2022, Wiley-Blackwell, ISBN-10: 1119719704, ISBN-13: 978-1119719700. (UNIT - I, II, III, IV)
2.	Iqbal Husain, “ Electric and Hybrid Vehicles Design Fundamentals ”, 3 rd Edition, CRC Press, 2021, ISBN: 978-0-367-69393-0 (pbk). (UNIT - I, V)
3	Thomas D. Gillespie, “ Fundamentals of Vehicle Dynamics ”, Revised Edition, SAE International, 2021, ISBN-10: 1468601768; ISBN-13: 978-1468601763. (UNIT - I)
4.	Gang Sheng, Jian Pang, Mohamad S. Qatu, Rao V. Dukkipatti, Zuo Shuguang, “ Road Vehicle Dynamics ”, 1 st Edition, SAE International, 2018, ISBN-10: 0768016436; ISBN-13:978-0768016437. (UNIT - I)

RUBRICS 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 50Marks , 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

RUBRICS FOR SEMESTER END EXAMINATION (THEORY)

Q.NO.	CONTENTS	MARKS
1	PART A 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					
DATA AND STORYTELLING Institutional Elective – II (Group G) (Theory)					
Course Code	:	AI375TGA	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	45L	SEE Duration	:	3Hours
Unit-I					09 Hrs
Understanding Data: Types, Sources, and Preparation: What is data and why it matters, Types of data – qualitative, quantitative, structured, unstructured, 3Vs of big data – volume, velocity, variety, Common data sources – government portals, sensors, APIs, crowd sourced platforms, Data representations – tabular, relational, JSON, XML formats, Introduction to spreadsheets and data frames, Basics of data preprocessing – missing value handling, normalization, type casting, cleaning workflows using Python (pandas) or spreadsheets					
Unit - II					09 Hrs
Data Collection for Exploratory Research: Methods of primary data collection – surveys, interviews, FGDs, observations, Designing structured questionnaires and interview guides, Ensuring question clarity, neutrality, and goal alignment, Sampling strategies – random, stratified, purposive sampling, Field planning and respondent communication, Ethical considerations – consent, privacy, data sensitivity, Transcription and textual data cleaning.					
Unit -III					09 Hrs
Sensor Data Collection and logging: Introduction to IoT and embedded data logging, Sensor interfacing – temperature, humidity, motion, light sensors, Analog-to-digital conversion and signal conditioning, Sampling rates and real-time clock synchronization, Wireless transmission – BLE, Wi-Fi, LoRa, Local and remote data logging – SD cards, cloud platforms, Handling data quality issues – noise, missing values, power constraints, security and privacy (Man in the middle attacks). Real-time plotting, Visualizing trends, anomalies, and multi-sensor overlays, Debugging and optimizing embedded data pipelines, Mapping Urban Tree Inequality: A Data-Driven Look at Green Access, Building a Local Data Chain to Map Green Equity in Our Cities, Project Pakshi					
Unit -IV					09 Hrs
Storytelling through Data: Communicating patterns and trends with clarity, Building simple, reproducible analysis notebooks, Introduction to data storytelling and presentation, Structuring analysis reports – insights, visuals, limitations, Creating visual narratives – dashboards, summaries, infographics, Ethical data interpretation – avoiding bias and misrepresentation					
Unit -V					09 Hrs
Statistics Done Wrong: Statistical Significance, Statistical Power, and the Problem of Underpowered Studies, Pseudo replication, Model Abuse, Researcher Freedom, Hiding the data. Final project – design, collect, visualize, and present data using field instruments, embedded systems, or secondary sources					

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand different types, sources, and representations of data, and perform basic preprocessing using modern tools.
CO2	Design and implement primary data collection strategies using surveys, interviews, and sampling techniques with ethical considerations.
CO3	Interface and configure sensors for real-time data logging, transmission, and visualization while addressing data quality and privacy issues.
CO4	Create structured analysis reports and visual narratives to communicate insights clearly and ethically using dashboards and notebooks.

**Reference Books**

1.	The Craft of Research, Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams, University of Chicago Press, Fifth Edition, 2024, ISBN-13: 978-0226826677
2.	Sensor Data Analysis and Management: The Role of Deep Learning, Editors: A. Suresh, R. Udendhran, M. S. Irfan Ahmed, Wiley-IEEE Press, 2021, ISBN-13: 978-1119682424
3.	Storytelling with Data: A Data Visualization Guide for Business Professionals, Cole Nussbaumer Knaflic, Wiley Publications, 2015, ISBN-13: 978-1119002253
4.	Statistics Done Wrong: The Woefully Complete Guide, Alex Reinhart, No Starch Press, 2015, ISBN-13: 978-1593276201

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 50Marks , 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)		
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					
AIRCRAFT SYSTEMS INSTITUTIONAL ELECTIVE – II (GROUP G) (Theory)					
Course Code	:	AS375TGB		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 3.00 Hours
Unit-I					09 Hrs
Flight Control Systems: History of Airplanes, Anatomy of an aircraft, Anatomy of an aircraft, Primary and secondary flight control surfaces, Flight control linkage system, Conventional Systems, Power assisted and fully powered flight controls, electronic flight control system-fly by wire system.					
Unit – II					09 Hrs
Aircraft Hydraulic & Pneumatic Systems: Components of a typical Hydraulic system, Working of hydraulic system, Power packs, Hydraulic actuators, Pressure regulating devices, Hydraulic pumps, Pneumatic system and components, Use of bleed air, Landing gear and braking,					
Unit -III					09 Hrs
Aircraft Fuel Systems: APU, RAT, Characteristics of aircraft fuel system, Fuel system and its components, different types of fuel tanks, types of fuel lines, Fuel pumps-classification, Fuel control unit, Gravity feed and pressure feed fuel systems,					
Unit -IV					09 Hrs
Environmental Control Systems: Air-conditioning system, vapour cycle system, deicing and anti-icing system, Fire detection- warning and suppression. Crew escape aids.					
Engine Systems: Engine starting sequence, Starting and Ignition systems, Engine oils and a typical lubricating system.					
Unit -V					09 Hrs
Aircraft Instruments: Instruments displays, Instrumentation grouping, Navigation instruments, Radio instruments, Hydraulic and Engine instruments.					
Air Data Instruments: Basic air data system and probes, Mach meter, Air speed indicator, Vertical speed indicator, Barometric pressure sensing, Altimeter, Air data alerting system- angle of attack sensing, stall warning, Mach warning, altitude alerting system.					

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

CO1	Demonstrate a comprehensive understanding of the fundamental components and operational principles of major aircraft systems
CO2	Analyze and explain the functions of various subsystems of aircraft in emphasizing their roles in safe and efficient flight operations
CO3	Apply knowledge of aircraft systems to identify typical issues and malfunctions related to flight controls and other subsystems
CO4	Evaluate the regulatory considerations in aircraft system technologies for different flight envelopes

Reference Books	
1	Introduction to Flight, John D. Anderson, 7 th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals Of Flight Vol 4: Aircraft Systems, Lalit Gupta, Op Sharma, Himalayan Books, ISBN-13: 9788170020974
3	Flight stability and automatic control, Nelson R.C, 2nd Edition, 1998, McGraw-Hill International Editions, ISBN 9780071158381.
4	Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, Ian Moir, Allan Seabridge, 3rd Edition, 2008, John Wiley & Sons, ISBN 978111965006.



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 adding up to 20 Marks. THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.	20
2.	TESTS: Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO TESTS will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	40
3.	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS.	40
MAXIMUM MARKS FOR THE CIE (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 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					
HEALTHCARE TECHNOLOGY FOR ENGINEERS INSTITUTIONAL ELECTIVE – II (GROUP G) (Theory)					
Course Code	:	BT375TGC	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	45Hrs	SEE Duration	:	3Hours
Unit-I					09 Hrs
Introduction to Healthcare Technology: National Digital Health Mission & Healthcare, IT Infrastructure, Telemedicine and remote healthcare applications, Basic Terminology and Role of Engineers in Healthcare Technology; Definition and importance of healthcare technology, Roles and responsibilities of engineers in the healthcare sector, Interdisciplinary collaboration between healthcare professionals and engineers, Key technologies used in modern healthcare systems.					
Unit – II					09 Hrs
Healthcare Data Management and Digital Epidemiology: Introduction to healthcare data types (structured, unstructured, real-time data), EHR in healthcare and its applications, Data security and privacy in healthcare, Role of digital epidemiology in tracking and predicting diseases, Use of AI and machine learning in healthcare data analysis.					
Unit – III					09 Hrs
Technology-Led Healthcare: Clinical Decision Support Systems (CDSS) and AI in Diagnosis Machine Learning and Deep Learning in Healthcare, Patient Monitoring Systems (PMS) and IoT Applications, Wearable Devices for Health Tracking.					
Technology-Led Healthcare: Quality Management Systems in Healthcare, Infection Prevention and Waste Management Technologies, Medical Device Development and Quality Assurance, Smart Hospitals: Case Study of a Technology-Enabled Hospital.					
Unit – IV					09 Hrs
Regulatory, Policy and Cybersecurity Aspects: Legal, Ethical and Intellectual Property Rights in Healthcare Technology, Cybersecurity in Healthcare; Data Protection and Privacy, Health Technology Assessment and Procurement Strategies.					
Unit – V					09 Hrs
Innovations in Healthcare Technology: Simulation and Organ Modelling for Medical Applications, 3D Printing and Tissue Engineering in Healthcare, Augmented Reality (AR) and Virtual Reality (VR) in Medical Applications, Robotics and Biomechanics in Healthcare, Emerging Digital Health Technologies and Future Trends.					

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Design, and implement healthcare technologies effectively
CO2	Analyze the perspective of sensing and imaging in technology for the better health
CO3	Ensuring compliance with regulatory and cybersecurity frameworks of healthcare data.
CO4	Evaluate various tools, techniques and advances for better formulation and productivity

**Reference Books**

1.	“Biomedical Engineering: Bridging Medicine and Technology.” Saltzman, W. Mark., Cambridge University Press, 2015. https://doi.org/10.1017/CBO9781139583831 .
2.	“Medical Instrumentation: Application and Design.”, Webster, John G., 4th ed., John Wiley & Sons, 2010.
3.	“Artificial Intelligence in Healthcare”. Mahajan, Parag., 2nd (General) ed., Updated 2022.
4.	“Healthcare Information Technology Exam Guide for CHTS and CAHIMS Certifications”. McCormick, Karen A., Barbara Gugerty, and James E. Mattison., McGraw Hill Professional, 2017.
5.	“Introduction to Biomedical Engineering”. Enderle, John D., and Joseph D. Bronzino, editors.,3rd ed., Academic Press, 2012. ISBN: 978-0-12-374979-6.
6.	“Healthcare Information Privacy and Security: Regulatory Compliance and Data Security in the Age of Electronic Health Records”. Robichau, Bernard Peter, Apress, 2014.

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 4 : Question 9 or 10	16
TOTAL		100



Semester: VII					
Green and Hydrogen Technology Institutional Elective – II (Group G) (Theory)					
Course Code	:	CH375TGD		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 3 Hours
Unit-I					09 Hrs
Hydrogen: Peculiarity and Types Salient features of hydrogen, properties of hydrogen, terminology and types of hydrogen, advantages, disadvantages, comparison with other fuels, and global status of supply and demand.					
Unit – II					09 Hrs
Hydrogen Generation Generation of different types of hydrogen, conventional methods (generation from non-renewable sources), nonconventional methods (generation from renewable sources).					
Unit –III					09 Hrs
Hydrogen Storage Storage as compressed gas, storage as cryogenic liquid, storage as metal hydrides, storage through liquid organic hydrogen carriers, and other storage methods.					
Unit –IV					09 Hrs
Hydrogen Handling and Safety Classification of hydrogen hazards, compressed and liquid hydrogen related hazards, regulation, codes and standards related to hydrogen handling and transport.					
Unit –V					09 Hrs
Hydrogen Applications Applications of hydrogen in various sectors such as refineries, petrochemicals, fertilizer industries, transport and automotive sectors, steel industries, and AI in hydrogen technology.					

Course Outcomes	
CO1	Understand the importance of hydrogen and its use as an energy carrier
CO2	Explain the production, storage and handling of hydrogen
CO3	Analyze the need for hydrogen as an alternate fuel and the associated challenges
CO4	Appraise the importance of safety, regulations and codes

Reference Books	
1.	Hydrogen Safety: Production, Transport, Storage, Use, and the Environment, Fotis Rigas, CRC Press, Taylor & Francis Group, 2 nd Edition, 2023, ISBN: 9781003313007
2.	Hydrogen Fuel: Production, Transport and Storage, Gupta, R. B., CRC Press, Taylor & Francis Group, 1 st Edition, 2009, ISBN: 9780429147364
2.	Hydrogen Production: Electrolysis, Agata Godula-Jopek, Wiley-VCH, 1 st Edition, 2015, ISBN:9783527333424
3.	Handbook of Hydrogen Storage, Michael Hirscher, Wiley-VCH, 1 st Edition, 2010, ISBN:9783527322732
4.	Fuel Cell Systems Explained, James Larminie and Andrew Dicks, John Wiley & Sons, 2 nd Edition, 2003, ISBN 978 0470 848579



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					
CHEMISTRY OF MATERIALS AND MOLECULAR ANALYSIS Institutional Elective – II (Group G) (Theory)					
Course Code	:	CM375TGE		CIE Marks	:
Credits L: T: P	:	3:0:0		SEE Marks	:
Total Hrs	:	45L		SEE duration	:
UNIT – I					09 Hrs
Advanced Materials for Smart Packaging: Biodegradable polymers, Bio-polymers, Nanomaterials, and Active packaging materials-Self-healing films, antimicrobial coatings and moisture-sensitive barriers for food and pharmaceutical industries. Thermal-responsive packaging used in food safety, drug stability and electronics protection.					
UNIT – II					09 Hrs
Innovations in Computational Chemistry: Introduction to ChemDraw and its Interface- basic to advanced functionalities for chemical drawing, reaction representation, and integration with computational tools. Cheminformatics and molecular screening. -molecular modeling and simulation techniques- molecular docking, virtual screening, and quantitative structure-activity relationships (QSAR)- generative AI for novel drug molecules-neural networks for toxicity prediction and AI-assisted biomolecular structure prediction.					
UNIT – III					09 Hrs
IR Spectroscopy: Introduction, principle, molecular vibrations, vibrational frequency, number of fundamental vibrations, factors influencing fundamental vibrations, instrumentation of IR spectrophotometer, application of IR spectroscopy in characterization of functional groups- IR spectroscopy in forensic science, pharmaceuticals, environmental monitoring and material characterization.					
UNIT – IV					09 Hrs
UV- visible Spectroscopy: Introduction-Electronic transitions- factors influencing position and intensity of absorption bands-absorption spectra of dienes, polyene and α , β -unsaturated carbonyl compounds, Bandgap calculations utilizing UV. Working of UV-Vis spectrophotometer. AI-driven spectral analysis, and computational approaches for UV-Vis data interpretation. UV-Vis spectroscopy in nanomaterials and biomedical applications.					
UNIT – V					09 Hrs
NMR spectroscopy: H^1 NMR Spectroscopy: Basic concepts- relaxation process. NMR spectrometer-FT NMR- Solvents used in NMR, internal standards-chemical equivalence - chemical shift-Factors affecting chemical shifts-shielding and deshielding effects – chemical and magnetic equivalent –magnetic anisotropy-spin-spin splitting rules- Application of NMR on in characterization of compounds- magnetic resonance imaging (MRI)-Bio-Engineering-Bio-Imaging. Problems on prediction of structure of compounds. Basics of Solid-State NMR.					

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

CO1	Apply the principles of chemistry for the synthesis of smart packaging materials, cheminformatics, drug discovery and materials analysis.
CO2	Utilize the knowledge of chemistry, AI-driven molecular modelling and spectral analysis to identify compounds and predict toxicity.
CO3	Analyse IR, UV-Vis, and NMR spectroscopic data for material characterization and biomolecular studies.
CO4	Propose smart packaging solutions and AI-assisted molecular screening methods for biomedical and pharmaceutical applications



Reference Books	
1.	"Introduction to Spectroscopy" by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James A. Vyvyan, Published by Cengage Learning, 5th edition, ISBN- 978-1285460123
2.	"Computational Chemistry: Introduction to the Theory and Applications of Molecular and Quantum Mechanics" – Errol G. Lewars. Published by Springer 2024, 4th edition, ISBN- 978-3031514425
3.	"Handbook of Materials Structures, Properties, Processing and Performance" by Lawrence E. Murr Published by Springer, ISBN- 978-3319018140.
4.	"Handbook of Biodegradable Polymers-Applications in Biomedical Sciences, Industry, and the Environment" by <u>Shakeel Ahmed</u> and <u>Riyaz Ali Osmani</u> Published by Jenny Standford Publishing 2024, ISBN -9789814968843
5.	"An Introduction to Chemoinformatics" by Andrew R. Leach and Valerie J. Gillet, published by Springer ISBN 978-1402062902.

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 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



Semester: VII					
PROMPT ENGINEERING Institutional Elective – II (Group G) (Theory)					
Course Code	:	CS375TGF		CIE	:
Credits: L:T:P	:	3:0:0		SEE	:
Total Hours	:	42 L		SEE Duration	:
Unit-I					8 Hrs
Introduction to Prompt Engineering: Raise of Context Learning, Prompts, Prompt Engineering, LLM Settings, Basic Prompt/ 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					8 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 Prompt Tuning vs. Fine-Tuning: Introduction and Types for Tuning, Tools & Libraries for Tuning-Hugging Face PEFT library (Parameter-Efficient Fine-Tuning), Trade-off decisions: when to prompt-tune vs. fine-tune					
Unit – III					8 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 Prompt Debugging & Interpretability Tools: Importance of interpretability in LLMs- Visualization tools- LIT (Language Interpretability Tool by Google) - OpenAI Playground, debug tools					
Unit – IV					8 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					8 Hrs
Ethics in AI-Generated Content: Introduction to AI Ethics in Generation, Key Ethical Concerns in Prompting-Bias and Discrimination, Misinformation and Hallucination. Opportunities: Model safety, Prompt Injection, Prompt Leaking, Jail Breaking; Reinforcement Learning from Human Feedback (RLHF)					

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.



Reference Books

1	Unlocking the Secrets of Prompt Engineering, 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. January 2025, ISBN: 9781098156152
4	OpenAI Cookbook - https://github.com/openai/openai-cookbook “Ethics of Artificial Intelligence and Robotics” – Stanford Encyclopedia of Philosophy- https://plato.stanford.edu/entries/ethics-ai/
5	“The Art of Prompt Engineering with OpenAI API” by Nathan Hunter (Beginner-friendly, focused on real-world use and debugging) ISBN: 9798389421630

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					
SOLID WASTE MANAGEMENT AND STATUTORY RULES					
Institutional Elective – II (Group G)					
(Theory)					
Course Code	CV375TGG		CIE	:	100 Marks
Credits: L:T:P	: 3:0:0		SEE	:	100 Marks
Total Hours	: 42L		SEE Duration	:	3 Hours
Unit-I					10 Hrs
Introduction: Present solid waste disposal methods. Merits and demerits of open dumping, incineration, pyrolysis, composting, sanitary landfill, Biogas Scope and importance of scientific solid waste management. Definition and functional elements of solid waste management.					
Sources: Sources of Solid waste, types of solid waste, composition of municipal solid waste, generation rate, Numerical Problems.					
Collection and transportation of municipal solid waste: Collection of solid waste- services and systems, Municipal Solid waste (Management and Handling) 2016 rules with amendments. Draft SWM 2024 rules. Site visit to collection system.					
Unit – II					08 Hrs
Composting Aerobic and anaerobic composting - process description, process microbiology, Vermicomposting, Site visit to compost plant, Numerical problems.					
Sanitary land filling: Definition, advantages and disadvantages, site selection, methods, reaction occurring in landfill- Gas and Leachate movement, Control of gas and leachate movement, Site visit to landfill site.					
Unit – III					08 Hrs
Hazardous waste management: Definitions, Identification of hazardous waste, Classification of hazardous waste, onsite storage, collection, transfer and transport, processing, disposal, Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016 with amendments. Hazardous and other wastes (Management and Transboundary Movement) amendment rules, 2024. Site visit to hazardous landfill site					
Unit – IV					08 Hrs
Bio medical waste management: Classification of bio medical waste, collection, transportation, disposal of bio medical waste, Biomedical waste management (Management & Handling Rules) 2016 with amendments. Site visit to hospital to observe biomedical waste collection and transportation system and visit to biomedical waste incineration plant.					
Unit – V					08 Hrs
E-waste management: Definition, Components, Materials used in manufacturing electronic goods, Recycling and recovery integrated approach. E-waste (Management) Rules 2022 and amendments. Site visit to e- waste treatment plant.					
Plastic waste management: Manufacturing of plastic with norms. Plastic waste management. Plastic waste management rules 2016 with amendments.					

Course Outcomes: After Completing the course, student will be able to,					
CO1	Understand the current solid waste management system and statutory rules.				
CO2	Analyze drawbacks in the present system and provide recycling and disposal options for each type of waste in compliance to rules.				
CO3	Distinguish Hazardous waste, Biomedical waste, E waste and to provide scientific management system.				
CO4	Evaluate and monitor the Biomedical waste, Hazardous waste, E waste, Plastic and Municipal waste management as per the rules laid by Ministry of Environment, Forest and Climate change.				



Reference Books

1.	Integrated Solid Waste Management, George.C.Tchobanogloous, International edition 2022, McGraw hill publication. ISBN 978-0070632370
2.	Electronic waste management, R.E. Hester, Roy M Harrison, , Cambridge, UK, 2009, RSC Publication, ISBN 9780854041121
3.	Solid Waste Management Rules 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 8th April 2016
4.	Hazardous and other wastes (Management and Transboundary Movement) Rules, 2016, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 04th April, 2016.
5.	Biomedical waste management (Management & Handling Rules) 2016, Ministry of Environment & Forest Notification, New Delhi, amendment on 28th March, 2016.
6.	E-waste (Management) Rules 2022 and amendments, Ministry of Environment, Forest and Climate Change Notification, New Delhi, 2 nd November, 2022.
7.	Plastic waste management rules 2016 with amendments., Ministry of Environment, Forest and Climate Change Notification, New Delhi, 6 th July 2022.

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 AND PRACTICE)		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					
Freight Transportation Systems and Logistics Planning Institutional Elective – II (Group G) (Theory)					
Course Code	:	CV375TGH		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	42L		SEE Duration	: 3 Hours
Unit-I					08 Hrs
Characteristics of Freight Transport: Freight Characteristics, Factors influencing Freight Travel, operators, problems in freight transportation, regional and urban goods travel, intermodal freight travel issues, passenger and freight demand models.					
Unit – II					09 Hrs
Freight Demand Estimation: Operations, Planning - purpose, process, Data, Freight Agents, costs, Planning Models and Methods-freight demand estimation and forecasting at the regional and urban level, Freight Generation and Freight Trip Generation, Trend and time series models, freight trip rate models, IO model					
Unit -III					08 Hrs
Freight Transport Planning and Operations: Freight supply – capacity issues; freight productivity and performance; distribution of freight flows; production/consumption to origin/destination, competing modes for specific commodity choice, route planning, scheduling, collection storage, distribution centres, regulation, and enforcement of freight transport.					
Unit -IV					09 Hrs
Logistics and Planning Strategies: Context of Logistics- Activities of Logistics, Aims of Logistics, Importance of Logistics, Current Trends in Logistics; Logistics Strategy- Strategic Decisions, Logistics Strategy, designing a Logistics Strategy; Locating Facilities- Importance of Location, Choosing the Geographic Region, Infinite Set Approaches, Feasible Set Approaches, Network Models, Location Planning; Planning Resources- Types of Planning, Capacity Planning, Adjusting Capacity, Tactical Planning, Schedules					
Unit -V					08 Hrs
Emerging Trends and Case Studies in Transportation Logistics: Sustainable and Green Logistics, Digital Transformation in Logistics-IoT, big data analytics, AI, and blockchain in logistics management.					
Case Studies and Real-World Applications: Case studies on logistics and transportation from various sectors. Analysis of successful logistics systems and lessons learned.					

Course Outcomes	
CO1	Explain the characteristics, components, and current trends in freight transportation and logistics
CO2	Analyze and apply freight demand estimation methods and logistics planning strategies for urban and regional transport systems
CO3	Evaluate freight transport systems and logistics networks with respect to performance, capacity, sustainability, and regulation
CO4	Design integrated freight and logistics solutions using data-driven models, technology, and strategic planning approaches



Reference Books

1	M. Ben-Akiva, H. Meersman, and E. V. de Voorde, "Freight Transport Modelling" Bingley, U.K.: Emerald Group Publishing, ISBN-13: 9781781902851,2013.
2	P. K. Sarkar, V. Maitri, and G. J. Joshi, "Transportation Planning: Principles, Practices and Policies", 3rd ed. New Delhi, India: PHI Learning, ISBN : 9788195161188, 2024
3	L. Tavasszy and G. de Jong, "Modelling Freight Transport". 1st ed. Amsterdam, Netherlands: Elsevier, ISBN-13: 9780124104006,2013.
4	M. Al-Azzawi, "Freight and Logistics Transport Modelling and Planning: Mathematical Theories and Practical Applications for the Analysis and Forecasting of Freight Transport Systems". Saarbrücken, Germany: LAP Lambert Academic Publishing, ISBN-13: 9783848428380,2012

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 AND PRACTICE)		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					
IoT FOR SMART SYSTEMS					
Institutional Elective – II (Group G)					
(Theory)					
Course Code	:	EC375TGI		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 3 Hours
Unit-I					09 Hrs
Introduction to IoT and Networking Basics					
IoT Architecture Layers (Perception, Network, Application), Overview of Networking Basics: TCP/IP, OSI Model, Wireless Concepts, Device Addressing: IPv4, IPv6, 6LoWPAN, IoT orchestration primitives, IoT Open-Source platforms.					
Unit – II					09 Hrs
IoT Communication Models and Protocols					
Smart Manufacturing-OPC-UA interfacing, Deterministic Ethernet & Time Sensitive Network, PLC gateways, MQTT-Sparkplug B, Predictive maintenance dashboard design with AI-based Optimization.					
Smart Construction Site: MQTT with QoS for equipment-telemetry and asset tracking, Edge gateway (rugged fog node) with aggregating sensor feeds (On-site construction).					
Unit – III					09 Hrs
IoT Networking Technologies					
Smart Healthcare: IEEE 802.15.6 BLE Body Area Networks, NFC for patient data access and device pairing, HL7 and FHIR standards for health data exchange.					
Smart Mobility: Next-gen V2X, LTE-M for roadside units and environmental sensors, Edge-cloud split for traffic-signal optimization, LPWAN & NB-IoT with link-budget exercise.					
Unit – IV					09 Hrs
IoT Software Stack					
Smart Agriculture Systems:					
Device Layer: Sensor nodes run on MCUs with firmware enabling periodic sensing, sleep scheduling, and uplink messaging over LPWAN. Network Layer: Embedded Operating Systems for IoT (FreeRTOS). Middleware Layer: Gateway running rule engine and device management, Device abstraction and Service Enablement, Secure bootloaders for wireless firmware updates in remote farms. Application Layer: Web/mobile dashboard for farmers with real-time alerts and analytics, Things Board for drag-and-drop rule engine.					
Unit – V					09 Hrs
Interoperability and Standardization in Practice: Challenges of integrating multi-vendor IoT devices, Interoperability issues in AI-Enabled IoT Deployments, Data Semantics & Model Portability, AI Bias & Fairness Across Domains, Security of AI pipelines, GDPR compliance & data retention policies in IoT platforms.					

Course Outcomes	
CO1	Develop a conceptual framework of IoT architectural layers and connectivity models.
CO2	Analyze IoT-specific communication models, protocols, and networking technologies.
CO3	Apply AI techniques for IoT communication optimization and network intelligence.
CO4	Evaluate secure, energy-efficient IoT networks with intelligent features.



Reference Books

2.	Internet of Things: Principles and Paradigms, Rajkumar Buyya, Amir Vahid Dastjerdi, Morgan Kaufmann Publishers, 2nd Edition, 2024, ISBN: 978-0-323-99167-2
2.	Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles Springer, 2nd Edition, 2023 ISBN: 978-3-031-10318-4
3.	IoT Applications for Next-Generation Smart Systems, D. Giusto et al., Springer, 2024, ISBN: 978-1-799-87541-3
4.	Artificial Intelligence for the Internet of Everything, William Lawless, Ranjeev Mittu, Donald Sofge Academic Press, 2023 ISBN: 978-0-12-820600-1

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). 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 AND PRACTICE)		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					
E-MOBILITY Institutional Elective – II (Group G) (Theory)					
Course Code	:	EE375TGJ		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 3 Hours
Unit-I					09 Hrs
History, Basics of Electric Vehicles, Components of Electric Vehicle, General Layout of EV, EV classification: Battery Electric Vehicles (BEVs), Hybrid Electric Vehicle (HEV), Fuel-Cell Electric Vehicles (FCEVs) Comparison with Internal Combustion Engine: Technology, Advantages & Disadvantages of EV, National Policy for adoption of EVs.					
Unit – II					09 Hrs
Electric Drive-Trains: Introduction to various electric drive-train topologies in EV and HEV, Power flow control in electric drive-train topologies, classification of electric machines used in automobile drivelines.					
E-Motor Drives Configuration (Control Block diagrams): Induction Motor Drive, Permanent Magnet (PM) motor Drive & Switched Reluctance Motor (SRM) Drive.					
Unit – III					09 Hrs
Battery Energy Storage: Types of Battery, Introduction to Electrochemical Battery, Electrochemical Reactions, Battery Parameters: Battery Capacity, Discharge Rate, Charging Rate, SOC, SOD, SOH, DOD, Specific Energy, Specific Power, Energy Efficiency.					
Battery Management Systems (BMS): Introduction to BMS, Objectives of the BMS: Discharging control, Charging control, Cell Balancing; BMS topologies: Distributed Topology, Modular Topology and Centralized Topology.					
Unit – IV					09 Hrs
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage, Hybridization of different energy storage devices. Introduction to BMS and its topologies.					
Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies and implementation issues of energy management strategies.					
Unit – V					09 Hrs
Charging Infrastructure: Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charging Standards and Technologies, SAE J1772. On-board chargers and Off-board chargers, Topologies and Standards, Types of Charging Station Charging Station Placement for Electric Vehicles: A Case Study.					

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



Reference Books

1.	Modern Electric Vehicle Technology C.C. Chan and K.T. Chau, 1st Edition, 2001, Oxford university press, ISBN 0198504160.
2.	Battery Management system for large Lithium Battery Packs, Davide Andrea, 1st Edition, 2010, ARTECH HOUSE, ISBN-13 978-1-60807-104-3.
3.	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, 1st Edition, 2018, Wiley, ISBN 9781119063667.
4.	Hybrid Vehicles from Components to System, F. BADIN, Ed, 1st Edition, 2013, Editions Technip, Paris, ISBN 978-2-7108-0994-4.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (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 AND PRACTICE)		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****DISEASE AND DIAGNOSTICS AN ENGINEERING PERSPECTIVE****Institutional Electives -II (Group G)****(Theory)**

Course Code	:	EI375TGK		CIE	:	100 Marks
Credits: L:T:P	:	03:00:00		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	03 Hrs

Unit-I**09 Hrs**

Cardiovascular System (CVS) - Functioning of CVS, Generation of Bio-Potentials of CVS, Common cardiovascular ailments. - Arrhythmias, Hypertension, Coronary vascular Diseases, Diagnostic devices- ECG, ECHO. Coronary Angiogram. Implantable devices: Pacemaker.

Unit – II**09 Hrs**

Respiratory System (RS) - Functioning of RS, Common ailments in RS, Lung volume and capacity, Diagnostic Devices- Spirometer and its recent advances, PPG Signals and its application in RS.

Unit – III**09 Hrs**

Renal System - Functioning of Renal System, Common diseases of Renal System, Diagnostics- Ultrasound and its application in Renal System. Therapeutic- Dialysis and its types. Bio-Markers in Renal System, Emerging dialysis technologies: Wearable artificial kidney.

Unit – IV**09 Hrs**

Central Nervous System (CNS) - Basics of CNS functioning, Common ailments, Diagnostics methods-EEG, Electrode Systems, Role of CT scans and MRI. Brain-Computer Interfaces (BCI): Basic concepts and diagnostic/therapeutic potential.

Unit – V**09 Hrs**

Introduction to Artificial Intelligence (AI) in Healthcare - Overview of AI, Machine Learning, Deep Learning, Need for AI in healthcare, Types of data in healthcare: structured, unstructured., Challenges of AI deployment: Data bias, privacy, and integration in clinical workflow.

Course Outcomes

CO1	Understand the basic functioning and common disorders of cardiovascular, respiratory, renal, and nervous systems.
CO2	Understand the working principles and clinical relevance of diagnostic devices such as ECG, EEG, spirometer, ultrasound, and imaging systems.
CO3	Analyze biomedical signals and interpret their significance in the diagnosis and monitoring of diseases.
CO4	Evaluate the potential and limitations of emerging technologies such as wearable devices, Brain-Computer Interfaces, and AI in healthcare applications.

Reference Books

1.	Handbook of Biomedical Instrumentation, R. S. Khandpur,3 rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553.
2.	Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2 nd Edition, Reprint 2015, ISBN: 9780130771315.
3.	Introduction to Biomedical Equipment Technology, Joseph J. Carr and John M. Brown, 4 th Edition, 2000, Pearson, ISBN:978-0130104922.
4.	Medical Instrumentation Application and Design, John G. Webster ,4 th Edition,2010, ISBN 13: 978- 0471-67600-3.



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					
Space Technology and Applications Institutional Elective (Group-G) (Theory)					
Course Code	:	ET375TGL		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 03 Hours

UNIT – I		9 Hours
Orbits and Launching Methods: Kepler's Laws, Orbital Elements and Perturbations, Inclined Orbits Antenna Look Angles, Earth Eclipse of Satellite, Sun Transit Outage.		
Launch Vehicles: Rocketry, Propellants, Propulsion, Combustion, Solid, Liquid and Cryogenic engines, Control and Guidance system, Ion propulsion and Nuclear Propulsion.		
UNIT – II		9 Hours
Satellite Sub-Systems: Classification of satellites., Payloads, Subsystems-Altitude and orbit control system, TT&C Sub-System, Power Systems.		
Communication sub systems: Transponder, Satellite antennas and Parameters, Satellite Antennas in Practice		
UNIT – III		8 Hours
Satellite Communications: LEO, MEO and GEO orbits, Multiple Access Techniques. -TDMA, FDMA and CDMA		
Space applications: Telephony, V-SAT, DBS system, Satellite Radio and TV, Tele-Education, Tele-medicine, Satellite navigation, GPS		
UNIT – IV		8 Hours
Remote Sensing: Remote Sensing – An Overview, Classification of Satellite Remote Sensing Systems, Remote Sensing Satellite Payloads, Sensor Parameters. Image processing techniques, Remote sensing cameras.		
Applications of Remote Sensing Satellites: - Land Cover Classification, Land Cover Change Detection Water Quality Monitoring and Management, Flood Monitoring, weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.		
UNIT – V		8 Hours
Space Missions: Technology missions, deep space planetary missions, Lunar missions, zero gravity experiments, space biology and international space Missions.		
Advanced space systems: planetary payloads, space shuttle, space station, Inter-space communication systems.		

Course Outcomes: After going through this course the student will be able to:	
CO1	Explore the different types of satellites, their orbital mechanics and associated subsystems.
CO2	Apply the basics of launching vehicles, satellites and sub systems for space applications.
CO3	Identify the applications of satellite in the Various areas such as communication, remote sensing, metrology etc.
CO4	Analyze the technology trends, satellite missions and advanced space systems.

Reference Books	
1.	Satellite Communications, Dennis Roddy, W. Linwood Jones, Jones Linwood, David G. Long, 5ed, McGraw Hill Education,2024, ISBN-10: 1265372543
2.	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN: 9788120324015.
3.	Satellite Communication, Timothy Pratt, John Wiley, 3ed,2019, ISBN: 978-1-119-48217-8
4.	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.



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

RUBRICS FOR SEMESTER END EXAMINATION (SEE-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: Question 2	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
	MAXIMUM MARKS FOR THE SEE	100



Semester: VII					
PROJECT MANAGEMENT Institutional Elective – II (Group G) (Theory)					
Course Code	:	IM375TGM		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	45L		SEE Duration	: 3 Hours
Unit-I					09 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 Work Breakdown Structure, 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, Project life cycle management concepts. Project life cycle costing.					
Unit – V					09 Hrs
Latest Trends and Open-Source Tools in Project Management: Agile and Hybrid Project Management Approaches, Digital Transformation in Project Management, Sustainability and ESG in Project Management, Overview and Classification of PM Software, Introduction and Demonstration of Key Open-Source Tools.					

Course Outcomes	
CO1	Understand the fundamental concepts of project management and its relationship with organizational strategy, operations management, and business value.
CO2	Apply techniques for generating, screening, and evaluating project ideas, considering factors such as net present value and project rating index.
CO3	Create Work Breakdown Structures (WBS), utilization of PERT/CPM for developing project schedule, alongside requirement collection, scope definition, scope validation, and scope control.
CO4	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). 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 AND PRACTICE)		100

RUBRICS 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						
GLOBAL SUPPLY CHAIN MANAGEMENT						
Institutional Elective – II (Group G)						
(Theory)						
Course Code	:	IM375TGN		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3 Hours
UNIT-I						09 Hrs
Building a Strategic Frame Work to Analyze Supply Chains: Definition and Objective of Supply Chain, the importance of Supply Chain Decisions, Decision Phases in a Supply Chain, Process View of Supply Chains. Competitive and Supply Chain Strategies, Achieving Strategic fit, Expanding Strategic Scope. Drivers of Supply Chain Performance, Frame work for Structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing, Pricing, Infrastructure, International Logistics.						
UNIT – II						09Hrs
Designing The Supply Chain Network: The Role of Distribution in the Supply Chains, Factors influencing Distribution Network design, Design Options for a Distribution Network, Online sales and the Distribution network, Distribution Networks in practice. Factors influencing network design decisions, Framework for Network design decisions, The impact of Globalization on Supply Chain networks.						
Designing And Planning Transportation Networks: The role of transportation in a Supply chain, Modes of transportation and their performance characteristics, Transportation infrastructure and policies, Design options for a transportation network, Trade-offs in transportation design, Tailored transportation, The role of IT in transportation, Problems.						
UNIT –III						09Hrs
Planning and Managing Inventories in a Supply Chain: The Role of Cycle inventory in a Supply Chain, Economies of Scale to Exploit Fixed costs, Managing Multi-echelon Cycle Inventory. The Role of Safety Inventory in a Supply Chain, Determining appropriate level of Safety inventory, Impact of supply Uncertainty on Safety inventory, Impact of aggregation on safety inventory, impact of replenishment policies on safety inventory, Managing Safety Inventory in a Multi-echelon Supply Chain, The Role of IT in inventory management. Problems						
Unit –IV						09Hrs
Sourcing Decisions in A Supply Chain: The role of sourcing in a supply chain, in-house or outsource, Third-and Fourth-party logistics providers, Total cost of Ownership, Supplier Selection-Auctions and Negotiations, Sharing Risk and Reward in the Supply chain, Ethical Sourcing.						
Pricing and Revenue management in Supply Chain: The role of pricing and revenue management in supply chain, pricing and revenue management for multiple customer segments, pricing and revenue management for perishable assets, pricing and revenue management for seasonal demand and role of IT in pricing and revenue management.						
UNIT –V						09 Hrs
Digital Supply Chain: The role of IT in a supply chain, the supply chain IT framework, the supply chain macro processes, Lack of Supply Chain co-ordination and the Bullwhip effect, managerial levers to achieve coordination, continuous replenishment and vendor-managed inventories, collaborative planning, forecasting and replenishment (CPFR).						

Course Outcomes	
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	Supply Chain Management – Strategy, Planning & Operation, Sunil Chopra, Peter Meindl & D V Kalra, 6 th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2.
2	Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1 st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135-5
3	Designing & Managing the Supply Chain – Concepts Strategies and Case Studies, David Simchi Levi, Philip Kaminsky, Edith Simchi Levi & Ravi Shankar, 3 rd Edition, 2008, Mc Graw Hill, ISBN: 978- 0-07-066698-6
4	Modelling the Supply Chain, Jeremy F Shapiro, 2 nd Edition, 2009, Cengage Learning, ISBN 0-495-12609-8.

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 AND PRACTICE)		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				
STATISTICAL METHODS FOR ENGINEERS				
Institutional Elective – II (Group G)				
(Theory)				
Course Code	: MA375TGO		CIE	: 100 Marks
Credits: L: T:P	: 3:0:0		SEE	: 100 Marks
Total Hours	: 45L		SEE Duration	: 3.00 Hours
Unit-I				09 Hrs
Multiple Linear Regression: Introduction to multiple linear regression model, least squares estimation of the parameters, Matrix approach to multiple linear regression, Properties of the least squares estimators, Hypothesis tests -Test for significance of regression, Tests on individual regression coefficients, Confidence intervals - Confidence intervals on individual regression coefficients, Confidence interval on the mean response, Polynomial regression models.				
Unit – II				09 Hrs
Design and Analysis of Single-Factor Experiments: Designing Engineering Experiments, Completely Randomized Single-Factor Experiment, Analysis of Variance (ANOVA), Multiple Comparisons following the ANOVA, Residual analysis and model checking, The random-effects model, Randomized complete block design - design and statistical Analysis				
Design of Experiments with Several Factors: Introduction, Factorial experiments, Two-factor factorial experiments, one observation per cell, General factorial experiments - 2^k Factorial designs, 2^2 Design, 2^k Design for $k \geq 3$ factors.				
Unit –III				09 Hrs
Discriminant Analysis and Factor Analysis: Introduction, Linear Discriminant Model, Linear discriminant function, Discriminant analysis, Principal Component, Factor Analysis, Principal Components versus Factor Analysis, Applications.				
Conjoint Analysis: Introduction, Additive tables, Multiplicative tables, Computing table margins based on an additive model, Applied conjoint analysis.				
Unit –IV				09 Hrs
Decision Trees and Clustering: Introduction, Basic tree model, Categorical or Quantitative Predictors, Decision Trees, Regression Trees, Bias-Variance Tradeoff, Pruning and Cross-Validation, Loss functions.				
Cluster Analysis-Introduction, Types of Clustering, Correlations and Distances, Hierarchical Clustering, Partitioning via k-means.				
Unit –V				09 Hrs
Time Series Analysis: Time series analysis-Trend, Seasonality, Noise decomposition, Autocorrelation, Stationarity, Lag features, Overview of Autoregressive (AR), Moving Average (MA), Autoregressive Integrated Moving Average (ARIMA) models.				

Course Outcomes:	
CO1	Apply fundamental concepts of multiple regression, design of experiments to analyze and interpret data in discriminant analysis, factor analysis, conjoint analysis, and statistical learning methods.
CO2	Analyze and interpret data using regression, experimental design, and multivariate techniques, and apply suitable statistical learning models to real-world problems.
CO3	Estimate model parameters and interpret results for multiple linear regression, ANOVA, discriminant analysis, factor analysis, and conjoint analysis to support data-driven decision-making using statistical learning techniques.
CO4	Implement multiple linear regression, ANOVA, discriminant analysis, factor analysis, conjoint analysis and time series analysis to support decision-making using statistical methods for solving engineering problems.



Reference Books

1	An Introduction to Multivariate Analysis, T. W. Anderson, 3 rd Edition, 2003, John Wiley & Sons, New Jersey, ISBN: 0-471-36091-0.
2	Douglas C. Montgomery and George C. Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th Edition, 2019, ISBN: 9781119570615.
3	Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer Series in Statistics, 2nd Edition, 2009.
4	Richard A Jhonson and Dean W. Wichern, Applied Multivariate Statistical Analysis, 6 th Edition, Pearson Education, ISBN-13: 978-0-13-187715-3.
5	Statistics I, SYSTAT 10.2, ISBN 81-88341-04-5.

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). THREE tests will be conducted (Two regular tests and one optional improvement test). 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)		
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				
INDUSTRY 5.0				
Institutional Elective (Group -G)				
Course Code	:	ME375TGP	CIE	: 100 Marks
Credits: L:T:P	:	3:0:0	SEE	: 100 Marks
Total Hours	:	42 Hrs	SEE Duration	: 3 Hours
Unit – I				06 Hrs
Evolution to Industry 5.0: Historical overview of industrial revolutions. Transition from automation-centric to human-centric manufacturing. Key drivers: personalization, sustainability, and resilience. Comparison between Industry 4.0 and Industry 5.0 frameworks.				
Unit -II				08 Hrs
Human-Machine Collaboration: Introduction to collaborative robots (cobots) and their applications. Designing ergonomic and safe human-robot workspaces. Augmented Reality (AR) and Virtual Reality (VR) in training and maintenance. Case studies on successful human-robot collaboration.				
Unit -III				08 Hrs
Advanced Digital Technologies: Digital twins and their role in predictive maintenance and system optimization. Integration of AI and machine learning in manufacturing processes. Cyber-Physical Systems (CPS) and their applications. Edge computing and real-time data analytics.				
Unit -IV				10 Hrs
Sustainable and Resilient Manufacturing: Principles of sustainable manufacturing and circular economy. Life Cycle Assessment (LCA) and its importance in product design. Strategies for building resilient supply chains. Regulatory frameworks and standards for sustainable practices.				
Unit - V				10 Hrs
Implementation and Case Studies: Roadmap for transitioning to Industry 5.0. Challenges and solutions in adopting Industry 5.0 principles. Case studies from automotive, aerospace, and electronics industries. Future trends and research directions in Industry 5.0.				

Course Outcomes: After completing the course, the students will be able to	
CO1	Assess the challenges of implementing Industry 5.0 principles in diverse industrial applications.
CO2	Analyze the strategies for transitioning from Industry 4.0 to Industry 5.0 in human-centric manufacturing systems.
CO3	Evaluate the benefits of integrating collaborative technologies and sustainable practices in smart manufacturing.
CO4	Examine the role of human-machine collaboration and ethical data-driven decision-making in achieving resilient and adaptive production systems.



Reference Books

1.	Industry 5.0: The Future of the Industrial Economy, Uthayan Elangovan, 2022, CRC Press, 1 st Edition, ISBN: 9781032041278 (Unit I)
2.	Industry 5.0: Concepts and Strategies for Digital Transformation, Kaswan, Rathi, Garza-Reyes, 2025, CRC Press, 1 st Edition, ISBN: 9781032878218 (Unit II, V)
3.	Industry 5.0: Design, Standards, Techniques and Applications for Manufacturing, Leong, 2024, The IET, 1 st Edition, ISBN: 9781837240098 (Unit IV)
4.	Towards Industry 5.0, Durakbasa, Gencyilmaz, 2022, Springer, 1 st Edition, ISBN: 9783031244568 (Unit III, V)
5.	Intelligent Manufacturing: Smart Choice, Sunil Kumar Wadhwa, 2023, ISBN: 9781802279153

RUBRICS 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 50Marks, 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

RUBRICS FOR 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					
PRINCIPLES OF ASTROPHYSICS					
Category: Institutional Elective – II (Group G)					
(Theory)					
Course Code	:	PY375TGQ		CIE	: 100 Marks
Credits: L:T:P	:	3:0:0		SEE	: 100 Marks
Total Hours	:	42L		SEE Duration	: 3 Hours
Unit-I					08 Hrs
The Celestial Sphere: The Geocentric Universe, Retrograde motion, The Copernican revolution, The celestial sphere, Altitude–Azimuth and Equatorial Coordinate System, Precession.					
Celestial Mechanics: Kepler's Laws of Planetary Motion from Newton's laws of mechanics, Position in the Orbit.					
Spectrum of Light: Stellar parallax, The magnitude scale, Apparent and Absolute Magnitude, Blackbody radiation and temperature, Spectral lines - Kirchhoff's Laws, Spectrographs.					
Unit – II					09 Hrs
Special Relativity: Einstein's postulates, The relativity of simultaneity, Time dilation, Length contraction, Galilean transformations, Lorentz transformations, Velocity transformation, Space-time diagrams and causality. Relativistic momentum and energy.					
General Relativity: The Principle of Equivalence, Gravitation as space-time curvature, (1) perihelion advance of planet Mercury, (2) gravitational red shift and (3) gravitational bending of light (qualitative).					
Unit – III					08 Hrs
Telescopes: Resolution and the Rayleigh Criterion, Aberrations, The Brightness of an Image and focal ratio, Refracting and Reflecting Telescopes, Adaptive Optics, Electronic Detectors - CCD, Radio Telescopes - Spectral Flux Density, Large Apertures and Interferometry, Infrared, Ultraviolet, X-Ray, and Gamma-Ray Astronomy.					
Unit – IV					09 Hrs
Stars: Stellar Spectra, The Harvard Spectral Classification, The Hertzsprung–Russell Diagram, Binary Stars and Stellar Masses - Classification of Binary Stars, Stellar Structure - Internal Equilibrium Conditions, The Sun - The Atmosphere, Solar Activity; Stellar Energy Sources - Nuclear Fusion Reactions, Stellar Evolution - Evolutionary Time Scales, The Contraction of Stars Towards the Main Sequence, The Main Sequence Phase, The Giant Phase, The Final Stages of Evolution - White Dwarfs, Neutron Stars, Black Holes.					
Unit – V					08 Hrs
Galaxies: The Classification of Galaxies, Masses, Galactic Structures, Structural Components of the Milky Way, Dynamics of Galaxies, Systems of Galaxies, The Origin and Evolution of Galaxies. The Interstellar Medium - Interstellar Dust, Interstellar Gas, Cosmic Rays.					
Cosmology: The Olbers Paradox, Hubble's Law, Cosmic Microwave Background Radiation, History of the Universe, Astrobiology.					

Course Outcomes	
CO1	Apply the principles of celestial mechanics to describe planetary motion, orbital dynamics, and gravitational interactions in astrophysical systems.
CO2	Interpret the foundational concepts of special relativity and analyse the implications of time dilation, length contraction, and relativistic mass in astronomical contexts.
CO3	Compare and evaluate different types of telescopes and their applications in various regions of the electromagnetic spectrum for observational astronomy.
CO4	Analyse the physical properties, life cycles, and classifications of stars using observational data and theoretical models.



Reference Books

1.	Bradley W. Carroll, Dale A. Ostlie, An Introduction to Modern Astrophysics: United States Edition, Pearson; 1st edition (7 September 2017), ISBN-10: 1108422160
2.	H. Karttunen, P. Kröger, H. Oja, M. Poutanen, K. J. Donner (Eds.), Fundamental Astronomy, 5th Edition, Springer, 2007, ISBN 978-3-540-34143-7
3	Suresh Chandra Mohit Kumar, A Textbook of Astronomy and Astrophysics, Dreamtech Press, 1 Nov 2019, ISBN-10: 9389520908
4.	Padmanabhan, T., Theoretical Astrophysics, Vols.1-3, 2015, Cambridge University Press, ISBN-9780521016278
5.	Modern Cosmology, Academic Press Inc; 2nd edition, 7 July 2020, ISBN-10: 0128159480,
6.	Harwit, M. Astrophysical Concepts, 4th Edition, 2015, Springer-Verlag, ISBN-10 : 1441921990
7.	Shapiro, Stuart L., and Saul A. Teukolsky. Black Holes, White Dwarfs, and Neutron Stars, 1st Edition, 1983, Wiley, ISBN: 9780471873167

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 AND PRACTICE)		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						
Mathematics of Music						
Institutional Elective – II (Group G)						
(Theory)						
Course Code	:	MA375TGR		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3 Hours
Unit-I					09 Hrs	
Fundamentals of Sound and Musical Structure						
Nature of sound: frequency, amplitude, harmonics, waveforms; Musical pitch and logarithmic perception of frequency, Shruti, Swara, Saptak; Musical notation systems.						
Unit – II					09 Hrs	
Tuning Systems and Modular Arithmetic in Music						
Pythagorean tuning, Just Intonation, and Equal Temperament, Circle of Fifths and the irrationality of $\log(3/2)$, Modular arithmetic and pitch class sets, Construction of scales: Melakarta Rāga (Carnatic) and Thaat (Hindustani) systems.						
Unit – III					09 Hrs	
Rhythm, Tāla, and Combinatorial Structures						
Tāla systems: concepts of mātra, vibhāga, āvartana; Analysis of Carnatic tālas (Adi, Rupaka, Jhampa, etc.); Combinatorics of tāla patterns and variation (korvais, tihāis); Algorithmic composition of rhythmic phrases						
Unit – IV					09 Hrs	
Timbre, Music Analysis and Processing						
Timbre and harmonic spectra, Fourier series and transforms in sound decomposition, Sub-harmonics, Limitation of Fourier Analysis: Noise; Introduction to sound synthesis and spectral envelopes.						
Unit – V					09 Hrs	
Algorithmic Music and Perception						
Fractals and recursion in music, Algorithmic and generative composition, Mathematical models of musical perception, Psychoacoustics: pitch, consonance/dissonance, critical bands.						

Course Outcomes	
CO1	Analyze musical phenomena using mathematical tools
CO2	Model rhythm, harmony, and timbre using algebraic and computational methods.
CO3	Apply signal processing concepts to sound synthesis and analysis.
CO4	Explore algorithmic and generative approaches to musical composition.

Reference Books	
1	Benson, D. J. (2006). <i>Music: A Mathematical Offering</i> . Cambridge University Press.
2	Fauvel, J., Flood, R., & Wilson, R. (Eds.). (2003). <i>Music and Mathematics: From Pythagoras to Fractals</i> . Oxford University Press.
3	Loy, G. (2006). <i>Musimathics: The Mathematical Foundations of Music</i> (Vol. 1 & 2). MIT Press.
4	Sethares, W. A. (2005). <i>Tuning, Timbre, Spectrum, Scale</i> (2nd ed.). Springer.
5	Venkatarama Krishnan, <i>A confluence of art and music on 72 Melakarta Ragas</i>



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 AND PRACTICE)		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 Institutional Elective Course (Group G) Theory						
Course Code : HS375TGS CIE : 100						
Credits: L:T:P : 3:0:0 SEE : 100						
Total Hours : 45 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 09 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 09 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 09 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 behaviour and mental processes.
CO2	Define learning and compare and contrast the factors that cognitive, behavioral, 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 into their own and others' lives in order to better understand their personalities and experiences.

Reference Books	
1.	Sterberg R.J and Sternberg Karin (2012) Cognitive Psychology 6 th Edition Woods worth Cengage 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). 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		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 & PRACTICES OF CYBER LAW						
Institutional Elective Course (Group G)						
Theory						
Course Code	:	HS375TGT		CIE	:	100
Credits: L:T:P	:	3:0:0		SEE	:	100
Total Hours	:	42L		SEE Duration	:	3 Hours
Unit-I						10 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 Act2000, 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						08 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: Dream tech Press, ISBN-10: 9789351194736, ISBN-13: 978-9351194736.
3.	Cyber Forensics in India: A Legal Perspective by Nishesh Sharma, 1 st Edition, ISBN: 9788131250709.
4.	Cyber Laws, Justice Yatindra Singh, 6 th Edition, Vol. 1, ISBN: 9789351437338

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 AND PRACTICE)		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	:	ME376SI		CIE	: 100 Marks					
Credits: L:T:P	:	0:0:3		SEE	: 100 Marks					
No. of Weeks	:	08		SEE Duration	: 3 Hours					
GUIDELINES										
1.	The duration of the internship shall be for a period of 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 colour for UG circuit Programs and Light Blue for Non-Circuit Programs.									
7.	The broad format of the internship final report shall be as follows									
•	Cover Page									
•	Certificate from College									
•	Certificate from Industry / Organization									
•	Acknowledgement									
•	Synopsis									
•	Table of Contents									
•	Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,									
•	Chapter 2 - Activities of the Department									
•	Chapter 3 - Tasks Performed: summary of the tasks performed during 8-week period									
•	Chapter 4 – Reflections: Highlight specific technical and soft skills acquired during internship									
•	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.	50 Marks
Review - II	Importance of resource management, environment and sustainability, presentation skills and report writing	50 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: VIII								
MAJOR PROJECT								
Course Code	:	ME481P		CIE	:	100 Marks		
Credits: L:T:P	:	0:0:12		SEE	:	100 Marks		
Hours/Week	:	24		SEE Duration	:	03 Hours		
GUIDELINES								
1.	The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8 th semester.							
2.	The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the 1st week after the commencement of 8 th semester.							
Batch Formation:								
<ul style="list-style-type: none">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:								
<ul style="list-style-type: none">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.

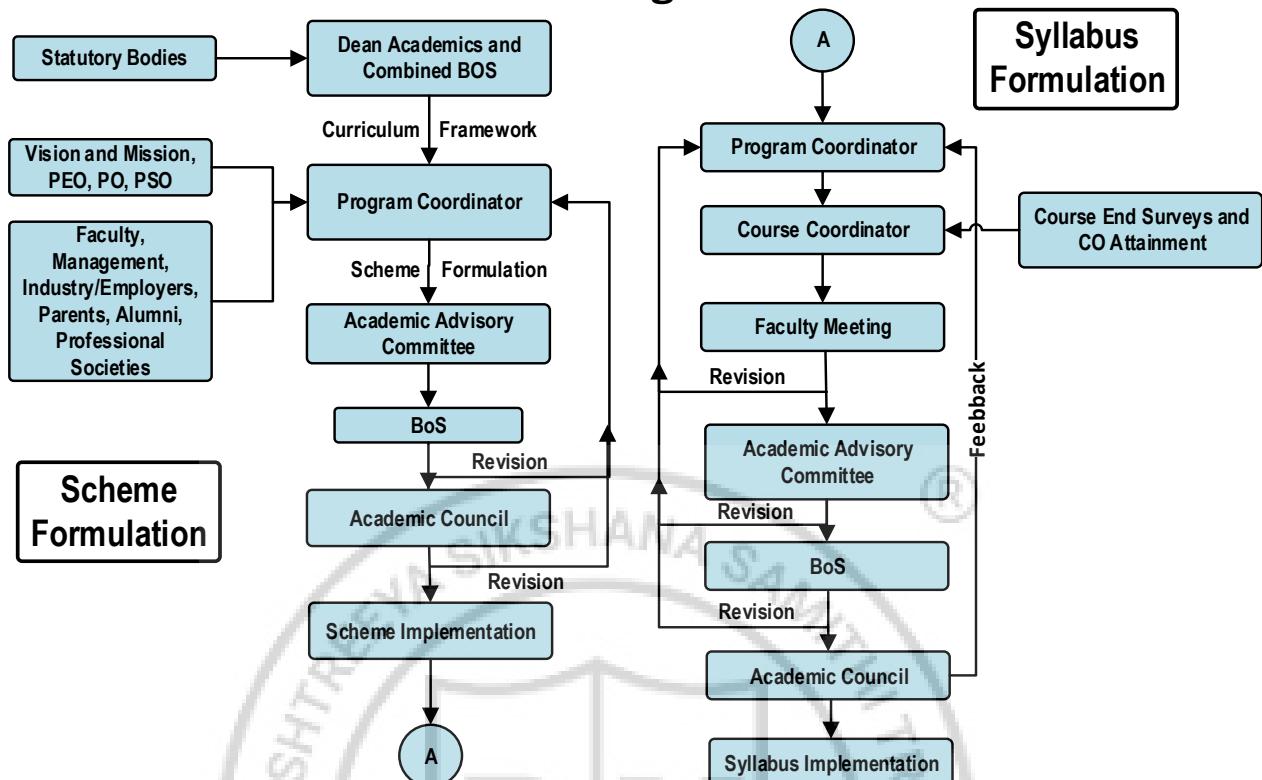
CO4 Function effectively as an individual, or leader in diverse teams, with the understanding of professional ethics and responsibilities.

Scheme of Continuous Internal Evaluation (CIE):

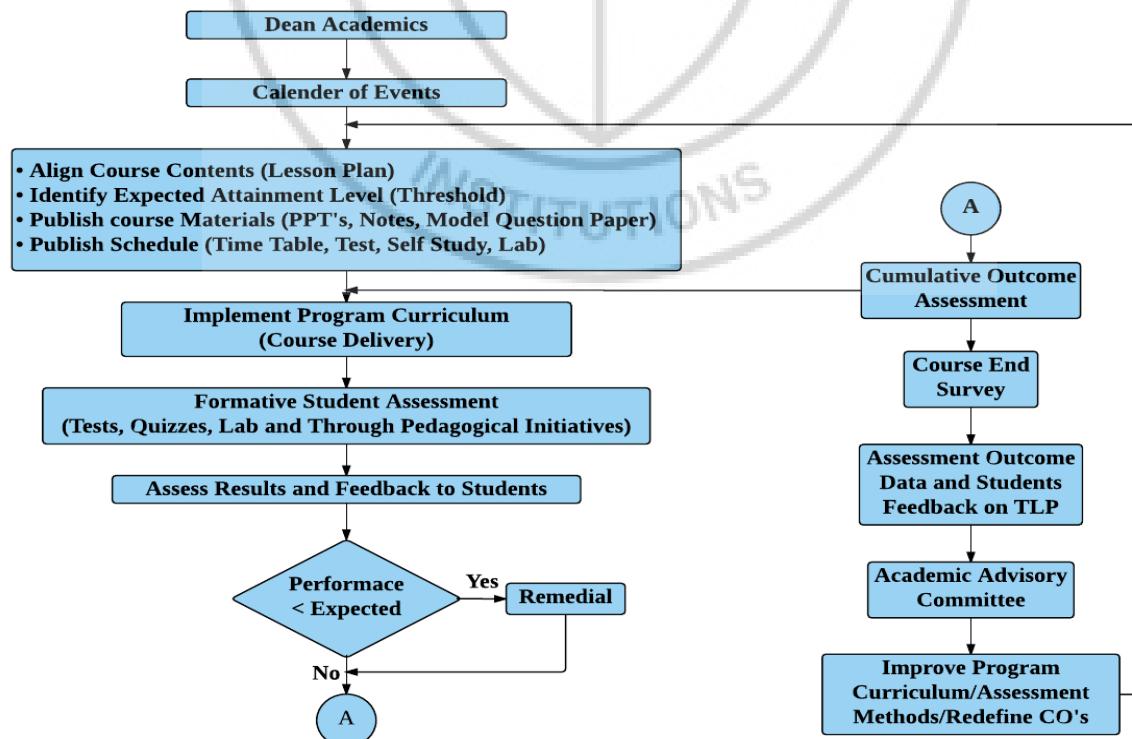
Scheme of Evaluation for CIE		Scheme of Evaluation for SEE	
Particulars	%Marks	Particulars	%Marks
Project Evaluation I	10%	Project Synopsis (Initial Writeup)	10%
Project Evaluation II	20%	Project Demo/Presentation	25%
Project Evaluation III	25%	Methodology, Results and Discussion	25%
Project Evaluation Phase-IV (Submission of Draft Project Report for Verification) (Project Final Internal Evaluation)	25%	Project Work Report	15%
Publication	20%	Viva-voce	25%
Total	100	Total	100



Curriculum Design Process

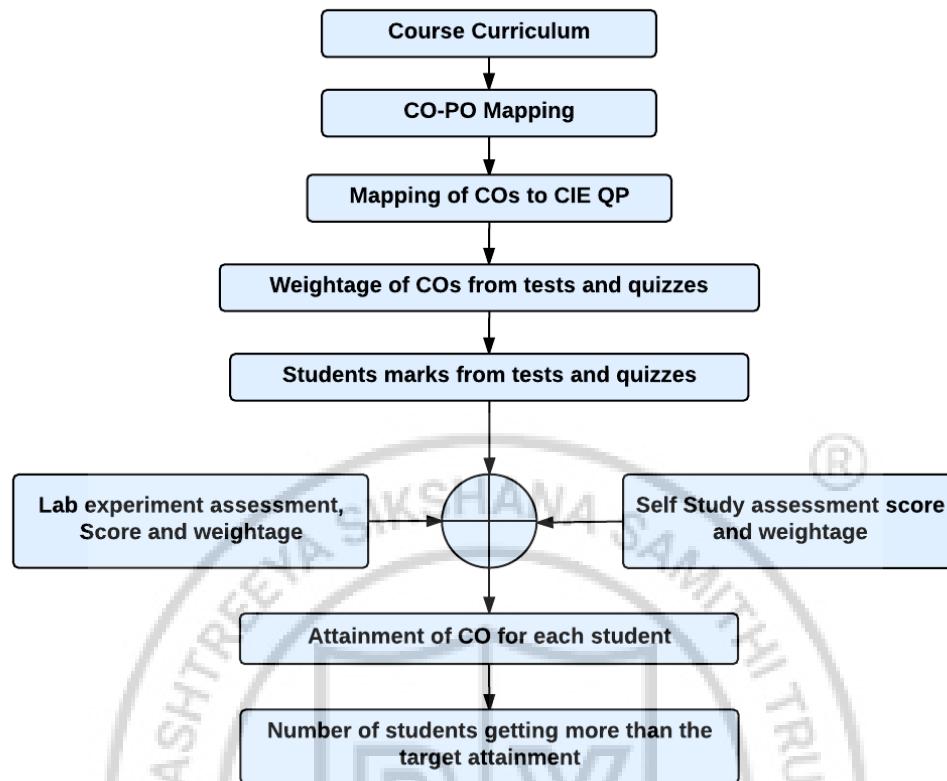


Academic Planning and Implementation

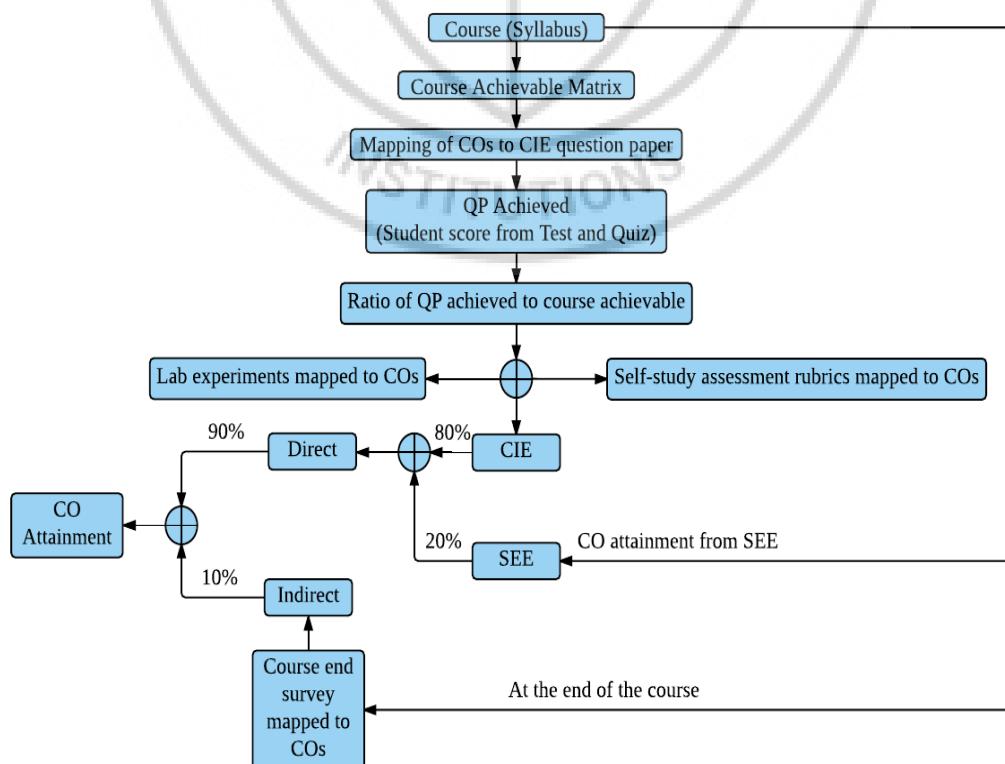




Process For Course Outcome Attainment

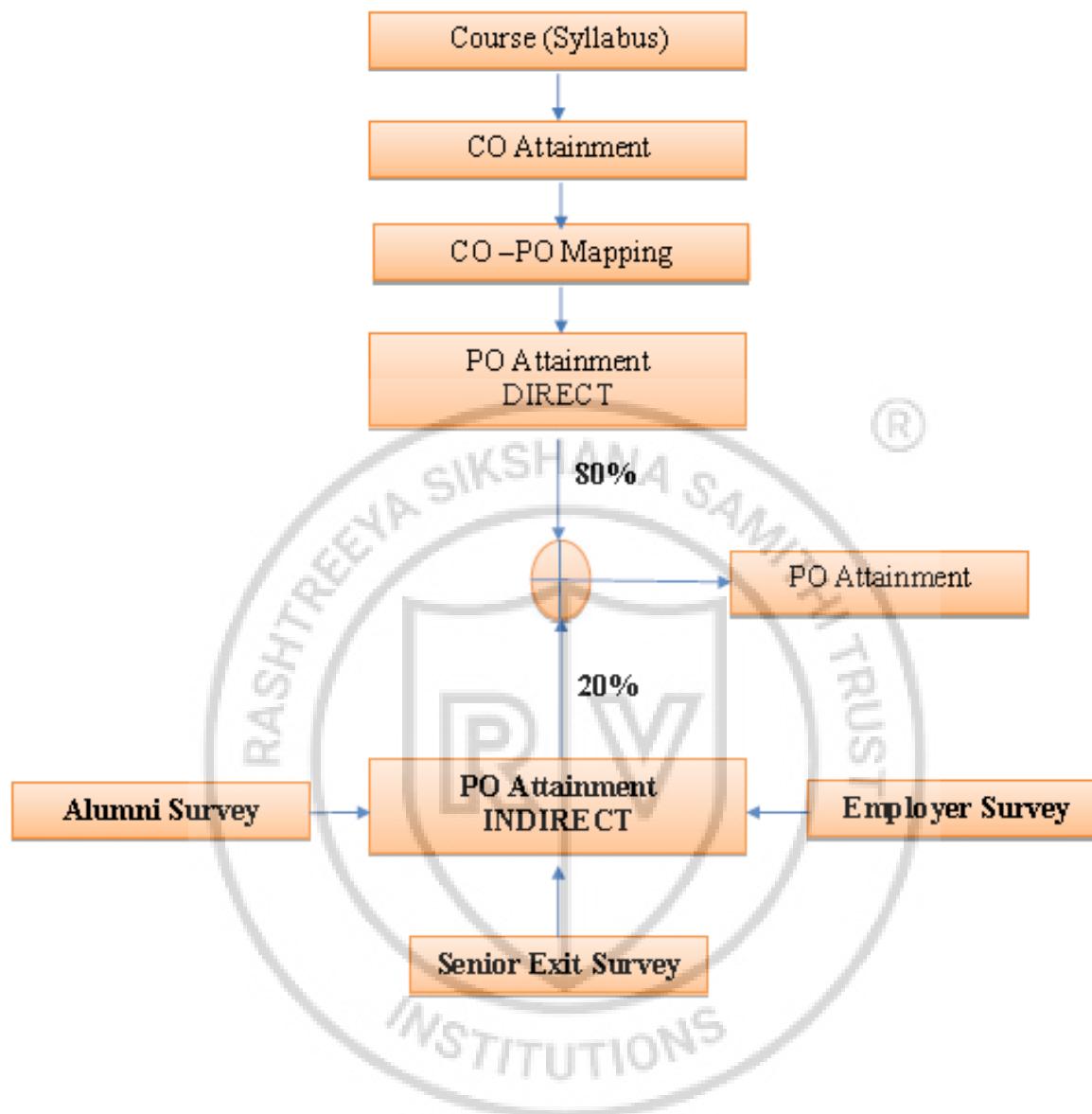


Final CO Attainment Process





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.

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.

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 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.

Chitrak : It is the official electric bike team of RV College of Engineering (RVCE) in Bangalore

Anoraniya: A Quantum based technical club initiated by students. The club is dedicated to addressing various technical challenges in quantum technologies and is on the verge of delivering some fascinating results.

Accelerate Club: organizes and participates in hackathons, bootcamps, workshops, and student-led innovation drives.

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



QUALITY POLICY

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



CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation



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