RV College of Engineering®

Chemical Engineering

Bachelor of Engineering (B.E)

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

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

2024

99TH
NIRF RANKING IN ENGINEERING (2024)

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

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

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

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

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

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

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

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

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

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2024

DEPARTMENT VISION

Imparting quality technical education in Chemical Engineering to promote leadership in research, innovation and sustainable technology through teamwork.

DEPARTMENT MISSION

- Impart quality education in basic and applied areas of Chemical Engineering.
- Enable students and faculty to achieve proficiency in the areas of Chemical Processes, Energy, Unit Operations and Computational Chemical Engineering using state-of-art laboratories and modern infrastructure.
- Encourage faculty and students to make career in research and contribute towards innovative processes and products.
- Develop inclusive technologies with a focus on new materials and sustainability.
- Collaborate with industries and research Institutes for academics and research.
- Inculcate leadership qualities, entrepreneurial skills, societal and ethical values in students and faculty.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Exhibit knowledge of basic sciences, concepts and principles of Chemical Engineering.

PEO 2: Comprehend, analyze, design and implement engineering systems with a focus on research,innovation and sustainability.

PEO 3: Work in multidisciplinary team and cater to the needs of process industries with appropriate safety, health and environmental regulations.

PEO 4: Demonstrate effective communication skills, leadership qualities and develop into successfulentrepreneurs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Gain knowledge of Chemical Engineering fundamentals and demonstrate problem formulation capabilities
PSO2	Analyze and solve engineering problems with a focus on environment and sustainability
PSO3	Contribute to multidisciplinary research using relevant Chemical Engineering tools

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.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PY	Physics
21.	CY	Chemistry
22.	MA	Mathematics
23.	AEC	Ability Enhancement Courses

INDEX

VII SEMESTER COURSES			
Sl. No.	**Course Code**	**Name of the Course**	**Page No.**
1.	21HS71	Constitution of India and Professional Ethics	1
2.	21CH72	Chemical Equipment Design and Drawing	3
3.	21CH73GX	Professional Core Elective-III	5-12
4.	21CH74HX	Professional Core Elective-IV	13-20
5.	21XX75IX	Institutional Electives – II	21-53
6.	21CH76I	Summer Internship - III	54-55
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VIII SEMESTER COURSES			
1	21CH81P	Major Project	58-60

Bachelor of Engineering in
CHEMICAL ENGINEERING

VII Semester													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	21HS71	Constitution of India and Professional Ethics	3	0	0	3	HS	Theory	100	***	**3**	100	***
2	21CH72	Chemical Equipment Design and Drawing	3	0	1	4	CH	Theory + Practice	100	50	**3**	100	50
3	21CH73GX	Professional Core Elective-III **(Group – G)**	3	0	0	3	CH	Theory	100	***	**3**	100	***
4	21CH74HX	Professional Core Elective-IV **(Group- H)**	3	0	0	3	CH	Theory	100		**3**	100	50
5	21XX75IX	Institutional Electives – II **(Group I)**	3	0	0	3	Resp Board	Theory	100	***	**3**	100	***
6	21CH76I	Summer Internship-III	0	0	2	2	CH	Internship	***	50	**2**	***	50
7	21CH77P	Minor Project	0	0	2	2	CH	Project	***	50	**3**	***	50
		Total				**20**							

Professional Core Electives - III Group - G		
Sl.No	**Course code**	**Course Title**
1	21CH73GA	Chemical Process Integration
2	21CH73GB	Process Instrumentation
3	21CH73GC	Transport Phenomena
4	21CH73GD	Biochemical Engineering
Professional Core Elective-IV Group- H		
Sl. No.	**Course Code**	**Course Title**
1	21CH74HA	Chemical Technology
2	21CH74HB	Pollution Control Engineering
3	21CH74HC	Instrumental Methods of Analysis
4	21CH74HD	Petrochemical Technology

Institutional Electives – II (Group I)			
Sl. No.	**Course Code**	**BoS**	**Course Title**
1	21AS75IA	AS	Unmanned Aerial Vehicles
2	21BT75IB	BT	Healthcare Analytics
3	21CH75IC	CH	Sustainability and Life Cycle Analysis
4	21CM75ID	CM	Advances in Corrosion Science and Management
5	21CS75IE	CS	Prompt Engineering
6	21CV75IF	CV	Integrated Health Monitoring of Structures
7	21EC75IG	EC	Wearable Electronics
8	21EE75IH	EE	E-Mobility
9	21EI75IJ	EI	Programmable Logic Controllers and applications.
10	21ET75IK	ET	Space Technology and Applications
11	21IS75IL	IS	Mobile Applications Development
12	21IM75IM	IM	Project Management
13	21IM75IN	IM	Supply Chain Analytics
14	21ME75IO	ME	Nuclear Engineering
15	21HS75IQ	HS	Cognitive Psychology
16	21HS75IR	HS	Principle and Practices of Cyber Law

Bachelor of Engineering in
CHEMICAL ENGINEERING

VIII SEMESTER													
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	21CH81P	Major Project	0	0	12	12	CH	Project	***	50	**3**	***	50
		Total				**12**							

Semester: VII						
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS **Category: Professional Core** **(Theory)**						
Course Code	**:**	**21HS71**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**10 Hrs**
Salient features of Indian Constitution; Preamble to the Constitution of India; Provisions Relating to Citizenship in India-Modes of Acquisition and Termination of Citizenship of India. Scope & Extent of Fundamental Rights-Articles 14-32 with case studies; Right to Information Act, 2005 with Case studies.	
Unit – II	**10 Hrs**
Significance of Directive Principles of State Policy; Fundamental Duties in the Constitution of India; Union Executive- President and State Executive- Governor; Parliament & State Legislature; Council of Ministers; Union and State Judiciary; Emergency provisions; Elections commission. Human Rights & Human Rights Commission.	
Unit –III	**05 Hrs**
Consumer Protection Law - Definition and Need of Consumer Protection; Consumer Rights under the Consumer Protection Act, 2019; Unfair Trade Practice, Defect in goods, Deficiency in services; Product liability and **Penal Consequences, False and Misleading Advertisement, E-Commerce, Alternate dispute Redress mechanism;** Redresses Mechanisms under the Consumer Protection Act, 2019.	
Unit –IV	**07 Hrs**
Introduction to Labour and Industrial Law, Theory and Concept of Industrial Relations, Industrial Relations Code 2020, Code on Social Security 2020, Code on Occupational Safety, Health and Working Conditions 2020, Code on Wages 2020, Industrial Disputes Act , **The Factories Act, 1948** ,Analysis of Recent Amendments made in Labour Laws.	
Unit –V	**07 Hrs**
Scope and aims of engineering ethics (NSPE Code of Ethics), Responsibility of Engineers, Impediments to responsibility. Honesty, Integrity and reliability, Risks, Safety and Liability in Engineering.Corporate Social Responsibility,Statutory Provision regarding prohibition and prevention of Ragging, The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013.	

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks.	**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	20
	PART B (Maximum of TWO Sub-divisions only) * (Small case lets and case example in one subdivision)case example in one subdivision)case example in one subdivision)	
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						
CHEMICAL EQUIPMENT DESIGN AND DRAWING **Category: Professional Core** **(Theory & Practice)**						
Course Code	**:**	**21CH72**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 Hrs**
Design of Heat Exchangers: Process and mechanical design of double pipe heat exchanger and shell and tube heat exchanger.	
Unit – II	**08 Hrs**
Design of Condensers: Process and mechanical design of horizontal and vertical condensers.	
Unit –III	**08 Hrs**
Design of evaporator: Types of evaporators, methods of feeding of evaporators, general design consideration of single effect evaporator, process, and mechanical design of evaporators.	
Unit –IV	**07 Hrs**
Design of distillation column: Process design of bubble cap distillation column. Design of column internals.	
Unit –V	**08 Hrs**
Design of absorption column: Process design of packed absorption column. Design of column internals.	

Laboratory Component

Development of 3D models and 2D layout drawings of

1. Shells of shell and tube heat exchanger and column.
2. Development of hemispherical, torrispherical heads/covers.
3. Tube sheets of shell and tube heat exchanger.
4. Segmental baffles of a shell and tube exchanger.
5. Flanges with bolt slots and threaded holes.
6. Tube bank of u-tube bundle.
7. 3D part development of nozzles.
8. 3D part assembly of pass partition plate in channel.
9. Development of trays in distillation column.
10. Assembly of parts into a model equipment.

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand design procedure of process equipment.
CO2:	Apply chemical engineering principles to design process equipment's.
CO3:	Estimate physical dimensions of various parts of chemical process equipment's and accessories
CO4:	Analyze various design options at all design stages

Reference Books	
1	Green, Don W., and Marylee Z. Southard, eds. 2019. Perry's Chemical Engineers' Handbook. 9th ed. New York: McGraw-Hill Education. https://www.accessengineeringlibrary.com/content/book/9780071834087
2	Chemical Engineering, J.M.Coulson and J.F.Richardson, Vol.6, 3rd Edition 1993, Pregman Press, ISBN: 0750641428.
3	Process Equipment Design, M.V.Joshi, 3rd Edition, Reprint 1998, Macmillan and Co. India, Delhi, ISBN 023-063-8104.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)	
COMPONENTS	**MARKS**
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**
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**
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**
LAB: 3D drawings of process equipment (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
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	
2	Design and sketch of equipment	80
	OR	
3	Design and sketch of equipment	80
	TOTAL	**100**

Semester: VII						
CHEMICAL PROCESS INTEGRATION **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH73GA**		**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**
Introduction – I: Process Synthesis, Process Analysis, Targeting minimum waste, and strategies for targets	
Unit – II	**09 Hrs**
Overall Mass Targeting – II: Sources, Sinks, Direct-Recycle, Material Recycle Pinch Diagram	
Unit –III	**09 Hrs**
Mass Integration – III: Mass Exchangers, Mass Exchange Pinch Diagram and Algebraic approach to targeting mass exchange networks	
Unit –IV	**09 Hrs**
Heat Integration – IV: Heat Exchange Networks, Heat Exchange Pinch Diagram, Minimum Utility Targeting through Algebraic Approach	
Unit –V	**09 Hrs**
Combined Heat and Power Integration – V: Heat engines, heat pumps, placement of heat engines and heat pumps in heat exchange networks	

CO1:	Understand the fundamentals, strategies and approaches of process integration.
CO2:	Apply process integration strategies on chemical engineering systems for mass and utility targeting.
CO3:	Analyze chemical engineering processes to identify limits on process integration.
CO4:	Evaluate purchase/waste/energy minimization in chemical engineering processes

1	Process Integration, Mahmoud M El-Halwagi, 1st Edition, 2006, Elsevier Academic Press, ISBN – 13: 978 0 12 370532 7
2	Chemical Process Design and Integration, Robin Smith, 2nd Edition, 2005, John Wiley & Sons, ISBN – 0 471 48681 7
3	Pinch Analysis and Process Integration, Ian C. K., 2nd Edition, 2007, Elsevier BH, ISBN – 13: 978 0 75068 260 2
4	Heat Exchanger Network Synthesis, Shenoy U. V., 1st Edition, 1995, Gulf Professional Publishing, ISBN – 0 884 15391 6

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10),	**40**

	Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : 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						
PROCESS INSTRUMENTATION **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH73GB**		**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**
Basic Concepts: Measurement and its Aim, Functional Elements - Primary, Secondary, Manipulating, Data Transferring, Static Characteristics, Dynamic Characteristics	
Unit – II	**09 Hrs**
Temperature measurement: Temperature Scales, Expansion Thermometer, Thermo- Electric sensors, Electrical resistance sensors, pyrometer	
Unit –III	**09 Hrs**
Pressure measurement: Moderate and high-pressure measuring instruments and high vacuum measuring instruments	
Unit –IV	**09Hrs**
Flow and level measurement: Method of flow measurement, Inferential flow measurement, Quantity flow meter Methods of liquid level measurement, Direct methods, Indirect methods, Solid level measurement.	
Unit –V	**09 Hrs**
Miscellaneous Measurements and P&ID Symbols: Measurements of concentration, density, viscosity, and pH; P&ID symbols	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the physics of pressure, temperature, level and flow measurement
CO2:	Select a suitable instrument for measuring pressure and vacuum, temperature, level and flow and other miscellaneous measurement
CO3:	Analyse a suitable instrumentation system for various industries
CO4:	Evaluate the use of various pressure, temperature level and flow measuring devices in Chemical industries

Reference Books	
1	Instrumentation Measurement and Analysis, B. C. Nakra and K. K. Chaudhry, 4th Edition, 2016, McGraw Hill Education India Private Limited, ISBN – 13: 978-9385880629
2	Industrial Instrumentation, D. P. Eckman, CBS Publishers & Distributors Pvt. Ltd., New Delhi, ISBN: 9788123908106
3	Process Instrumentation, Napta, 2nd Edition, 2020, Pearson, ISBN – 13: 978-0135213926
4	Fundamentals of Industrial Instrumentation and Process Control, William Dunn, 1st Edition, 2005, McGraw-Hill Education, ISBN – 13: 978-0071457354

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,	**40**

	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.**	
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **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						
TRANSPORT PHENOMENA **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH73GC**		**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**
Shell momentum balance: Shell momentum balance, Equation continuity and equation of motion, Development of steady state models using shell momentum balance approach for falling film, pipe, annulus, wetted wall column and solution of these models.	
Unit – II	**09 Hrs**
Equations of change: Use of Equations of change, their modifications simplifications. Application of equations of change to deduce models and interpret the solutions for annulus, pipe, wetted wall column, falling film, flow through narrow slit, Couette flow, rotating cylinder.	
Unit –III	**09 Hrs**
Heat Transfer models: Shell energy balance, heat conduction in an annulus (varying k), models for electrical heat source, viscous heat source, nuclear heat source	
Unit –IV	**09 Hrs**
Mass Transfer Models: Shell mass balance and boundary conditions, Application of shell mass balance to simple steady state mass transfer models: diffusion through stagnant gas, determination of diffusivity, diffusion with heterogeneous reaction, homogeneous reaction, diffusion and reaction in porous catalyst	
Unit –V	**09 Hrs**
Turbulent Flow: Introduction to turbulent flow, Comparison of Laminar and turbulent flow (For circular and non-circular conduits), Time smoothed equations of change-Reynold's decomposition and stresses, Near wall turbulent flow region (Qualitative treatment). Boussinesq eddy viscosity-concept of free and wall turbulence, Prandtl mixing length.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply fundamentals of science to arrive at force, momentum, heat and mass balance equations.
CO2:	Develop and solve the models for steady state heat, mass and momentum transfer systems.
CO3:	Analyze and interpret the solutions of the models.
CO4:	Use equations of change to formulate and solve steady state models
Reference Books	
1	R. Byron Bird et al, Transport Phenomena, 2nd Ed., Wiley, 2013, ISBN: 978-81-265-08008--2
2	Harry C. Hershey (Author), Robert S. Brodkey Transport Phenomena: A Unified Approach: A Unified Approach, Vol 1, Bordkey Publishing, 2013, ISBN 0-9726635-9-2.
3	Fundamentals of Momentum, Heat and Mass Transfer, James R. Welty et al., 4th Ed., Wiley India, 2007, ISBN: 978-81-265-1526-4.
4	Introduction to transport phenomena: momentum, heat and mass, Bodh Raj, PHI Learning Private Ltd, New Delhi, 2012, ISBN-978-81-203-4518-8

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). 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						
BIOCHEMICAL ENGINEERING **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH73GD**		**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**
Microbiology: Scope, Classification of microorganisms, Whitaker‟s 5–Kingdom concept. Prokaryotic and Eukaryotic cells. **Biochemistry:** Cell construction, Amino acids and proteins, Carbohydrates, Nucleic acids.	
Unit – II	**09 Hrs**
Enzyme Catalyzed Reactions: Introduction, Enzyme kinetics, MM, BH approach, evaluation of kinetic parameters. **Enzyme Inhibitors:** Types of inhibitors, Effects of temperature and pH, Enzyme immobilization, methods of immobilization	
Unit –III	**09Hrs**
Stoichiometry of Cell Growth and Product Formation: Elemental balances, available electron balances, degrees of reduction; yield coefficients of biomass and product formation, maintenance coefficients. Growth media formulation, Oxygen consumption and heat evolution in aerobic cultures. **Sterilization Techniques:** Continuous and batch sterilization, sterilization of Air.	
Unit –IV	**09 Hrs**
Kinetics of Microbial Growth and Product Formation: Phases of cell growth and kinetics in batch cultures, Monod and Leudeking-Piret equations, unstructured non-segregated models, models with growth inhibitors. Introduction to structured models, Ideal Bioreactors, Batch reactor, Ideal Chemostat	
Unit –V	**09 Hrs**
Recovery and purification of products: Removal of microbial cells and other solid matter, foam separation, precipitation, filtration, centrifugation, cell disruption, chemical methods.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Recall the basics of microbiology and enzymes
CO2:	Explain the various product recovery operations
CO3:	Analyze the enzyme kinetics and the factors affecting enzyme kinetics
CO4:	Predict appropriate sterilization Techniques and Design Bioreactors

Reference Books	
1	Bio-Process Engineering, Shuler and Khargi, 3rd edition, 2017, PrenticeHall, ISBN-13: 978 0137062706
2	Fundamentals, Bailey and Ollis, 2ndedition, 1986, McGraw-Hill, Chemical Engineering Series ISBN-13: 978-0070032125
3	Bioprocess Engineering Principles, Pauline M Doron, 1995, Elsevier Science & Technology Books, ISBN: 0122208552
4	Biochemical Engineering, Mukesh Doble, Sathyanarayana N Gumaadi, First Edition, 2101, PHI Learning 0 *ISBN*: 9788120330528

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 (10) Designing & Modeling (10) **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					
CHEMICAL TECHNOLOGY **Category: Professional Elective** **(Theory)**					
Course Code	**:**	**21CH74HA**	**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	**3:0:0**	**SEE**	**:**	100 Marks
Total Hours	**:**	**45L**	**SEE Duration**	**:**	3.00 Hours

Unit-I	**09Hrs**
Fuel and Industrial Gases: Technology options of producing producer gas, syngas, pyrogas, nitrogen, oxygen and carbon dioxide **Chlor-Alkali Industries:** Production of common salt, caustic soda, chlorine, hydrochloric acid and soda ash.	
Unit – II	**09 Hrs**
Acids and Soap Industries Acids: Sulfuric acid, Nitric acid, Hydrochloric acid and Phosphoric acid by electric furnace method. **Soaps and detergents :** Soaps and detergents, manufacture of soaps and heavy duty detergents, linear alkyl benzenes (LAB).	
Unit –III	**09 Hrs**
Fertilizers: Ammonia, Urea, Ammonium Nitrate, Ammonium Phosphate, Ammonium Sulfate, DAP, Super phosphate and Triple Super Phosphate	
Unit –IV	**09 Hrs**
Sugar and Starch Industries: Production of cane sugar, chemistry of starch. Manufacturing of industrial starch and its applications.	
Unit –V	**09 Hrs**
Pesticides: Processes for manufacturing of insecticides, fungicides and herbicides. **Pulp and Paper:** Raw materials, pulping processes, recovery of chemicals, stock preparation and paper making.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe various manufacturing processes used in chemical process industries
CO2:	Predict major engineering problems encountered in chemical process industries
CO3:	Draw and explain process flow diagrams for a given process
CO4:	Analyze the flow of raw materials to finished products in process industry

Reference Books	
1	Chemical Technology: From Principles to Products, Andreas Jess and Peter Wasserscheid, 2nd edition, 2020, Wiley-VCH, ISBN: 3527344217
2	Shreve's Chemical Process Industries, Austin T George, 5th Edition, 2017, Mc. Graw Hill, ISBN: 1259029455
3	Dryden's Outlines of Chemical Technology, M. GopalaRao Marshall Sittig, 2nd Edition, 1997, East-West Press Publications, New Delhi, ISBN: 8185938790.
4	Textbook of Chemical Technology, G.N. Pandey, Vols. II, 2000, Vikas Publishing House Pvt Ltd, ISBN:0706986873

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 (10) Designing & Modeling (10) **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						
POLLUTION CONTROL ENGINEERING **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH74HB**		**CIE Marks**	**:**	**100**
Credits: L:T:P	:	**3:0:0**		**SEE Marks**	**:**	**100**
Total Hours	:	**45L**		**SEE Duration**	**:**	**3**

Course Learning Objectives: The students will be able to

1.	The student is able to classify and characterize the waste according to various criteria in accordance with the waste catalogue.
2.	The student is able to use the knowledge of the applicable legal regulations.
3.	Student can use the principles of waste management
4.	Student can analyse methods and techniques of disposal, storage and organization of recycling

Unit – I	**9 Hrs**
Quality requirements of boiler and cooling waters, Quality requirements of process water for Textiles, Food processing and Brewery Industries, Boiler and cooling water treatment methods.	
Unit – II	**9 Hrs**
Manufacturing process and origin of liquid waste from Textiles, Paper and Pulp industries, and Tanneries, Special Characteristics, Effects and treatment methods	
Unit – III	**9 Hrs**
Manufacturing process and origin of liquid waste from Fertilizers, Distillers, and Dairy, Special Characteristics, Effects and treatment methods.	
Unit – IV	**9 Hrs**
Manufacturing Process and origin of liquid waste from Sugar Mills, Steel Plants, and Oil Refineries, , Special Characteristics, Effects and treatment methods.	
Unit – V	**9 Hrs**
Common Effluent Treatment Plants – Advantages and Suitability, Limitations, Effluent Disposal Methods.	

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Course Outcomes: After completing the course, the students will be able to	
CO 1:	Provide knowledge of the classification of waste and principles of waste management
CO 2:	Familiarize the current legal regulations and economic mechanisms of waste management
CO 3:	Acquaint the methods and techniques of neutralization and waste disposal on selected examples.
CO 4:	Acquire practical skills in using the knowledge of basic methods and techniques used in waste management.

Reference Books:	
1.	Environmental Pollution Control Engineering, C.S. Rao, 2nd Edition (Reprint), 2015, New Age International, ISBN:978-81-224-1835-4.
2.	Waste Water Engineering Treatment Disposal Reuse, Metcalf and Eddy, 4th Edition, 2003, Tata McGraw Hill, ISBN: 978-0071241403.
3.	Pollution Control in Process Industries, S.P. Mahajan, 27th Edition, 2012, Tata McGraw Hill, ISBN: 9780074517727.
4.	Waste Water Treatment, M.N. Rao and Dutta, III edition, 2017, Oxford & IBH, New Delhi, ISBN: 8120417127

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 (10) Designing & Modeling (10) **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						
INSTRUMENTAL METHODS OF ANALYSIS **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH74HC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction: Selection of techniques, Measurement and readings, errors in analysis, Graph and measurement, Statistics to data evaluation, Uncertainty in chemical analysis. **Sampling and sample preparation:** Homogenization of samples, sample integrity, separation, types of sample, sample matrices, sample preparation. **Quantitation and calibration:** Response factor, peak area, composition, external and internal standard methods, standard addition method, calibration method, linear regression.	
Unit – II	**09 Hrs**
General Introduction to Spectroscopy: Types of spectroscopy, representation of a spectrum, nature and interaction of electromagnetic radiation, energies corresponding to various kinds of radiations, atomic and molecular transitions, selection rules, spectral width, factors influencing positions and intensity of spectral lines. **Electronic Spectroscopy (Absorption Spectroscopy):**Quantitative aspects of absorption measurements – Beer's law and its limitations, terminology associated with electronic spectroscopy, types of absorption bands and theoretical interpretation, effect of solvent and structure on l_{max}, Instrumentation for Qualitative and Quantitative analysis, structure determination.	
Unit –III	**09 Hrs**
Infrared Spectroscopy: Theory of IR absorption, types of vibrations, theoretical number of fundamental nodes of vibrations and group frequencies, factor affecting the group frequencies and band shapes. Instrumentation – FITR Instrument and its advantages, sample handling techniques. Qualitative applications of IR. Applications of IR to structural elucidation of sample organic molecules.	
Unit –IV	**09 Hrs**
Flame Photometry and Atomic Absorption Spectroscopy: Introduction, principle, flames and flame spectra, variation of emission intensity with flame, metallic spectra in flame, flame ground, role of temperature on absorption emission and fluorescence. Comparative study of flame emission spectroscopy (FES) and Atomic absorption spectroscopy (AAS). Application – Qualitative and Quantitative determination of alkali and alkaline earth metals.	
Unit –V	**09 Hrs**
Chromatography: General description, definitions, terms and parameters used in chromatography, classification of chromatographic methods, working principle, Instrumentation and applications of high pressure liquid chromatography (HPLC), Gas chromatography (GC).	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Recollect the basic principles of spectroscopy and chromatography;
CO2:	Interpret and communicate an analytical result
CO3:	Identify suitable technique for analysis.
CO4:	Formulate analytical procedure to characterize samples

Reference Books	
1	Silverstein, R. M., Webster, F. X., and Kiemle, D. J. Spectrometric Identification of Organic Compounds, 8th ed.; John Wiley and Sons: Hoboken, NJ, 2014. ISBN: 978-0-470-61637-6
2	Ewing G.W; Instrumental methods of Chemical Analysis; Mc Graw Hill International; 1985;ISBN:07-085210-3
3	Chatwal Anand; Instrumental Methods of Chemical Analysis;5th edition, Himalaya Publishing House; 2023; ISBN: 978-93-5142-088-0
4	Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principles of Instrumental Analysis, 7th edition, Cengage Learning, 2017. ISBN: 978-1-337-46803-9

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **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						
PETROCHEMICAL TECHNOLOGY **Category: Professional Elective** **(Theory)**						
Course Code	**:**	**21CH74HD**		**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 Petrochemicals: Overview of Petrochemical Industry: History, significance, and current trends. Raw Materials: Sources of petrochemicals (natural gas, crude oil, coal), feedstock selection. Petroleum Refining: Overview of refining processes, products, and their uses.	
Unit – II	**09 Hrs**
Production of Basic Petrochemicals: Olefins: Production of ethylene, propylene, butadiene. Aromatics: Production of benzene, toluene, xylenes. Synthesis Gas: Production methods, applications in petrochemicals.	
Unit –III	**09 Hrs**
Derivatives of Basic Petrochemicals: Polymers: Production and applications of polyethylene, polypropylene, polystyrene, PVC. Synthetic Rubbers: Production and applications of SBR, butadiene rubber. Industrial Chemicals: Production of methanol, formaldehyde, acetic acid, etc.	
Unit –IV	**09 Hrs**
Process Technologies in Petrochemicals: Steam Cracking: Process description, feedstock selection, operating conditions. Catalytic Reforming: Process description, catalysts, and applications. Polymerization Technologies: Bulk, solution, suspension, and emulsion polymerization.	
Unit –V	**09Hrs**
Advanced Petrochemical Processes Biomass to Petrochemicals: Processes, challenges, and opportunities. Gas to Liquids (GTL): Technologies, products, and market potential. Coal to Liquids (CTL): Processes, environmental impact, and economics.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the technology of different processes
CO2	Understand and evaluate the effect of different variables on processes
CO3	Asses environmental impact of different products
CO4	Understand hazard and safety associated in chemical processes

Reference Books	
1.	N.N. Lebdev, Chemistry and technology of basic organic and petrochemical synthesis, Vol. 1 & 2 Mir publications , Moscow
2.	Dryden, Charles E., Outlines of Chemical Technology, Affilated East-West Press Pvt Ltd.; Standard Edition (1 January 1997), ISBN-13 : 978-8185938790
3.	Dr. B.K. Bhaskarrao , " A text on Petrochemicals" 4th Ed, Khanna publishers, New Delhi.- 110094, ISBN No. 81 -7409 -044 - 4
4.	G.N .Sarkar , " Advanced Petrochemicals" 1st Ed, Khanna Publishers, New Delhi Publication Year - 1998 ISBN: 978-81-7409-096-6

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **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						
UNMANNED AERIAL VEHICLES **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	**21AS75IA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

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

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Appraise the evolution of UAVs and understand the current potential benefits of UAVs
CO2:	Apply the principles of Aerospace Engineering in design and development of UAVs
CO3:	Evaluate the performance of UAV designed for various Missions and applications
CO4:	Assess the performance and airworthiness of the designed UAV

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks 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 ANALYTICS **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	**21BT75IB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42 Hrs**		**SEE Duration**	**:**	**3 Hours**
Unit-I						**09 Hrs**
Introduction to tools and databases: Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases, Applications of these databases, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method						
Unit – II						**09 Hrs**
Sequence Analysis: Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation.						
Unit –III						**09 Hrs**
Introduction to Next-Generation Sequencing (NGS) analysis: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads						
Unit –IV						**09 Hrs**
Structural analysis & Systems Biology: Gene prediction programs – ab initio and homology-based approaches.. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition, Prediction of secondary structure. Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology.						
Unit –V						**09 Hrs**
Drug Screening: Introduction to Computer-aided drug discovery, target selection, ligand preparation and enumeration, molecular docking, post-docking processing, molecular dynamics simulations, applications and test cases.						

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

Reference Books	
1.	Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13.
2.	Buehler LK, Rashidi HH, editors. Bioinformatics basics: applications in biological science and medicine. CRC Press; 2005 Jun 23.
3.	Ghosh Z, Mallick BM. Bioinformatics principles and Applications. Oxford University Press; 2018 Jun 13.
4.	Low L, Tammi MT. Introduction to next generation sequencing technologies. Bioinformatics. WORLD SCIENTIFIC. 2017 Jul 26:1-21.
5.	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
6.	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
	COMPONENTS	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

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

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

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

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

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

Course Learning Objectives: The students will be able to	
1	Understand the fundamental & socio, economic aspects of corrosion.
2	Identify practices for the prevention and remediation of corrosion.
3	Analyzing methodologies for predicting corrosion tendencies.
4	Evaluate various corrosion situations and implement suitable corrosion control measures.

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

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the causes and mechanism of various types of corrosion
CO2:	Apply the knowledge of chemistry in solving issues related to corrosion.
CO3:	Analyse and interpret corrosion with respect to practical situations.
CO4:	Develop practical solutions for problems related to corrosion.
Reference Books	
1	Corrosion Engineering, M.G, Fontana, 3rd Edition, 2005, Tata McGraw Hill, ISBN: 978-0070214637.
2	Principles and Prevention of Corrosion, D. A Jones, 2nd Edition, 1996, Prentice Hall, ISBN: 978-0133599930.
3	Design and corrosion prevention, Pludek, 1978, McMillan, ISBN: 978-1349027897
4	Introduction to metal corrosion, Raj Narain, 1983, Oxford &IBH, ISBN: 8120402995.

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

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

Semester: VII						
PROMPT ENGINEERING **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	21CS75IE		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	40L		**SEE Duration**	**:**	03 Hours

Course Learning Objectives: The students will be able to	
1	Describe the principles and concepts underlying prompt engineering
2	Design and formulate effective prompts for various AI models to achieve desired outputs
3	Analyse and assess the performance of different prompts to improve the quality and reliability of AI-generated outputs.
4	Apply prompt engineering techniques to solve real-world problems in various domains

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

Course Outcomes: After completing the course, the students will be able to	
CO1	**Demonstrate an understanding of prompt engineering principles** including how prompt structure and phrasing impact the performance of AI models.
CO2	**Design and implement effective prompts-** to create and apply prompts for various natural language processing (NLP) tasks, such as text generation, summarization, and translation, using AI models.
CO3	**Critically evaluate the effectiveness of prompts -** assess the quality and performance of prompts in terms of accuracy, coherence, and relevance, identifying areas for improvement.
CO4	**Apply prompt engineering techniques in real-world scenarios -** use prompt engineering strategies to address practical problems in domains such as education, healthcare, and business, demonstrating the applicability of AI-driven solutions.
CO5	**Collaborate on projects involving prompt engineering -** work effectively in teams to design, implement, and evaluate prompt-based solutions, showcasing their ability to contribute to complex AI-related projects.

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **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 (10**)** Real time problemsolving (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						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	**21CV75IF**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3Hours**

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

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**

2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

Course Learning Objectives: The students will be able to

1	Explain the types and application of wearable sensor.
2	Describe the working of sensitivity, conductivity and energy generation in wearable devices.
3	Explain the various facets of wearable application, advantage & challenges.
4	Understand different testing and calibration in wearable devices.

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

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

Reference Books	
1	Wearable Sensors: Fundamentals, Implementation and Applications, Edward Sazonov, Michael R. Neuman Academic Press, 1st Edition, 2014, ISBN-13: 978-0124186620.
2	Electronic Textiles: Smart Fabrics and Wearable Technology, Tilak Dias, Woodhead Publishing; 1 edition,**ISBN-13:** 978-0081002018.
3	Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, 1st Edition, ISBN-13: 978-1260116151.
4	Flexible and Wearable Electronics for Smart Clothing: Aimed to Smart Clothing, Gang Wang, Chengyi Hou, Hongzhi Wang , Wiley, 1st Edition, ISBN-13: 978-3527345342
5	Printed Batteries: Materials, Technologies and Applications, Senentxu Lanceros-Méndez, Carlos Miguel Costa, Wiley, 1 edition , ISBN-13: 978-1119287421

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10**)** Real time problem solving (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

Unit-I	**06 Hrs**
Introduction: Introduction to Industrial Automation, Historical background, Different parts and types of Industrial automation, Block diagram of PLC, PLC Versus Other types of Controls, PLC Product Application Ranges, Fixed and Modular I/O Hardware PLC Operation: Binary Data representation, Input and output status files for modular PLC, Addressing concept.	
UNIT II	
PLC Hardware: The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications Input and Output modules: Brief overview of Discrete and Analog input modules, Discrete and TTL/Relay output modules	
Unit –III	**09 Hrs**
Basics of PLC Programming: Processor memory organization, Program scan, PLC programming languages, Basic Relay Instruction, Bit or relay instructions, NO, NC, One Shot, Output latching software, negated Output and Internal Bit Type instructions, mode of operations	
Unit –IV	
Special programming Instructions: Timer and Counter Instructions: On delay and Off delay and retentive timer instructions, PLC Counter up and down instructions, combining counters and timers. **Program Control &Data manipulation Instructions**: Data handling instructions, Sequencer instructions, Programming sequence output instructions.	
UNIT V	**09 Hrs**
SCADA & DCS Building Block of SCADA System, Hardware structure of Remote Terminal Unit, Block diagram of Distributive Control System **Case Studies**: Bottle filling system, Material Sorter. Elevator, Traffic control, Motor sequencers, Piston extraction and retraction using timers and counters.	

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

CourseOutcomes:Aftercompletingthecourse,thestudentswillbeableto	
CO1	Explain various Orbital Parameters, Satellite Link Parameters, Propagation considerations and Radar systems.
CO2	Apply the concepts to determine the parameters of satellite, performance of radar and navigation systems.
CO3	Analyze the design issues of satellite and its subsystems, radars and navigation systems.
CO4	Evaluate the performance of the satellite systems and its parameters,radar and navigation systems

Reference Books	
1.	Atmosphere, weather and climate, RGBarry ,Routledge publications,2009,ISBN-10:0415465702.
2.	Fundamentals of Satellite Communication, KNRajaRao,PHI,2012,ISBN:
3.	Satellite Communication, Timothypratt, JohnWiley,1986ISBN: 978-0-471-37007 -9, ISBN10: 047137007X.

4	Remote sensing and applications, BCPanda, VIVAbooksPvt.Ltd.,2009, ISBN: 108176496308.

RUBRICFORSEMESTERENDEXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PARTA	
1	Objective type ofquestions covering the entire syllabus	20
	PARTB (MaximumofTHREESub-divisions only)	
2	Unit 1: (Compulsory)	16
3 &4	Unit2: Question3 or4	16
5 &6	Unit3: Question5 or6	16
7 &8	Unit4: Question7 or8	16
9 &10	Unit5:Question9 or10	16
	TOTAL	**100**

RUBRICFORTHECONTINUOUSINTERNALEVALUATION(THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:**Quizzes will be conducted in online/offline mode. **QUIZZES**willbeconducted&EachQuizwillbeevaluatedfor10Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**.Each test will be evaluated for **50 Marks**,addingupto100 Marks.**FINALTESTMARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIALLEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode(Demo/Prototype/anyoutcome). ADDINGUPTO40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30Marks),labtest(10Marks)and Innovative Experiment/ Concept Design and Implementation(10Marks)addingupto50Marks.**THEFINALMARKS WILL BE 50 MARKS**	**50**
	MAXIMUMMARKS FORTHE CIE THEORY	**150**

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

Prerequisite: - Programming in Java.

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

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

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4	Professional Android2ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898
5	BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1
6	AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

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

Reference Books	
1.	Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9
2.	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6.
3.	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2.
4.	Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

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

Reference Books	
1.	Kurt Y. Liu, Supply Chain Analytics - Concepts, Techniques and Applications, Palgrave – Macmillan, Springer Nature Switzerland AG, 2022, ISBN 978-3-030-92224-5 (eBook)
2.	Işık Biçer, Supply Chain Analytics - An Uncertainty Modeling Approach, 2023, Springer Texts in Business and Economics, Springer Nature Switzerland AG, e-ISSN 2192-4341, e-ISBN 978-3-031-30347-0

3.	Supply Chain Management – Strategy, Planning & Operation, Sunil Chopra, Peter Meindl & D V Kalra, 6th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2.
4.	Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135–5

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

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

Unit-I	**09 hrs**

Introduction to Nuclear Engineering

Historical Development of Nuclear Engineering, Overview of Nuclear Energy Applications, Nuclear Physics Fundamentals: Atomic Structure and Nuclear Models: Nuclear Forces and Interactions, Nuclear Reactions and Cross-sections, Types of Nuclear Reactions: Fission and Fusion Reactions, Neutron-Induced Reactions, Applications in Power Generation and Industry, Nuclear Power Generation: Basic Principles of Nuclear Reactors, Types of Nuclear Reactors, Radiation Basics, Types of Radiation (Alpha, Beta, Gamma), Radioactive Decay and Decay Chains, Units of Radioactivity and Radiation Measurement

Unit-2	**10 hrs**

Nuclear Reactors

Types of Nuclear Reactors, Reactor Components and Their Functions, Nuclear Reactor Kinetics and Control, Neutron Interactions and Transport, Neutron Moderation and Absorption, Reactor Kinetics and Dynamics, Specific Types of Nuclear Reactor, Light Water Reactors: Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR), Heavy Water Reactors: Canada Deuterium Uranium (CANDU), Gas-Cooled Reactors: Gas-Cooled Reactor and Fast Breeder Reactor (and HTGR), Liquid Metal-Cooled Reactors (LMFR).

Unit - 3	**10 hrs**

Nuclear Fuel Cycle

Introduction to the Nuclear Fuel Cycle: Importance of Fuel Cycle Management, Uranium Mining and Ore Processing, Types of Uranium Deposits, Mining Methods and Processing Techniques, Environmental and Health Considerations, Uranium Enrichment and Fuel Fabrication: Enrichment Technologies (Centrifugation, Gaseous Diffusion), Fuel Fabrication Processes, Quality Control and Safety Measures, Nuclear Reactors and Fuel Utilization: Fuel Assembly Design and Composition.

Unit-4	**08 hrs**

Radiation Protection and Safety:

Basics of Ionizing Radiation, Types of Ionizing Radiation, Interaction of Radiation with Matter, Units of Radiation Measurement, Biological Effects of Radiation, Deterministic and Stochastic Effects, Acute and Chronic Radiation Effects, Risk Assessment and Dose, Response Relationships, Radiation Dose Assessment: External and Internal Dosimetry, Radiation Monitoring Devices, Occupational and Public Dose Limits, Radiation Safety Measures:, Emergency Response and Contingency Planning: Emergency Procedures and Drills, Communication Strategies During Radiation Incidents.

Unit-5	**08 hrs**

Environmental and Societal Aspects

Environmental Impact Assessment: Life Cycle Analysis of Nuclear Energy, Impact of Uranium Mining and Fuel Cycle Operations, Radioactive Waste Management and Environmental Considerations, Societal Perceptions and Attitudes, Factors Influencing Public Perception, Ethical Considerations: Principles of Ethics in Nuclear Engineering, Nuclear Energy and Social Justice, Ethical Dilemmas in Nuclear Technology, Nuclear Energy and Climate Change: Carbon Footprint of Nuclear Power.

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 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: (Internal Choice)	16
5 & 6	Unit 3: (Internal Choice)	16
7 & 8	Unit 4: (Internal Choice)	16
9 & 10	Unit 5: (Internal Choice)	16
	TOTAL	**100**

Semester: VII						
COGNITIVE PSYCHOLOGY **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	**21HS75IQ**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**

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

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Describe the basic theories, principles, and concepts of cognitive psychology as they relate to behaviours and mental processes.
CO2	Define learning and compare and contrast the factors that cognitive, behavioural, and Humanistic theorists believe influence the learning process.
CO3	Develop understanding of psychological attributes such as reasoning, problem solving creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4	Apply the theories 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 6th Edition Woods worth Cenguage Learning
2.	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.
3.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
4.	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Some of the Experiential learning topics may include Reading Leadership books and summarizing, Analysis and interpretation of various economic reports, Visit to various organizations to understand organizational mechanics. Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VII						
PRINCIPLES AND PRACTICES OF CYBER LAW **Category: Institutional Elective - I** **(Theory)**						
Course Code	**:**	**21HS75IR**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3;0;0**		**SEE**	**:**	**100**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3 Hours**

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

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**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.	**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; wherein one sub division will be a caselet in the related topics)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VII						
SUMMER INTERNSHIP						
Course Code	**:**	**21CH76I**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours/Week	**:**	**04**		**SEE Duration**	**:**	**2 Hours**

GUIDELINES

1. The duration of the internship shall be for a period of ***6/8 weeks*** on full time basis after VI semester final exams and before the commencement of VII semester.
2. The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3. Internship must be related to the field of specialization of the respective UG programme in which the student has enrolled.
4. Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5. Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for UG circuit Programs and Light Blue for Non-Circuit Programs.
7. The broad format of the internship final report shall be as follows
    - 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.	25 Marks
Review - II	Importance of resource management, environment and sustainability, presentation skills and report writing	25 Marks

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

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

Semester: VII						
MINOR PROJECT						
Course Code	**:**	**21CH77**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours/Week	**:**	**04**		**SEE Duration**	**:**	**2 Hours**

GUIDELINES

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

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

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

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

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

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

The minor-project tasks would involve:

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

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

Course Outcomes:
After going through the minor project the student will be able to:
CO1: Interpreting and implementing the project in the chosen domain by applying the concepts learnt.
CO2: The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any of the domains in his / her future career.
CO3: Appling project life cycle effectively to develop an efficient product.
CO4: Produce students who would be equipped to pursue higher studies in a specialized area or carry out research work in an industrial environment.

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

ReviewPhase	Activity	Weightage

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

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

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

Semester: VIII						
MAJOR PROJECT						
Course Code	**:**	**21CH81P**		**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 8th semester.
2. The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the 1st week after the commencement of 8th semester.

Batch Formation:

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

Project Topic Selection:

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

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

Project Evaluation:

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

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

Course Outcomes:

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

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

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

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

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

Scheme of Continuous Internal Evaluation (CIE):

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

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

Scheme for Semester End Evaluation (SEE):

The following are the weightages given during Viva Examination.

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

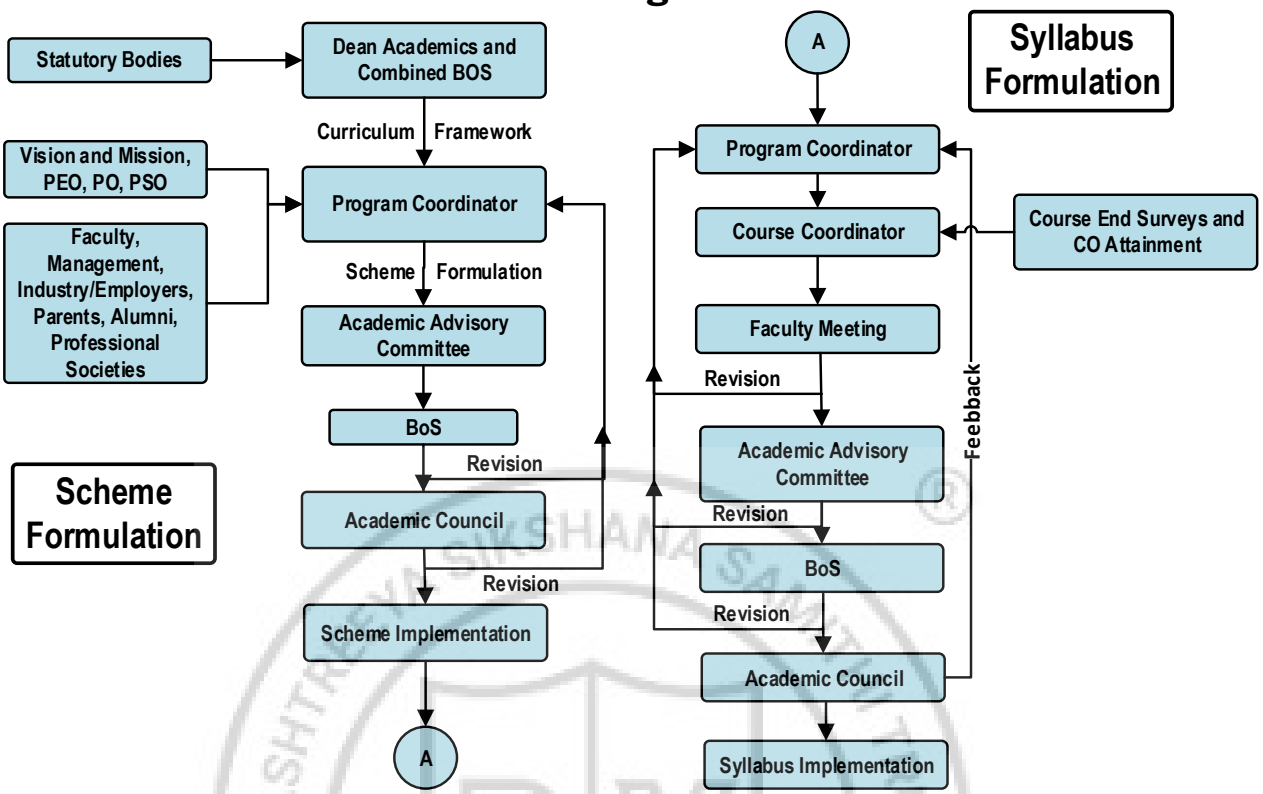
Calendar of Events for the Project Work:

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

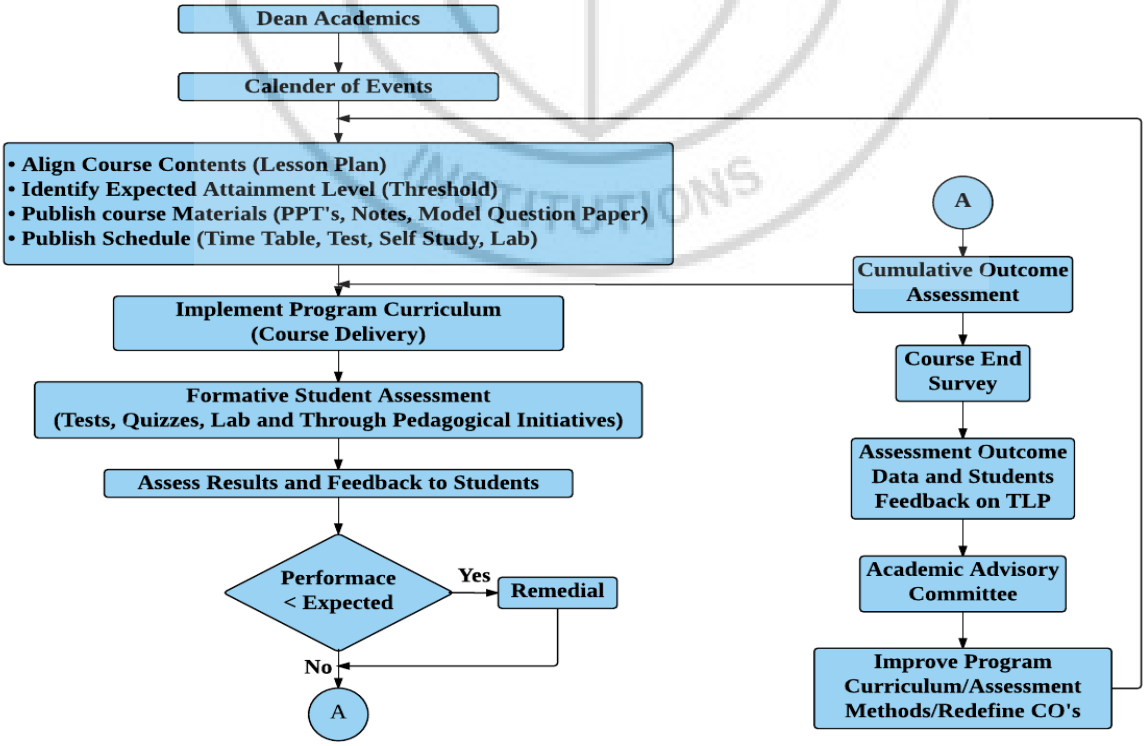
Evaluation & Scheme for CIE and SEE

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

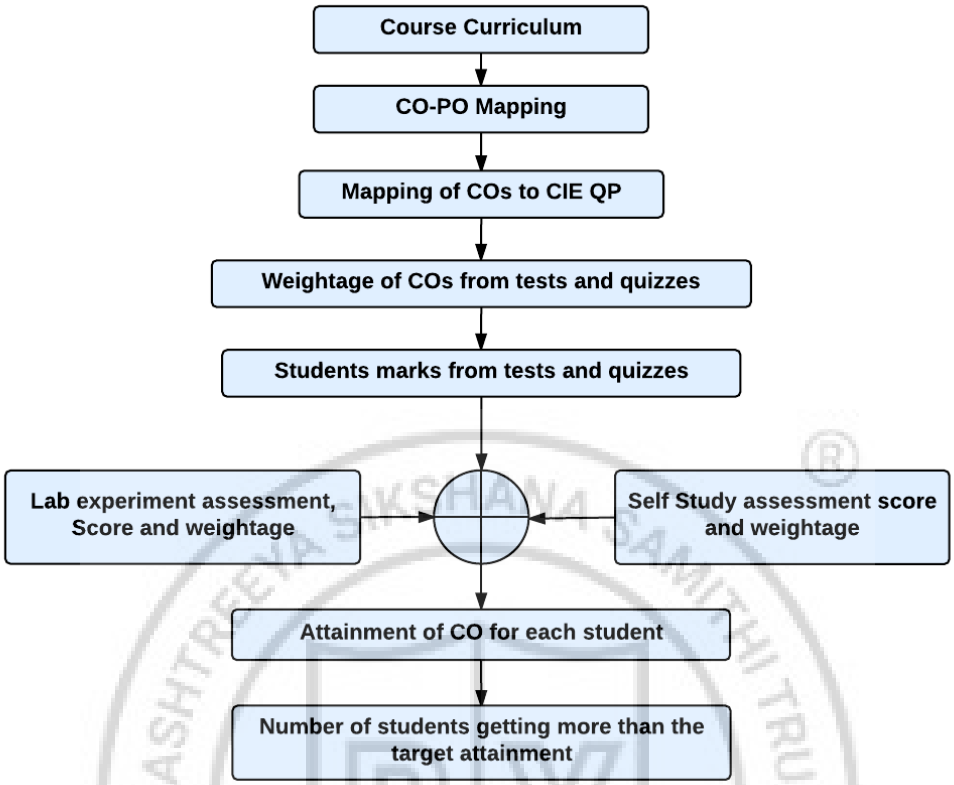
Curriculum Design Process



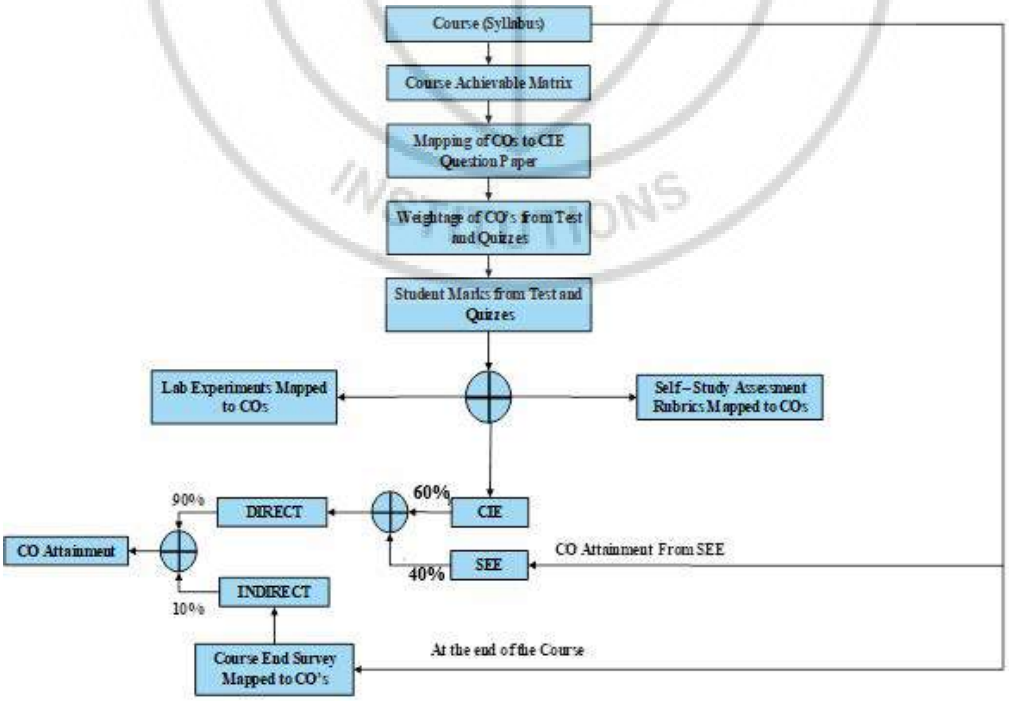
Academic Planning and Implementation



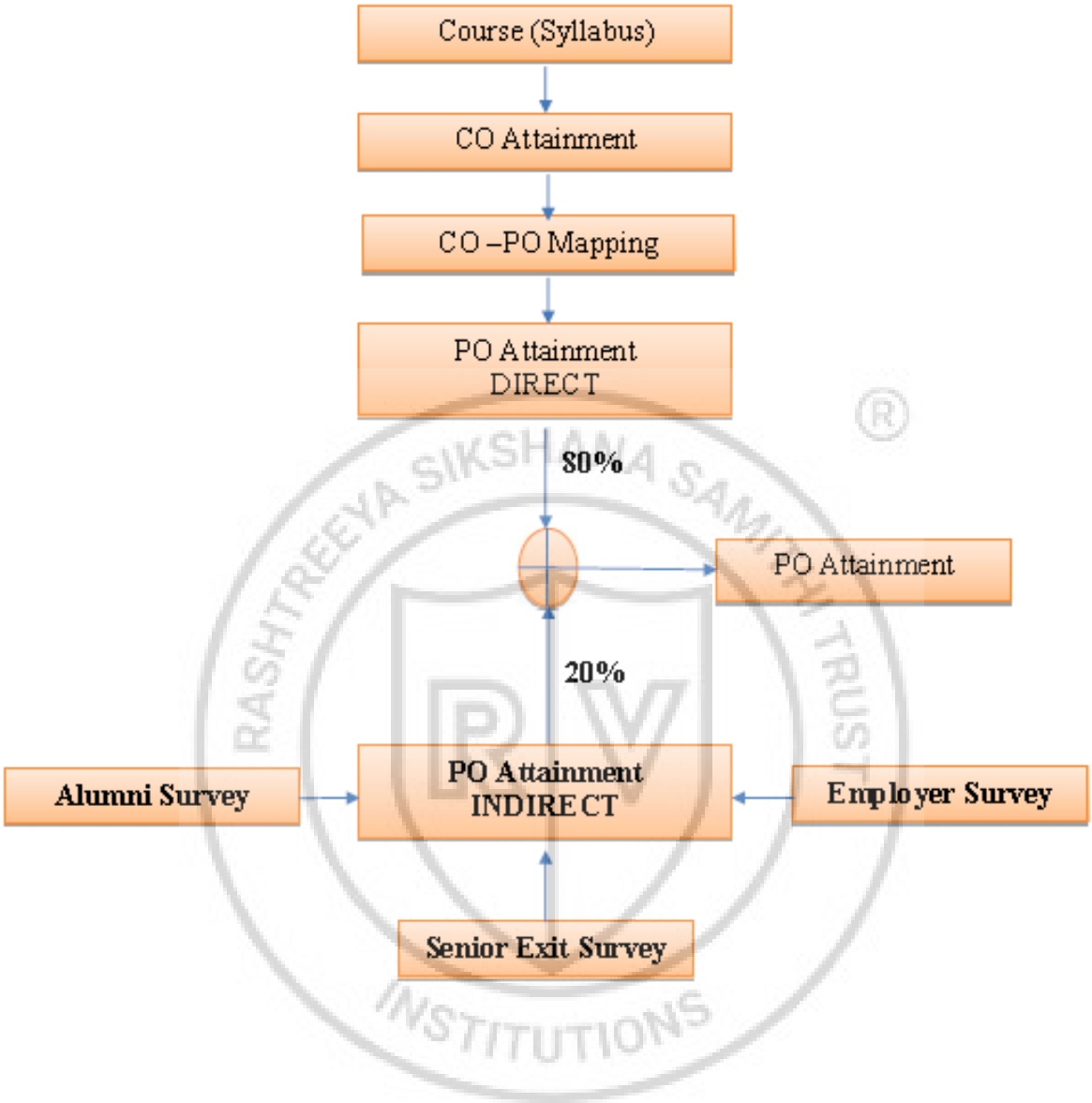
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



KNOWLEDGE & ATTITUDE PROFILE

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

PROGRAM OUTCOMES (POs)

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

INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation