RV College of Engineering®

Biotechnology

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

A Premier Department in Biotechnology Education, Research and Innovation with a Focus on Sustainable Technologies for the Benefit of Society and Environment.

DEPARTMENT MISSION

- Create state-of-the-art infrastructure for research and training in Biotechnology.
- Develop graduates who are ethical and socially concerned.
- Promoting collaboration with academia, industries and research organizations at national and international level.
- Contribute to socioeconomic development through sustainable and inclusive technologies

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Have a strong foundation in scientific and engineering fundamentals that prepare them for a successful career in Biotechnology and allied fields

PEO2: Function at a technically competent level in formulating and solving problems in Biotechnology

PEO3: Organize and utilize the knowledge to develop Biological processes and gene manipulation techniques

PEO4: Exhibit professionalism, ethical attitude, oral and written communication skills, team work and develop an outlook for lifelong learning

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Gain knowledge in Basic sciences, Mathematics and Biology to understand the Engineering problems related to Biotechnology and Bioinformatics.
PSO2	Develop the skills in the area of Biotechnology, Chemical Engineering and Informatics to solve complex Biological problems.
PSO3	Acquire technical knowledge to design, analyse, optimize and scale up Bio processes to develop value added products.
PSO4	Develop intellectual, personal and professional abilities through experiential learning and interdisciplinary projects

Lead Society: American Society of Agricultural and Biological Engineers.

ABBREVIATIONS

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

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RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world®

Bachelor of Engineering in
BIOTECHNOLOGY
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	HSS	Theory	**100**	********	**3**	**100**	********
2	21BT72	Downstream Process and Product Recovery (Theory and Practice)	3	0	1	4	BT	Theory+Lab	**100**	**50**	**3**	**100**	**50**
3	21BT73GX	Professional Core elective III (Group G)	3	0	0	3	BT	Theory	**100**	********	**3**	**100**	********
4	21BT74HX	Professional Core elective IV (Group H)	3	0	0	3	BT	Theory	**100**	********	**3**	**100**	********
5	21XX75IX	Institutional Electives (Group I)	3	0	0	3	XX	Theory	**100**	********	**3**	**100**	********
6	21BT761	Summer Internship -III	0	0	2	2	BT	Internship	********	**50**	**2**	********	**50**
7	21BT77P	Minor Project	0	0	2	2	BT	Project	********	**50**	**3**	********	**50**
		Total	**15**	**0**	**5**	**20**							

Note: * Internship (6 weeks) is to be carried during the vacation after 6th semester and evaluation shall be conducted during 7th semester for 2 credits

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	21BT81P	Major Project	0	0	12	**12**	BT	Lab	********	**50**	**3**	********	**50**

VII Semester			
Professional Core elective III (Group G)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	21BT73GA	Nanobiotechnology	3
2	21BT73GB	Sustainable and Precision Agriculture	3
3	21BT73GC	Human Diseases	3
4	21BT73GD	Next Generation Sequencing Informatics	3

VII Semester			
Professional Core elective IV (Group H)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	21BT74HA	Forensic Sciences	3
2	21BT74HB	Metabolites and Bioprospecting	3
3	21BT74HC	Non-Conventional Energy Resources	3
4	21BT74HD	Genomics and Proteomics	3

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

VIII Semester			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	21BT81P	Major Project	61

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. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar / presentation / demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
MAXIMUM MARKS FOR THE CIE		**100**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only) * (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						
DOWNSTREAM PROCESS AND PRODUCT RECOVERY **Category: Professional Core** **(Theory and Practice)**						
Course Code	**:**	**21BT72**		**CIE**	**:**	**100+50=150 Marks**
Credits: L:T:P	**:**	**4:0:1**		**SEE**	**:**	**100+50=150 Marks**
Total Hours	**:**	**52L**		**SEE Duration(Theory)**	**:**	**3.00 Hours**
				SEE Duration (Practicals)	**:**	**3.00 Hours**

Unit-I	**08 Hrs**
Introduction to Downstream processing: Overview of upstream and downstream processing, Basic concepts of bio separation technology, Economic importance of downstream processing in biotechnology, properties of biological materials. Characteristics of biological molecules, Separation characteristics of recombinant proteins, enzymes, Vaccines and monoclonal antibodies.	
Unit – II	**08 Hrs**
Biomass removal and disruption: Cell disruption by Mechanical and non- mechanical methods, Chemical lysis, Enzymatic lysis, physical methods, Sonication, High pressure Homogenizer, Flocculation methods and its applications. Centrifugation and ultracentrifugation. Simple Numerical on cell disruption and centrifugation	
Unit –III	**12 Hrs**
Filtration: Separation of products by filtration: dead end filtration, depth filtration, concept of filter medium resistance, Rotary Vacuum Filtration, scale up of filtration systems, different modes of operation. **Extraction:** Principles of solid-liquid extraction, Liquid - Liquid extractions, multistage and counter current multistage extraction. Selection of solvent, Extraction equipment: working of Bollman, Mixer-settler and York-Scheibel extractors. Precipitation (salt, pH, organic solvent, high molecular weight polymer).Numerical problems on filtration and extraction.	
Unit –IV	**12 Hrs**
Membrane Based Separation: Structure and characteristics of membranes, types of membranes, membrane equipment, Phenomenon of concentration polarization, membrane fouling and its consequences. Membrane based purification: Microfiltration, Ultrafiltration, Nanofiltration and Diafiltration. Biotechnological applications of membrane based separations. **Industrial bioproducts processing**: Baker's yeast, cheese, alpha amylase, HFCS production, Biopolymers, Hepatitis B. Numerical on membrane based bioseperation	
Unit –V	**12 Hrs**
Advanced Separation Techniques: Chromatography:- general theory; separation based on Size, Charge, Hydrophobicity and Affinity: Gel filtration, Ion exchange chromatography, Affinity chromatography, and hydrophobic interaction chromatography (HIC). Polishing of Bio products by Crystallization, Drying equipment-Tray Drier, Rotary Drier and Freeze Drier.	

Case studies: Large scale separation and purification of Recombinant human Insulin, Monoclonal Antibodies, Biodiesel and Biobutanol production
LAB EXPERIMENTS
1. Cell disruption techniques- physical method 2. Solid-liquid separation methods: sedimentation by flocculating agents. 3. Solid-liquid separation methods: Membrane filtration. 4. Solid-liquid separation methods: Centrifugation 5. Product enrichment operation: ammonium sulphate precipitation of proteins. 6. Product enrichment operation: aqueous two phase extraction (single stage). 7. Separation of amino acids/vitamins/pigments by adsorption Chromatography. 8. Efficiency of centrifugation on the citric acid broth separation. 9. Product drying technique-vacuum tray drier. 10. Crystallization Technique for bioactive compound. Note: Each student has to perform 10 experiments in a semester. 10 Experiments are guided experiments

Course Outcomes: After completing the course, the students will be able to	
CO1:	Highlight the importance of downstream processing of biological products.
CO2:	Interpret the techniques for various intracellular and extracellular products from complex biological mixtures.
CO3:	Apply techniques to concentrate and purify biological products
CO4:	Initiate different processes for separation and purification of biological products

Reference Books	
1	Filtration and Purification in the Biopharmaceutical Industry, Uwe Gottschalk, 3rd Edition, 2019, CRC Press, ISBN:9781315164953.
2	Principles of Bioseparation Engineering, Ghosh R, 1st edition, 2006, World Scientific Publishing. ISBN: 9812568921.
3	Bio separations Science and Engineering, Roger G. Harrison, Paul Todd, Scott R. Rudge, Demetri P. Petrides, 2nd Edition 2015, Oxford University Press., ISBN: 0195391810.
4	Downstream Process Technology: A New Horizon In Biotechnology, Krishnaprasad N, Eastern Economy Edition, 2010, PHI Learning India ltd., ISBN: 9788120340404.

Continuous Internal Evaluation (CIE); Theory (100 Marks)

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**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**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab	**50**

	test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks**. THE FINAL MARKS WILL BE 50 MARKS**	
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

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**

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	**10**
2	Conduction of the Experiments	**20**
3	Viva	**20**
	TOTAL	**50**

VII Semester						
NANOBIOTECHNOLOGY **Professional Core Elective III – Group G** **(Theory)**						
Course Code	**:**	**21BT73GA**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hrs**

Unit-I	**08Hrs**
Introduction to Nanomaterials and Nano synthesis: History, Types of nanomaterials: Fullerenes (Graphene, Bucky ball, Nano tubes, Nano shells, Quantum dots, Dendrimers. **Nanobiomaterials:** DNA and Protein based Nano array structures. Function and application of DNA and protein-based nanostructures. Bionanomaterials in Nature: Lotus leaf as a model self-cleansing system as example **Nano synthesis:** Ball milling, CVD, Sol gel, Plasma arching. Biosynthesis of Nanoparticles.	
Unit – II	**08Hrs**
Nanofabrication: Approaches of fabrication. Top-Down and Bottom-up methods of nanofabrication Nanolithography: Hard and soft lithography. **Characterization methods** :Spectroscopic methods: FTIR spectroscopy and Raman spectroscopy, **Microscopic methods:** Scanning Electron Microscopy (SEM) Transmission Electron Microscopy (TEM), **Scanning probe microscopy**: Atomic Force Microscopy (AFM) and Scanning Tunneling Microscopy (STM).	
Unit –III	**08Hrs**
Nanosensors and Nanobiosensors: Overview of nanosensors, prospects and market. Types of Nanosensors and their applications. Electromagnetic nanosensors: Magnetic nanosensors. Mechanical nanosensors. Types of nanobiosensors: Cantilever, nanotube, nanowire and nanoparticle-based sensor, Nanosensors, Mechanics of CNTs, Biosensors in modern medicine.	
Unit –IV	**08Hrs**
Micro & Nano Electromechanical systems **and Microfluidics**: MEMS/NEMS: Nanotransducers: Nano-mechanical, electrical, electronic, Magnetic and Chemical Transducers. Nano sensors and Nano Actuators: types of actuators. Microfluidics: Laminar flow, Hagen- Peouiselle equation, basic fluid ideas, Special considerations of flow in small channels, mixing, microvalves & micropumps. Body on a chip and lab on a chip.	
Unit –V	**10Hrs**
Medical Nano Technology: Diagnostics, therapeutics, drug delivery, Nano Surgery and Tissue Engineering. Diagnostics: Nano chips, gene and protein chips. Therapeutic: Drug delivery: Bioavailability, Sustained and targeted release. Benefits of Nano drug delivery system. Use of Microneedles and nanoparticles for targeted and highly controlled drug delivery. Nano robots in drug delivery and cleaning system. Design of nanoparticles for oral delivery of drugs, Tissue Engineering. Nanotoxicity assessment: In-vitro laboratory tests on the interaction of nanoparticles with cells.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Remember, understand and apply knowledge about nanomaterials and their uses. Interpret and apply the techniques of synthesis, manufacturing and characterization processes.
CO2:	Understand and apply knowledge of nanosensors and nanobiosensors applications like electronics, mechanical, chemical, and biological systems
CO3:	Understand the Micro & Nano Electromechanical systems and Microfluidics Interpret and apply the techniques and processes.
CO4:	Apply knowledge of nanobiosensors to create and evaluate nano- design, devices and systems applicable to various medical disciplines.

Reference books	
1	Textbook of Nanosciences and Nanotechnology, B.S. Murty, P. Shankar, B. Raj, B. B. Rath and J. Murday, 2013, Springer (Illustrated) Co-publication with University Press (India) Pvt. Ltd. VCH, XII. ISBN- 978-3-642-28030-6.
2	Springer Handbook of Nanotechnology**,** Editors: Bhushan, Bharat (4th Edition), 2017, Springer, ISBN 978-3-662-54357-3.
3	Nanotechnology and Nanomaterial Applications in Food, Health, and Biomedical Sciences (Innovations in Agricultural & Biological Engineering), Deepak Kumar Verma, Megh R. Goya, Hafiz Anasr Rasul Suleria (1st Edition), 2019, Apple Academic Press, CRC Press, Taylor & Francis Group**,** ISBN-10 1771887648.
4	Nanotechnology Trends and Future Applications, Tahir, Muhammad Bilal, Rafique, Muhammad, Sagir, Muhammad, 2021, Springer, (1st Edition), ISBN 978-981-15-9437-3.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks 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 AND PRACTICE)	**100**

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

Semester: VII						
SUSTAINABLE AND PRECISION AGRICULTURE **Professional Core Elective III – Group G** **(Theory)**						
Course Code	**:**	**21BT73GB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45Hrs**		**SEE Duration**	**:**	**3Hours**

Unit-I	**06 Hrs**
Concept of Sustainable and Precision Agriculture: Sustainable agriculture- Introduction, definition, goal and current concepts, factors affecting sustainable agriculture and its impact on environment. Organic Farming: Concepts and principles of organic farming. Key indicators of sustainable agriculture. Aqua, hydro and aeroponics; Perspective and application	
Unit – II	**10 Hrs**
Understanding and Identifying Variability: soil water and soil nutrient sampling in space and time, Spatial variability. Precision Soil Sampling, Yield Monitoring and Nutrient Spatial Variability. Factors that influence variability in crop production. Land, water and crop production related problems and its management for sustainable agriculture. Pest Measurement and Management.	
Unit –III	**10 Hrs**
Satellite-based Positioning Systems for Precision Agriculture: Global Positioning System (GPS) and Differential Global Positioning Systems (DGPSs) in Precision Agriculture technology; Principles, errors and applications. Differential Correction and Data Transmission. Spatial Data Management Platforms, Intelligent Devices, and Implements. Telematics: ISOBUS Concept and Technology **Geographic Information Systems and Remote Sensing Coordinate System in Precision Agriculture:** IS Data: Vector and Raster Information; Basic Components, Maps and Display, Variable Rate Technology, Remote Sensing Equipment,	
Unit –IV	**10 Hrs**
Plant Phenomics for Precision Agriculture: Principle and mechanism, Image-Based High-Throughput Phenotyping in Crops. Imaging platforms, Imaging techniques; Visible Light Imaging, Thermal Imaging, Hyperspectral Imaging, Fluorescence Imaging, Tomographic Imaging. Challenges and Applications in Phenomics.	
Unit –V	**09 Hrs**
Agriculture 4.0: Future of farming technology; IoT and Future Digital Tools, Artificial Intelligence in agriculture Concept and application, Data collection and preparation. Agricultural Drones & Robotics. FarmBot Network, Sensor technology; real-time information for crop management. computer vision, and intelligent decision-making for smart agriculture. Lean and intelligent online Crop management approach.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	*Recognize* the scientific, social and economic implications in Sustainable and precision agriculture
CO2:	Analyse the perspective of sensing and imaging in technology for the better yield
CO3:	Analyse and interpret precision agriculture data.
CO4:	Evaluate various tools, techniques and advances for better formulation and productivity
CO5	Formulate the proof of concept for sustenance and precision agriculture for global outreach

Reference Books	
1.	Organic Farming for Sustainable Agriculture, Nandwani,Dilip, 2016, Springer publishers, ISBN 978-3- 319-26803-3
2.	Precision Agriculture Basics. D. Kent Shannon David E. ClayNewell R. Kitchen. 2018. John Wiley & Sons, Inc.ISBN:9780891183662
3.	Precision Agriculture Technologies for Food Security and Sustainability. Sherine M. Abd El-Kader, Basma M. Mohammad El-Basioni.2021.IGI Global publisher. ISBN: 978179985000
4.	Precision Agriculture: Technology and Economic Perspectives. **Pedersen**, Søren Marcus, **Lind**, Kim Martin. 2017. Springer International Publishing. ISBN 978-3-319-68713-1

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**) 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						
HUMAN DISEASES **Professional Core Elective III – Group G** **(Theory)**						
Course Code	**:**	**21BT73GC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45Hrs**		**SEE Duration**	**:**	**03 Hours**

Unit-I	**06 Hrs**
Unit 1: Cardiovascular Diseases (CVDs) : Role of cholesterol, triglycerides, and lipoproteins (HDL, LDL) in CVDs, Role of diet and lifestyle factors. Oxidative stress and free radicals in CVDs. Biomarkers: troponins, C-reactive protein (CRP), and homocysteine, Statins and their role in cholesterol biosynthesis inhibition, Antioxidants in reducing oxidative stress **Engineering Applications in CVDs:** Applications of of machine learning in predicting CVD risk	
Unit – II	**10 Hrs**
Cancer Biology and Oncology: Mutations, tumor growth, metastasis, Biochemical pathways of apoptosis and their evasion in cancer cells, Types and stages of cancer, Warburg effect: altered glucose metabolism in cancer cells, Tumor markers: alpha-fetoprotein (AFP), CA-125, PSA, Biochemical principles of chemotherapy and targeted therapy **Engineering Solutions in Cancer** Imaging technologies: MRI, CT, PET scans, Role of nanotechnology in targeted drug delivery, Artificial intelligence in cancer detection and personalized treatment	
Unit –III	**10 Hrs**
Unit 3: Diabetes and Metabolic Disorders: Insulin and glucagon: role in glucose and lipid metabolism, Glycolysis, gluconeogenesis, and glycogen metabolism in diabetes, Biochemical basis of hyperglycemia and insulin resistance, HbA1c and other biochemical tests for diabetes monitoring, mechanism of action: metformin and insulin analogs, Role of diet, exercise, and genetics **Engineering Applications in Diabetes Management:** Glucose monitoring devices: glucometers, continuous glucose monitors, Insulin delivery systems: insulin pumps and artificial pancreas, Telemedicine and mobile apps for diabetes self-management	
Unit –IV	**10 Hrs**
Chronic Respiratory Diseases : Gas exchange and role of hemoglobin in oxygen transport, Acid-base balance and respiratory acidosis/alkalosis, Role of oxidative stress and inflammatory mediators (e.g., cytokines) in asthma and COPD, Biomarkers: nitric oxide (NO), inflammatory markers in exhaled air. **Engineering Solutions in Respiratory Care:** Wearable technology and sensors for respiratory health	
Unit –V	**09 Hrs**
Infectious Diseases and Public Health Engineering: Types of pathogens: viruses, bacteria, fungi, and parasites, Transmission routes and immune response **Case Studies of Major Infectious Diseases** - HIV/AIDS, tuberculosis, COVID-19, malaria, Control and prevention strategies **Technological and Engineering Applications in Infectious Diseases:** Diagnostics: PCR, ELISA, rapid testing technologies, Public health surveillance and data analytics in disease outbreak management, Vaccination technology and innovations in preventive measures	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the etiological factors of diseases
CO2	Apply the knowledge of various principles of pathophysiology of diseases
CO3	Illustrate techniques of diagnosis for various human diseases
CO4	Discuss the causes and therapeutics of various diseases

Reference Books	
2.	Ian Penman, Stuart H. Ralston, Mark Strachan, Richard Hobson, Davidson's Principles and practice of medicine, 24th edition, Elsevier, 2022, ISBN-13 : 978-0702083488
2.	Park and Park, Textbook of Preventive and Social Medicine, 4th Edition, Jaypee Brothers, 2013, ISBN: 978-93-5090-187-8.
3.	Harsh Mohan, Textbook of Pathology, 6th Edition, Jaypee Brothers Medical Publishers., 2013, ISBN:978-81-8448-702-2.
4.	John Firth, Timothy Cox, Christopher Conlon, Oxford Textbook of Medicine, 6th Edition, Oxford University Press, 2020, ISBN-13 : 978-0198853435

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						
NEXT GENERATION SEQUENCING INFORMATICS **Professional Core Elective III – Group G** **(Theory)**						
Course Code	**:**	**21BT73GD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**7 Hrs**
Introduction to next generation sequencing: 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 – II	**8 Hrs**
Tools and Techniques in NGS: Burrows-Wheeler Aligner (BWA) and Bowtie Alignment programs, burrows wheeler algorithm. Reference indexing and Alignment. Building from source, The bowtie aligner, The -n alignment mode, The -v alignment mode, Reporting Modes, Paired- end Alignment, Color space Alignment, Color space reads, Building a color space index, Decoding color space alignments, Paired-end color space alignment, Performance Tuning, SAM and BAM format. Artifacts in alignment programs	
Unit –III	**9 Hrs**
Multi-omics approaches: MicroRNA Expression Profiling and Discovery, Analysis of Metagenomic Data with real time applications. Spatial transcriptomics: This technique combines NGS with spatial information to map gene expression across a tissue sample. Gene expression analysis, Proteomics analytics, Single cell RNA-seq	
Unit –IV	**8 Hrs**
Exome sequencing: Exome sequencing as a discovery and a diagnostic tool, Challenges of NGS based molecular diagnostics, NGS-Based Clinical Diagnosis of Genetically Heterogeneous Disorders, Molecular Diagnosis of Congenital Disorders of Glycosylation (CDG), NGS improves the Diagnosis of X-Linked Intellectual Disability (XLID), NGS Analysis of Heterogeneous Retinitis Pigmentosa.	
Unit –V	**7 Hrs**
Role of HPC and big data analysis: Handling Big Data, The use of next-generation sequencing for solving diagnostic dilemmas, Methods used in patient populations to uncover associations between genome variation and common diseases, Predictive tests for common, complex diseases.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental concepts of properties and representation of graphs, different measures of statistical distribution using central moments.
CO2:	Solve the problems involving characterization and operations on graphs, fitting of a curve for the given data and functions of random variables.
CO3:	Apply the acquired knowledge to solve the problems on different types of graphs, correlation, regression and measures of probability distributions.
CO4:	Evaluate the solutions of application problems in graph theory and probability distributions.

Reference Books	
1	Graph-Based Modelling in Science, Technology and Art, Stanisław Zawiślak and Jacek Rysiński ED., 2021, Springer International Publishing, Vol 107, ISBN: 978-3- 030-767877
2	Next Generation Sequencing and Data Analysis, Kappelmann-Fenzl**,** Melanie ED., 2021, Springer International Publishing, ISBN 978-3-030-62490-3
3	Introduction to Next Generation Sequencing Technologies, Lloyd Low and Martti T. Tammi ED., 2021,Bioinformatics, ISBN 978-981-3144-74-3
4	Probability: Statistics for Engineers; Scientists, Ronald E. Walpole Raymo, nd H. Myers, ED., 2016, Pearson Education, ISBN-13: 978-0134115856. .

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: VI						
FORENSIC SCIENCES **Category: Professional Core Elective -IV (Group H)** **(Theory)**						
Course Code	**:**	**21BT74HA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Introduction: Introduction to Forensics, Definition and scopes of forensics, History and chronology of the events in forensics, and important milestones in the forensics, importance and significance of court in forensics; procedure and protocol: Inquest and medical examiners systems, powers of courts, documentary evidences and witness, (Doctors guide to court), application of the forensics: Forensic anthropology, Forensic entomology, Forensic psychiatry, Forensic odontology. Forensic pathology: Rigor mortis, livor mortis, algor mortis.	
Unit – II	**08 Hrs**
Crime Lab and Crime Scene Analysis: Organization of crime lab at various levels in India (Center and State), facilities offered by various laboratories. Services of the crime lab, basic services of the crime lab, optional services. **Dactyloscopy**- Definition, various events and its significance, fingerprints its classification and patterns (concept of LAW). Crime scene- Identification (Race, Sex, Age), methodical search for evidence. Analysis of the physical evidences- definition, importance and source of evidence, type, collection and preservation, expert unit men, handling, package and sealing of physical evidence,	
Unit –III	**08 Hrs**
Crime Scene Evidence Classification of crime scene evidence – physical and trace evidence. Locard principle. Collection, labeling, sealing of evidence. Hazardous evidence. Preservation of evidence. Chain of custody. Reconstruction of crime scene. **Forensic Physics:** Glass evidence – collection, packaging, analysis. Paint evidence – collection, packaging and preservation. Fibre evidence – artificial and man-made fibres. Collection of fibre evidence. Identification and comparison of fibres. Soil evidence – importance, location, collection and comparison of soil samples. **Cyber forensics**: Fundamentals and application	
Unit –IV	**08 Hrs**
Crime Scene Management: Types of crime scenes – indoor and outdoor. Securing and isolating the crime scene. Crime scene search methods. Safety measures at crime scenes. Legal considerations at crime scenes. Documentation of crime scenes – photography, videography, sketching and recording notes. Duties of first responders at crime scenes. Coordination between police personnel and forensic scientists at crime scenes. The evaluation of 5Ws (who?, what?, when?, where?, why?) and 1H (how?). Crime scene logs. Toolmark evidence. Classification of toolmarks. Forensic importance of toolmarks. Collection, preservation and matching of toolmarks. Restoration of erased serial numbers and engraved marks.Forensic gemmology. FRYE standard and DAUBERT criteria.	
Unit –V	**07 Hrs**
Toxicology and ethics in Forensic Science: Forensic toxicology, General Materials, Custodial Deaths, General Toxicology, Corrosive Poisons, Vegetable Alkaloid Poisons, Irritant Poisons, Non–Metallic& Metallic poisons, Inebriant Poisons Irrespirable Gases, Drug & Insecticides, Food Poisoning. Science and professional ethics: significance and limitations, code of conduct and code of ethics for forensics and their application, ethical requirement, ethical dilemmas and their resolutions.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the food components in detail for the healthier society
CO2	Analyse the various food preservation techniques and its effect.
CO3	Apply the techniques learnt for milk analysis and its preservation
CO4	Evaluate the milk processing and food packaging techniques

Reference Books	
1	Criminalistics: An Introduction to Forensic Science; R Saferstein; 2007, Prentice Hall; 9st ed;. ISBN: 0-13-221655-8
2	Forensic Science in Crime Investigation, B.S.Nabar; 2002 Asia Law House; 3rd edition;;ISBN: 81861969944
3	The essentials of Forensic Medicine and Toxicology; K.S.Narayana Reddy; 2004;Chand & Sons, 23rd edition; ISBN: 8139427131
4	Forensic science : from the crime scene to the crime lab, Saferstein, Richard, 2009, Prentice Hall; 2nd ed., ISBN 0-13-139187-9 (978-0-13-139187-1)

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 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 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						
METABOLITES AND BIOPROSPECTING **Category: Professional Core Elective -IV (Group H)** **(Theory)**						
Course Code	**:**	**21BT74HB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**8 Hrs**
Introduction of Bioprospecting: Basics of Bioprospecting, Potential value of Bioprospecting. status of bioprospecting in India. Approaches to Bioprospecting-: Random search and Algorithm based search (Using indigenous knowledge, Ecological based knowledge, Evolutionary based knowledge) Phylogenetic approach. **Bioprospecting for known and unknown metabolites**-Case studies. **Databases and drug discovery**-NAPRALERT, NCI and CDRI databases.	
Unit – II	**8 Hrs**
Biosynthesis of secondary metabolites and metabolic engineering: secondary metabolite pathways, rate limiting steps. **Over-expression systems**: Bioprospecting for genes involved in the production of bioactive compounds, case studies. GIS based technology to predict species distribution for bioprospecting.	
Unit –III	**8 Hrs**
Strategic plans for bioprospecting with reference to global scenario: Laboratory tools and techniques in bioprospecting., Bioassays. **Chemical profiling**: Chromatographic techniques, molecular characterization using molecular markers. Molecular markers in bioprospecting for known metabolites, microsatellites, AFLP, SNP's etc. *In-vivo* and *in-vitro* protocols for multiplication and production of economically important metabolites-hairy roots, suspension cultures, micropropogation etc.	
Unit –IV	**8 Hrs**
Valuation of biodiversity hotspots for bioprospecting: Bioprospecting, Creating a Value for Biodiversity. Western Ghats, Eastern Himalayas. Valuation techniques. Potential for bioprospecting in India. **Medicinal plant diversity:** indigenous knowledge, human resource. Traditional Knowledge and practice and its role in bioprospecting.	
Unit –V	**7 Hrs**
Bioprospecting of natural bioactive compounds: Natural products from Marine world. Microbial natural products. Bioprospecting of plant-associated microbiomes, Bioprospecting of metagenomes. Role of industry, academic institution collaboration in accelerating research in bioprospecting. IPR issue and trade related issue in Bioprospecting.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the fundamental concepts of Potential value of Bio prospecting, platforms and databases..
CO2:	Analyse the bio prospecting of genes for overexpression studies and for enhancement of metabolites
CO3:	Apply the acquired knowledge to strategize bio prospecting in global scenario and the techniques involved to characterization and understand the IPR and trade related issues
CO4:	Evaluate the hotspots for bioprospecting of natural products

Reference Books	
1	Bioprospecting Success, potential and constraints. Russell Paterson, Nelson Lima., 2017, Springer International Publishing., ISBN – 978-3-319-47935-4
2	Bioprospecting in Life Sciences. Rajendra Kumar Behara , Ekamber Kariali.2019.Narosa publishers. ISBN-9788184876512
3	Plant Metabolites: Methods, Applications and Prospects. Swapna Thacheril, Sukumaran, Shiburaj Sugathan, Sabu Abdulhameed.2020. Springer; ISBN-978- 9811551352

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 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						
NON-CONVENTIONAL ENERGY RESOURCES **Category: Professional Core Elective -IV (Group H)** **(Theory)**						
Course Code	**:**	**21BT74HC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39 Hrs**		**SEE Duration**	**:**	**3Hours**

Unit-I	**7 Hrs**
Introduction to Energy Sources: Energy sources and their availability, non-conventional sources, advantages of renewable energy sources, prospects of renewable energy sources. World Energy Status, Energy Scenario in India, Energy use & efficiency, biofuel production, biofuel feedstocks - starch, sugar, lignocellulosic, agro & Industrial by-products.	
Unit – II	**8 Hrs**
Solar Energy: Solar energy collectors – flat plate collectors and concentrating collectors, applications of solar energy – solar water heating, solar distillation, solar cooking. **Wind Energy:** Basic principles of wind energy conversion, basic components of Wind Energy Conversion System (WECS) , applications of wind energy. **Geothermal Energy:** Origin and distribution of geothermal energy, Types of Geothermal Resource, Tidal Energy, Wave Energy, applications of geothermal energy.	
Unit –III	**8 Hrs**
Energy from Biomass: Biomass conversion technologies, biogas generation, factors affecting biogas generation, classification of biogas plants – floating drum plants and fixed dome plants, selection of site for biogas plant, utilization of biogas, methods for obtaining energy from biomass, biomass gasification, classification of biomass gasifiers, applications of gasifiers, advantages and limitations of gasifiers,	
Unit –IV	**7 Hrs**
Green Energy: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies, hydrogen energy storage, applications of hydrogen energy, sources and benefits of hydrogen energy.	
Unit –V	**9 Hrs**
Nonconventional Fuels: Bioethanol production using sugar – feedstocks, selection of micro-organisms, associated unit operations, determination of bioethanol yield, recovery of bioethanol, quality control aspects and properties of fuel standard bioethanol. Biodiesel production – transesterification and supercritical esterification, saponification and hydrolysis, acid & base catalysis. Sources of oils. Methods of biodiesel production – general procedure and large-scale production, quality control aspects, properties of fuel standard biodiesel, PLA and PHB,	

Course Outcomes: After completing the course, the students will be able to :-	
CO1	Discuss non-conventional sources of energy and explain their working applications
CO2	Understand the concept of biomass energy resources and green energy
CO3	Acquire the basic knowledge of non-conventional energy resources
CO4	Explain the working principle of different fuel cells and energy conversion systems
Reference Books	
3.	Renewable Energy Resources and Emerging Technologies, D.P. Kothari, R. Rakesh and K.C. Singal, 2011, Prentice India Pvt. Ltd, 2nd edition,ISBN: 9788120344709
2.	Non-Conventional Energy Sources, G.S. Sawhney, 2012, Prentice India Pvt. Ltd, 2nd edition, ISBN : 8120346092
3.	Biofuels – Methods and Protocols (Methods in Molecular Biology Series), Jonathan R.M, 2012, Humana Press, New York, 2nd edition,ISBN: 1617796476.
4.	Biofuels Engineering Process Technology, Caye M. Drapcho, N.P. Nhuan and T. H. Walker, 2020, Mc Graw Hill Publishers, New York, 2nd edition, ISBN: 9781259585722.

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				
GENOMICS AND PROTEOMICS **Category: Professional Core Elective -IV (Group H)** **(Theory)**				
Course Code:	**21BT74HD**		**CIE Marks:**	**100**
Credits: L:T:P	**3:0:0**		**SEE Marks:**	**100**
Hours:	**42 L**		**SEE Duration:**	**3 Hrs**

UNIT-I	**08 Hrs**
Introduction: Eukaryotic genes and Polymorphisms: Organization of eukaryotic (microbial, plant and animal genomes) within nucleus, transcription, post transcriptional modification, translation, post translational modification and Inheritance pattern. Mitochondrial and chloroplast genome. Polymorphism. C-Values of eukaryotic genomes.	
UNIT II	**08 Hrs**
Sequencing and genome projects: Early sequencing efforts, Methods of preparing genomic DNA for sequencing, **Sequencing strategies**: shot-gun approach, clone contig approach, **DNA sequencing methods:** Gilbert and Maxim, Sanger Dideoxy method, Fluorescence method, Highthroughput sequencing. **Major genome sequencing projects:** *E.coli*, *Saccharomyces cerevicea*, rice, *Arabidopsis thaliana*, *Drosophila melanogaster*, *Caenorhabditis spp* for human disease and drug targets.	
UNIT III	**09 Hrs**
Genomics: Expressed sequenced tags (ESTs) - Human disease & drug targets. Gene variation & Single Nucleotide Polymorphisms (SNPs) - drug discovery, disease association, diagnostic genes, comparative genomics. **Functional genomics:** Finding genes in the genome, assigning functions to the gene. **Genotyping** – DNA chips and diagnostics assays, RT-PCR, SAGE & DD-PCR. Importance of non coding sequences – miRNA and RNAi. Molecular markers	
UNIT IV	**09 Hrs**
Proteomics: Methods of protein isolation, purification and quantification, protein separation in 2-DE, staining of 2DE gels, Image analysis of 2DE gels, **Protein – proteininteractions:**C0- Immuno precipitation, Y2H and its variants, protein chip interaction detection techniques, Applications of proteome analysis to drug development. Mass spectrometry in protein analysis: ionization sources, mass analyzers, different types of mass spectrometers	
UNIT V	**08 Hrs**
Quantitative proteomics - Stable isotope labelling by amino acids in cell culture (SILAC), isotope-coded affinity tag (ICAT), isobaric tagging for relative and absolute quantitation (iTRAQ); immunoprecipitation, protein microarrays, Label-free nanotechnologies in proteomics. Modificomics: understanding post-translational modifications; Structural proteomics; Bioinformatics in proteomics.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and remember the concepts of various genes and their expression.
CO2:	Apply various large-scale sequencing methods for sequencing various organisms' genome.
CO3:	Acquire and evaluate the methods involved in analysis of genome and proteome.
CO4:	Develop or create a diagnostic tool for plant, animal and human diseases.

Reference Books	
1.	Principals of Genomics and Proteomics, Rakeeb Ahmad Mir, Sheikh Mansoor Shafi, Sajad Majeed Zargar 1st edition,2023, Elsevier, ISBN: 9780323990455
2.	Genomics and Proteomics: Principles, Technologies, and Application Devarajan Thangadurai and Jeyabalan Sangeetha, 1st Edn, 2021, Apple Academic Press, ISBN 9781774635377.
3.	Introduction To Genomics, 2Nd Edn by Lesk, Oxford University Press, 2015, Paperback, 9780198745891
4.	Genome analysis and Genomics- S.B Primrose and R M Tayman, 3rd Ed.,2002 Wiley- Blackwell ISBN: 978-1-4051-0120.

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						
UNMANNED AERIAL VEHICLES **Category: Institutional Electives-II (Group 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
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
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
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
Payloads for UAVs: Barometers, Accelerometer, Magnetometer, RADAR and range finder, Non-dispensable and dispensable Payloads- Optical, electrical, weapon, imaging payloads.
Unit –V
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 Electives-II (Group 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 Electives-II (Group 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	
	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 (2021 Scheme)						
ADVANCES IN CORROSION SCIENCE AND MANAGEMENT **Category: Institutional Electives-II (Group I)** **(Theory)**						
Course Code	**:**	21CM75ID		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	42		**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

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

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

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

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

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.

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	1
CO2	2	3	2	2	2	-	-	-	-	1	-	1
CO3	3	3	2	1	-	-	-	-	-	1	-	1
CO4	3	3	3	3	2	-	-	-	-	1	-	1

High-3: Medium-2: Low-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**) 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						
Prompt Engineering **Category: Institutional Electives-II (Group 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 modelsto achieve desired outputs
3	Analyse and assess the performance of different promptsto improve the quality and reliability of AI-generated outputs.
4	Apply prompt engineering techniques to solve real-world problems in various domains

Unit-I

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

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

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

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

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

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

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

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

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

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

Semester: VII						
SPACE TECHNOLOGY AND APPLICATIONS **Category: Institutional Electives-II (Group 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.	

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

ReferenceBooks	
1.	Atmosphere,weather and climate, RGBarry, Routledge publications,2009,ISBN- 10:0415465702.
2.	FundamentalsofSatelliteCommunication,KNRajaRao,PHI,2012,ISBN:
3.	SatelliteCommunication,Timothypratt,JohnWiley,1986ISBN: 978-0-471-37007 -9, ISBN10: 047137007X.
4	Remotesensingandapplications, B C Panda, VIVAbooksPvt.Ltd.,2009, ISBN: 108176496308.

RUBRICFORTHECONTINUOUSINTERNALEVALUATION(THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode.**TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10Marks. 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 beconducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINALTESTMARKS WILLBEREDUCEDTO40 MARKS.**	**40**
3.	**EXPERIENTIALLEARNING:** Studentswillbeevaluatedfortheir creativity and practical implementation of the problem. Case study based teachinglearning (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) ADDING UP TO 40 MARKS**.	**40**
	MAXIMUM MARKS FORTHE CIE THEORY	**100**

RUBRICFORSEMESTERENDEXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PARTA	
1	Objectivetypeofquestionscovering theentiresyllabus	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**

Semester: VII						
MOBILE APPLICATION DEVELOPMENT **Category: Institutional Electives-II (Group 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 Electives-II (Group 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	
	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 Electives-II (Group 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 Electives-II (Group I)** **(Theory)**						
Course Code	**:**	**21ME75IO**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45**		**SEE Duration**	**:**	**3 Hours**

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

Unit-I	**09 hrs**

Introduction to Nuclear Engineering

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

Unit-2	**10 hrs**

Nuclear Reactors

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

Unit - 3	**10 hrs**

Nuclear Fuel Cycle

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

Unit-4	**08 hrs**

Radiation Protection and Safety:

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

Unit-5	**08 hrs**

Environmental and Societal Aspects

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

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

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). 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**

COGNITIVE PSYCHOLOGY Category: Institutional Electives-II (Group I) (Theory)						
CourseCode	**:**	21HS75IQ		**CIE**	**:**	100
Credits:L:T:P	**:**	03		**SEE**	**:**	100
TotalHours	**:**	42Hrs		**SEEDuration**	**:**	3Hours

Unit-I	**08Hrs**
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	**08Hrs**
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	**08Hrs**
Reasoning, Creativity and Problem-Solving: Reasoning definition, types, influencing factors. Creativity- definition, steps involved in creative process, obstacles involved in creativity, enhancing techniques of creativity. Meta cognition: Problem-solving, steps in problem solving, types, methods, obstacles and aids of problem Solving.	
Unit–IV	**08Hrs**
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	**08Hrs**
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.	

CourseOutcomes:Aftercompletingthecourse,thestudentswillbeableto:-	
CO1	Describe the basic theories, principles, and concepts of cognitive psychology as they relate to behaviours and mental processes.
CO2	Apply 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.	Sternberg R.J and Sternberg Karin(2012) Cognitive Psychology 6th Edition Woods worth Cengage Learning
2.	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.
3.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
4.	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India

RUBRICFORTHECONTINUOUSINTERNALEVALUATION(THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:**Quizzeswillbeconductedinonline/offlinemode.TWOQUIZZESwillbe conducted&EachQuizwillbeevaluatedfor10Marks.**THESUMOFTWO QUIZZESWILLBETHEFINALQUIZMARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexitylevels(RevisedBloom'sTaxonomyLevels:Remembering,Understanding, Applying,Analyzing,Evaluating,andCreating).THREEtestswillbeconducted.Each testwillbeevaluatedfor50Marks,addingupto150Marks.**FINALTESTMARKS WILLBEREDUCEDTO40MARKS.**	**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)**ADDINGUPTO40MARKS**.	**40**
	MAXIMUMMARKSFORTHECIETHEORY	**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) * (Small case lets and 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						
PRINCIPLES AND PRACTICES OF CYBER LAW **Category: Institutional Electives-II (Group I)** **(Theory)**						
Course Code	**:**	21HS75IR		**CIE**	**:**	100
Credits: L:T:P	**:**	03		**SEE**	**:**	100
Total Hours	**:**	03		**SEE Duration**	**:**	3 Hours

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

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

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	20
	PART B (Maximum of TWO Sub-divisions only) * (Small case lets and 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						
SUMMER INTERNSHIP						
Course Code	**:**	**21BT76I**		**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	**:**	**21BT77P**		**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	**:**	**21BT81P**		**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:

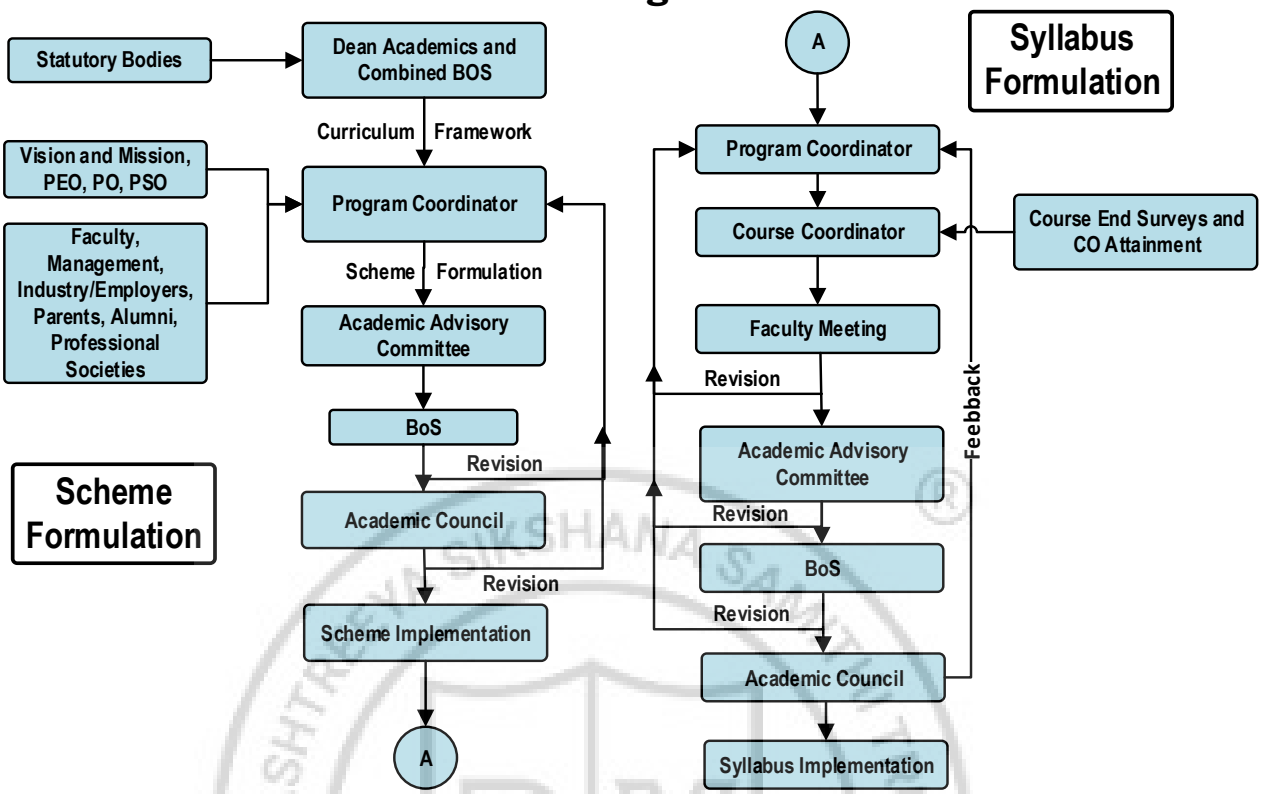
Week	Event
Beginning of 7th Semester	Formation of group and approval by the department committee.
7th Semester	Problem selection and literature survey
Last two weeks of 7th Semester	Finalization of project and guide allotment
II Week of 8th Semester	Synopsis submission and preliminary seminar
III Week	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.

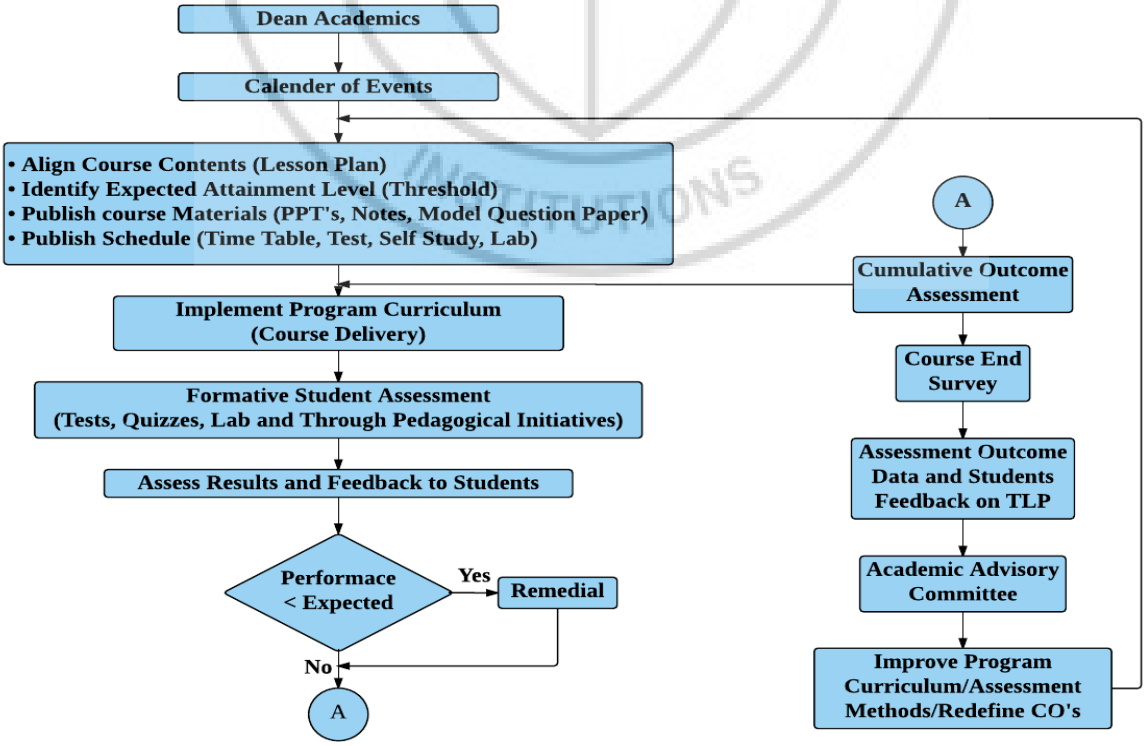
Evaluation & Scheme for CIE and SEE

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

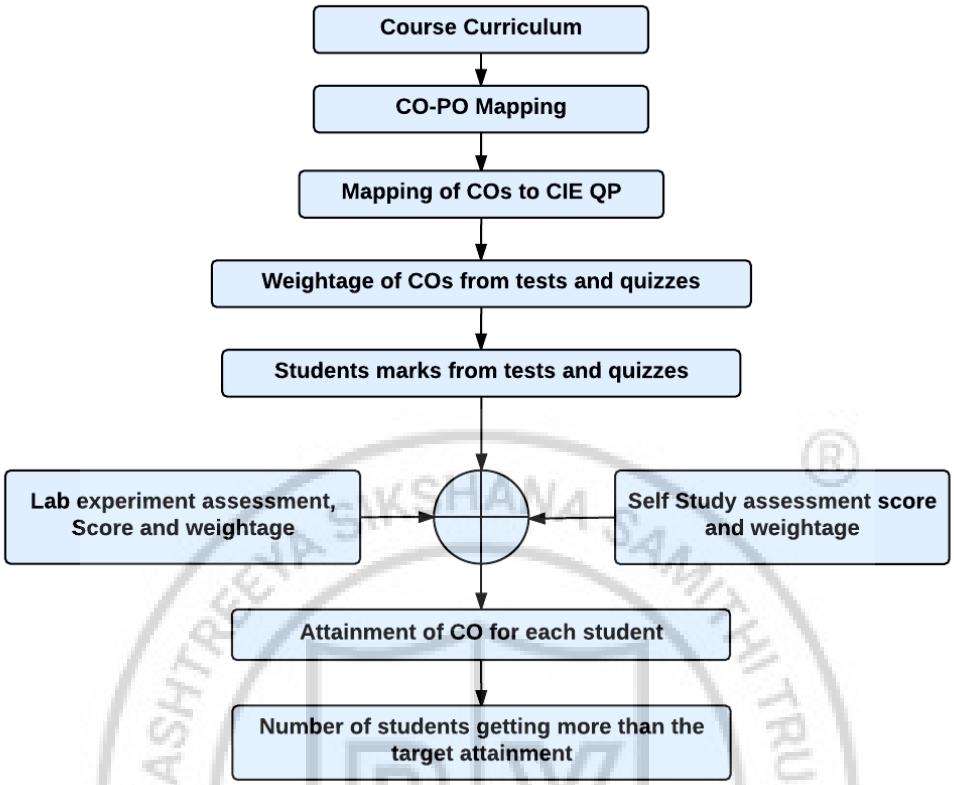
Curriculum Design Process



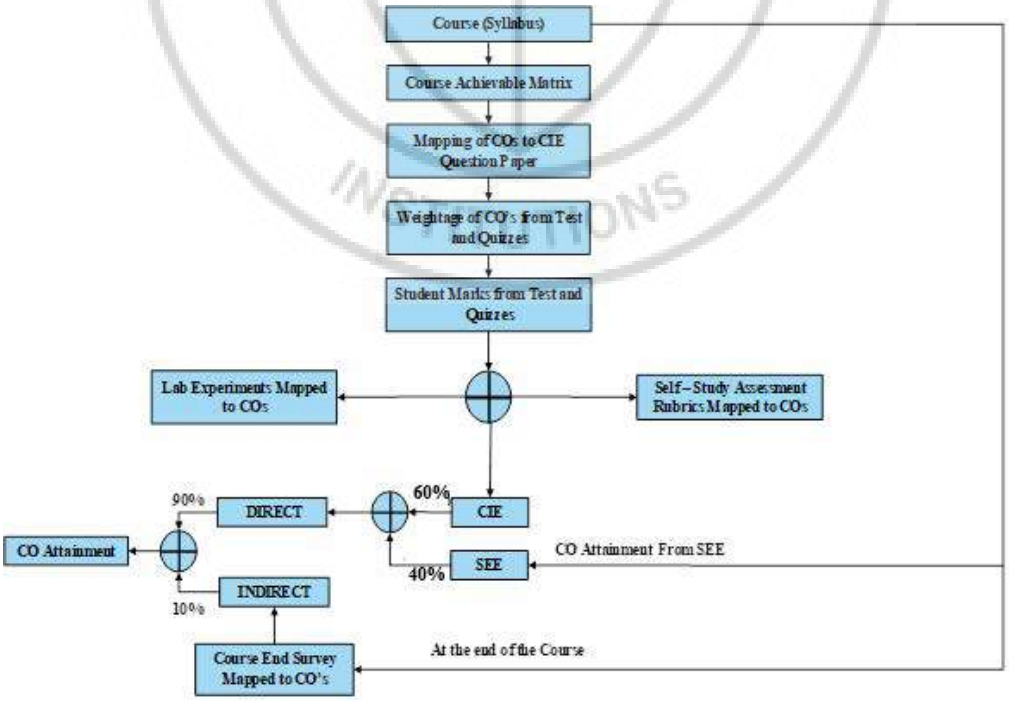
Academic Planning and Implementation



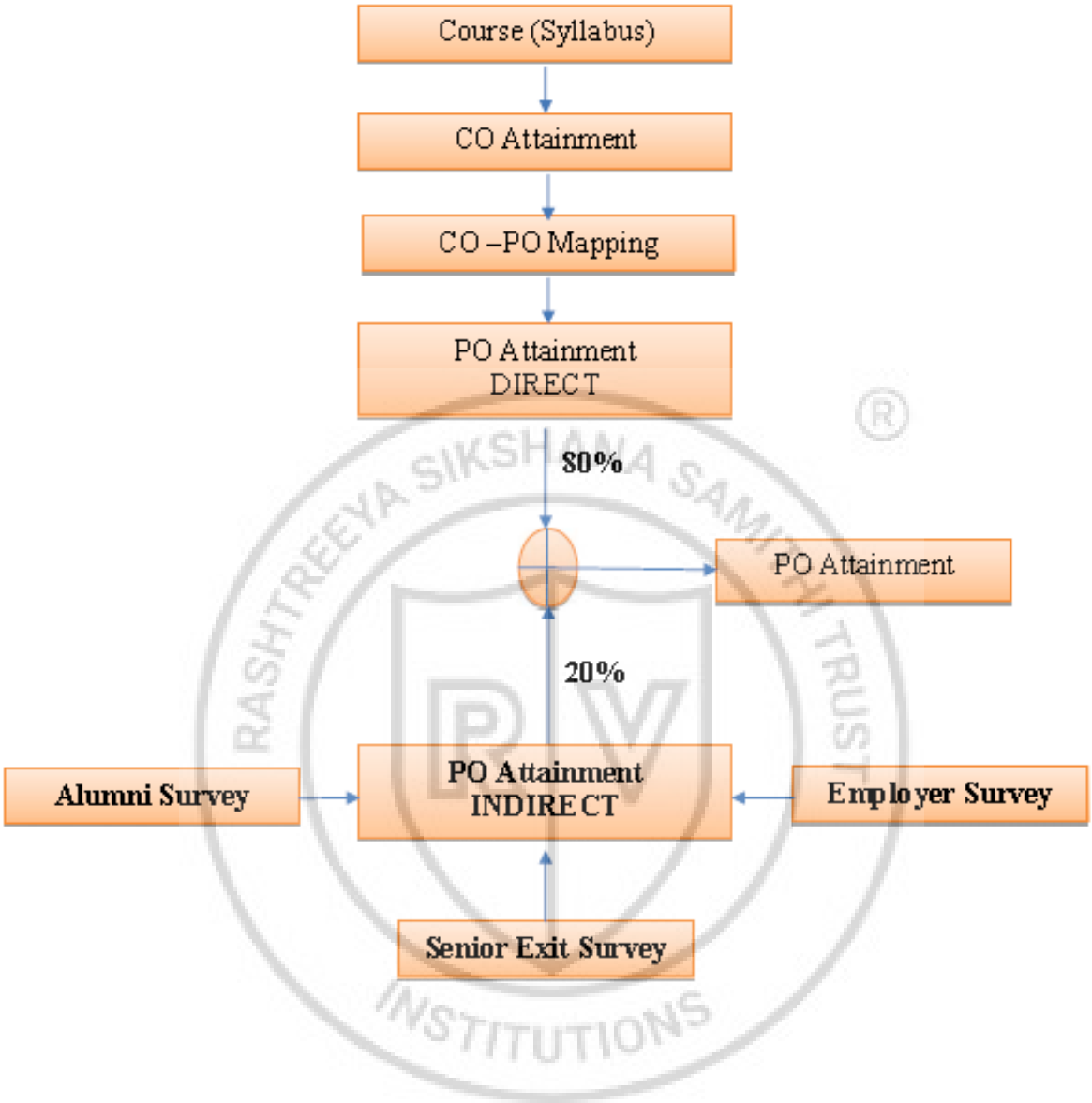
Process For Course Outcome Attainment



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