



**RV College of
Engineering®**



Artificial Intelligence & Machine Learning

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-IQUAGE
DIAMOND UNIVERSITY
RATING (2021-2024)

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

11
Skill Based
Laboratories
Across Four Semesters

61
Published Patents

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.

MOUS: 90+ WITH
INDUSTRIES / 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 OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

DEPARTMENT VISION

To develop sustainable solutions for the greater good of society, through quality engineering education in Artificial Intelligence and Machine Learning, with innovation, research, and consultancy activities.

DEPARTMENT MISSION

- To impart cutting-edge knowledge and skills in Artificial Intelligence and Machine Learning with a foundation in Computer Science and Engineering.
- To promote innovative research and development in Artificial Intelligence and Machine Learning and its allied fields in collaboration with industries.
- To prepare the students for solving real-world problems by imparting engineering skills through experiential learning mode.
- To provide a pleasant environment in pursuit of excellence by keeping high personal and professional values and ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop graduates capable of applying the principles of Mathematics, Science, core Computer Science Engineering with Artificial Intelligence, and Machine learning knowledge to solve real-world interdisciplinary problems.

PEO2: To develop the ability among graduates to analyse and understand the state-of-the-art technologies and industrial practices in the Artificial Intelligence and Machine-learning domain through experiential learning.

PEO3: Develop graduates who will exhibit cultural awareness, teamwork with professional ethics, and practical communication skills with an inspiration to understand the social and economic impact of Artificial Intelligence and Machine learning in the foreseeable future.

PEO4: Prepare employable graduates for the right roles in industries / to become entrepreneurs to achieve higher career goals or take up higher education to pursue lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Problem Solving and Analysis

The student will be able to:

1. Appreciate the importance of Mathematics, Electronics and Sensors, Data organization and Algorithms, Design thinking, and Software Engineering principles in building Intelligent Computational Systems.
2. Learn the applicability of Artificial Intelligence and Machine learning algorithms to solve real-world problems.
3. Identify the need for Deep learning, Computer vision, and Natural language processing to develop intelligent software products focusing on application performance.
4. Display team participation, good communication, project management, and documentation skills.

PSO2: Experiential Learning

The student will be able to:

1. Demonstrate the application of knowledge to develop intelligent software programs for various use case scenarios in industrial sectors like healthcare, agriculture, education and skilling, governance, energy, automotive, infrastructure, banking and finance, and manufacturing.
2. Participate in planning and developing enterprise-level solutions with cutting-edge technologies, displaying group dynamics and professional ethics.
3. Employ experiential learning throughout the program to enrich the practical aspects to reach state-of-the-art in the domain



ABBREVIATIONS

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



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VII SEMESTER COURSES			
Sl. No.	Course Code	Name of the Course	Page No.
1.	21HS71	Constitution of India and Professional Ethics	1
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3.	21AI73GX	Professional Core Elective-III – Group- G	5-12
4.	21XX74HX	Professional Core Elective-IV– Group – H	13-20
5.	21XX75IX	Institutional Electives – II - Group I	21-52
6.	21AI76I	Summer Internship-III	53
7.	21AI77P	Minor Project	55
VIII SEMESTER			
1.	21AI81P	Major Project	57



Bachelor of Engineering in ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING 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	21AI72	Stream Processing and Analytics (Theory & Practice)	3	0	1	4	AI	Theory + Lab	100	50	3	100	50
3	21AI73GX	Professional Core Elective-III – Group - G	3	0	0	3	AI	Theory	100	***	3	100	***
4	21XX74HX	Professional Core Elective-IV– Group - H	3	0	0	3	Resp. Board	Theory	100	***	3	100	***
5	21XX75IX	Institutional Electives – II Group – I	3	0	0	3	Resp. Board	Theory	100	***	3	100	***
6	21AI76I	Summer Internship-III	0	0	2	2	AI	Internship	***	50	2	***	50
7	21AI77P	Minor Project	0	0	2	2	AI	Project	***	50	3	***	50
		Total				20							



Professional Core Elective-III			
Group - G			
Sl. No.	COURSE CODE	COURSE TITLE	CREDITS
1	21AI73GA	Artificial Intelligence in Autonomous Vehicles	03
2	21AI73GB	Hardware Architectures for Artificial Intelligence	03
3	21AI73GC	Fuzzy Logic in Artificial Intelligence	03
4	21AI73GD	Ethical Artificial Intelligence	03

Professional Core Elective-IV			
Group - H			
Sl. No.	Course Code	Course Title	CREDITS
1	21AI74HA	Generative Artificial Intelligence (Common to AI ,CS,IS)	03
2	21CS74HB	Intelligent Software Defined Networks (Common to AI, CS ,IS)	03
3	21CS74HC	Robotics Process Automation (Common to CS ,IS,AI)	03
4	21AI74HD	Artificial Intelligence Product Management	03



**INSTITUTIONAL ELECTIVES - II
GROUP - I**

Sl. No.	Course Code	Course Title	Credits
1	21AS75IA	Unmanned Aerial Vehicles	03
2	21BT75IB	Healthcare Analytics	03
3	21CH75IC	Sustainability and Life Cycle Analysis	03
4	21CM75ID	Advances in Corrosion Science and Management	03
5	21CS75IE	Prompt Engineering	03
6	21CV75IF	Integrated Health Monitoring of Structures	03
7	21EC75IG	Wearable Electronics	03
8	21EE75IH	E-Mobility	03
9	21XEI75IJ	Programmable Logic Controllers and applications	03
10	21ET75IK	Space Technology and Applications	03
11	21IS75IL	Mobile Applications Development	03
12	21IM75IM	Project Management	03
13	21IM75IN	Supply Chain Analytics	03
14	21ME75IO	Nuclear Engineering	03
15	21HS75IQ	Cognitive Psychology	03
16	21HS75IR	Principle and Practices of Cyber Law	03



RV College of Engineering®

Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world®

Bachelor of Engineering in ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING 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	21AI81P	Major Project	0	0	12	12	AI	Lab	***	50	3	***	50



Semester: VII					
CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS					
Category: Professional Core Course					
(Common to All Branches)					
(Theory)					
Course Code	:	21HS71	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	39T	SEE Duration	:	3.00 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- V					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	Demonstrate the citizen's fundamental Rights, duties & consumer responsibility capability and to take affirmative action as a responsible citizen.
CO2	Identify the conflict management in legal perspective and judicial systems pertaining to professional environment, strengthen the ability to contribute to the resolve of human rights & Ragging issues and problems through investigative and analytical skills.
CO3	Understanding process of ethical and moral analysis in decision making scenarios and inculcate ethical behavior as a trait for professional development
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, 2020 edition
2.	V.N. Shukla's Constitution of India by Prof (Dr.) Mahendra Pal Singh (Revised) Edition: 13th 2017, Reprinted with Supplement 2021
3.	Avtar Singh: Law of Consumer Protection: Principles and Practice, Eastern Book Company, 5 th Edition, 2015, ISBN -13:978-9351452461
4.	S.C. Srivastava: Industrial Relation and Labour Laws, Vikas Publishing House, 6th Edition, 2012, ISBN: 9789325955400



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 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			
STREAM PROCESSING AND ANALYTICS			
Category: Professional Core Course			
(Theory and Practice)			
Course Code	:	21AI72	CIE : 100+50 Marks
Credits: L: T: P	:	3:0:1	SEE : 100+50 Marks
Total Hours	:	45L+30P	SEE Duration : 3.00 Hours

Unit-I	9Hrs.
Introducing Streaming Data: What is Real time system – Differences between real time and streaming systems – architectural blue print – security for streaming systems – scaling	
Data Ingestion: Common Interaction patterns – scaling the interaction patterns – Faulty tolerance	
Unit – II	9Hrs.
Data Transportation: Message queue – Core concepts – security – application of core concepts to business logic	
Analysing Streaming Data: Inflight data analysis – Distributed stream processing architecture – key features of stream processing frame work	
Unit –III	9Hrs.
Algorithms for Data Analysis: Accepting constraints and relaxing – Thinking about time – Summarization Technique	
Storing the analyzed or collected data: Long time storage – keeping it in memory	
Unit –IV	9Hrs.
Making data available: Communication Patterns – Protocols – Filtering the stream	
Introduction to Kafka: Why Kafka – Kafka Eco System – Kafka Origin - Kafka Producers and Consumers	
Unit –V	9Hrs
Building Data Pipe lines – When to use pipe lines – when to use kafka connect vs producer and consumer	
Kafka Streams – Stream Processing design patterns - Architecture over view – How to choose Stream processing framework - Kafka streams by example – word count – stock market statistics – click stream enrichment	

Lab Component
Group of two students of same batch are required to build an application using stream processing tools for various real time applications like (i) Real time Sentiment Analysis (ii) Stock Market analysis (iii) Click stream enrichment (iv) In-flight analysis (v) video stream processing etc

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Analyze the need and the application of real time and stream processing in real world applications.
CO2	Comprehend and apply the various operations like data ingestion, data communication, data analysis and storage for different streaming data applications.
CO3	Investigate and apply streaming concepts using modern tools to solve problems related to society and industry.
CO4	Demonstrate a prototype application for streaming data

Reference Books	
1.	Streaming Data – Understanding the Real time Pipe Line ,Andrew Psaltis, Manning Publications, 1 st Edition: 2017, ISBN: 9781617292286



2.	Kafka: The Definitive Guide: Real-Time Data and Stream Processing at Scale ,Gwen Shapira, Todd Palino, Rajini Sivaram, Krit Petty, , O'Reilly Media, 2 nd Edition, November 2021, ISBN: 978-1-492-08736-6
3.	Streaming Systems ,Tyler Akidau, Slava Chernyak, and Reuven Lax, , O'Reilly Media , 1 st Edition 2018 , ISBN : 978-1-491-98387-4
4.	Fundamentals of Stream Processing Application Design, Systems, and Analytics ,Henrique C. M. Andrade, Bugra Gedik , Deepak S. Turaga ,Cambridge University Press 2014 , 1 st Edition, ISBN 978-1-107-01554-8 Hardback

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION

#	COMPONENTS	MARKS
1.	QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	20
2.	TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50Marks , adding upto 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	40
3.	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) ADDING UPTO 40 MARKS.	40
4.	LAB: Conduction of laboratory exercises, lab report, observation, and analysis (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	50
MAXIMUM MARKS FOR THE CIE (THEORY+LAB)		150

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)

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

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



Semester: VII			
ARTIFICIAL INTELLIGENCE IN AUTONOMOUS VEHICLES			
Category: Professional Core Elective			
(Theory)			
Course Code	:	21AI73GA	CIE : 100Marks
Credits: L: T: P	:	3:0:0	SEE : 100 Marks
Total Hours	:	40T	SEE Duration : 3.00 Hours

Unit-I	8 Hrs.
Introduction to Autonomous Driving: Autonomous Driving Technologies Overview, Autonomous Driving Algorithms, Autonomous Driving Client System, Autonomous Driving Cloud Platform Autonomous Vehicle Localization: Localization with GNSS, Localization with LiDAR and High-Definition Maps, Visual Odometry, Dead Reckoning and Wheel Odometry, Sensor Fusion	
Unit – II	8 Hrs.
Perception in Autonomous Driving: Introduction, Datasets, Detection, Segmentation, Stereo, Optical Flow, and Scene Flow, Tracking Deep Learning in Autonomous Driving Perception: Convolutional Neural Networks., Detection, Semantic Segmentation, Stereo and Optical Flow	
Unit –III	8 Hrs.
Prediction and Routing: Planning and Control Overview, Traffic Prediction, Lane Level Routing Decision, Planning, and Control: Behavioral Decisions, Motion Planning, Feedback Control	
Unit –IV	8 Hrs.
Reinforcement Learning-Based Planning and Control: Introduction, Reinforcement Learning, Learning-Based Planning and Control in Autonomous Driving Client Systems for Autonomous Driving: Autonomous Driving: A Complex System, Operating System for Autonomous Driving, Computing Platform	
Unit –V	8 Hrs
Cloud Platform for Autonomous Driving: Infrastructure, Simulation, Model Training, HD Map Generation Autonomous Last-Mile Delivery Vehicles in Complex Traffic Environments: Autonomous Delivery Technologies in Complex Traffic Conditions, Safety and Security Strategies, Production Deployments	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Analyse the various driving conditions for autonomous cars and apply AI techniques
CO2	Identify various problems involved in developing Autonomous Driving cars and suggest the appropriate solutions
CO3	Integration of advanced driver assistance system with cloud infrastructure for training and modelling
CO4	Development of Deep learning techniques to analyse the data for decision making.
CO5	Demonstrate the use of modern tools by exhibiting teamwork and effective communication skills



Reference Books	
1.	Creating Autonomous Vehicle Systems, Second Edition Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, and Jean-Luc Gaudiot ,2 nd Edition, September 2020, ISBN: ISBN: 9781681739366
2.	George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Autonomous Vehicles Technologies, Regulations, and Societal Impacts, 1 st Edition,Elsevier Publications, 2021 , ISBN-10 1681730073
3.	Hanky Sjafrie, “Introduction to Self-Driving Vehicle Technology”, 1 st Edition, Published December 11, 2019 by Chapman and Hall/CRC, ISBN: 978-0-323-90137-6
4	Creating Autonomous Vehicle Systems Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, and Jean-Luc Gaudiot October 2017, ISBN-10 1681730073

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 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					
HARDWARE ARCHITECTURES FOR ARTIFICIAL INTELLIGENCE					
Category: Professional Core Elective					
(Theory)					
Course Code	:	21AI73GB	CIE	:	100 Marks
Credits: L: T: P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	45L	SEE Duration	:	3.00 Hours

UNIT-I		7 Hrs
AI Accelerators for Standalone Computer		
Introduction, Hardware Accelerators for Standalone Compute: Inference and Training of DNNs, Accelerating DNN Computation, Considerations in Hardware Design, Deep Learning Frameworks, Hardware Accelerators in GPU: History and Overview, GPU Architecture, GPU Acceleration Techniques, Hardware Accelerators in NPU: History and Overview, Standalone Accelerating System Characteristics, Architectures of Hardware Accelerator in NPU, SOTA Architectures		
UNIT-II		10 Hrs
Introduction to Hardware Accelerator Systems for Artificial Intelligence and Machine Learning - I		
Introduction, Deep learning, and neural network acceleration, HW accelerators for artificial neural networks and machine learning, SW framework for deep neural networks, Comparison of FPGA, CPU and GPU		
Introduction to Hardware Accelerator Systems for Artificial Intelligence and Machine Learning - II		
Hardware inference accelerators for deep neural networks: Architectures of hardware accelerators, Eyeriss: hardware accelerator using a spatial architecture, UNPU and BIT FUSION: hardware accelerators using shift-based multiplier, Digital neuron: a multiplier-less massive parallel processor, Power saving strategies for hardware accelerators, Hardware inference accelerators using digital neurons, System architecture, Implementation, and experimental results.		
UNIT-III		9 Hrs
Hardware Accelerator Systems for Embedded Systems		
Introduction, Neural network computing in embedded systems: Driving neural network computing into embedded systems, Considerations for choosing embedded processing solutions, Hardware acceleration in embedded systems: Hardware acceleration options, Commercial options for neural network acceleration, Software frameworks for neural networks		
UNIT-IV		10 Hrs
FPGA-based Neural Network Accelerators		
Introduction, Background: Field programmable gate array, FPGA-based acceleration systems, Challenges of FPGA-based neural network acceleration Accelerator architecture: Processing element, Vector architecture, Array architecture, multi-FPGA architecture, Narrow bit-precision architecture, Design methodology: Hardware/software co-design, High-level synthesis, OpenCL, Design automation framework, Applications: Image recognition, Speech recognition, Autonomous vehicle, Cloud computing, Evaluation: Matrix-vector multiplication, Deep neural networks, Vision kernels		
UNIT-V		9 Hrs
Deep learning with GPUs		
Deep learning applications using GPU as an accelerator, Overview of graphics processing unit: History and overview of GPU architecture, Structure of GPGPU applications, GPU microarchitecture, Evolution of GPUs, Deep learning acceleration in GPU hardware perspective: NVIDIA tensor core, Deep learning application-specific core, High-bandwidth memory, multi-GPU system, Multiple-instance GPU, GPU software for accelerating deep learning: Deep learning framework for GPU, Software support specialized for deep learning, Software to optimize data communications on multi-node GPU, Cons and pros of GPU accelerators.		
Architecture of Neural Processing Unit for Deep Neural Networks		
Considerations in hardware design, NPU architectures: NPU architectures for primitive neural networks, NPU architectures for DNN		



Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the fundamental principles of popular hardware architectures available for building AI applications.
CO2	Design and implement AI applications over Hardware Accelerators to address the requirements of real-world problems.
CO3	Explore the need for new-generation hardware architectures to accelerate deep learning applications.
CO4	Analyze and review the different AI Hardware Architectures applications in various domains.
CO5	Collaborate in a group to study various case studies based on AI hardware architectures.

Reference Books	
1.	Artificial Intelligence and Hardware Accelerators ,Ashutosh Mishra, Jaekwang Cha, Hyunbin Park, Shiho Kim, Springer, ISBN 978-3-031-22170-5 (eBook), 2023. (Unit-1)
2.	Advances in Computers: Hardware Accelerator Systems for Artificial Intelligence and Machine Learning ,Shiho Kim, Ganesh Chandra Deka, Elsevier, ISBN: 978-0-12-823123-4, 2021. (Unit-2,3,4,5)
3.	General-Purpose Graphics Processor Architecture ,Tor M. Aamodt, Wilson Wai Lun Fung, and Timothy G. Rogers, Morgan & Claypool Publishers, ISSN-1935-3235 (Print), 1935-3243 (Electronic), 2018.
4.	Artificial Intelligence Hardware Design: Challenges and Solutions ,Albert Chun Chen Liu and Oscar Ming Kin Law, IEEE Press, ISBN: 9781119810452, 2021.

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)		
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			
FUZZY LOGIC IN ARTIFICIAL INTELLIGENCE			
Category : Professional Core Elective			
(Theory)			
Course Code	: 21AI73GC	CIE	: 100 Marks
Credits: L:T:P	: 3:0:0	SEE	: 100 Marks
Total Hours	: 45L	SEE Duration	: 3.00 Hrs

Unit – I	09 Hrs
Introduction – Introduction, Models of human reasoning, Learning and Reasoning Taxonomy, Crisp and Fuzzy Logic, Foundations of Fuzzy logic, Fuzzy logic and approximate reasoning, on monotonic reasoning, Sets and Logic	
Classical Relations and Fuzzy Relations – Cartesian Product, Crisp Relations, Fuzzy Relations, Tolerance and Equivalence Relations, Fuzzy Tolerance and Equivalence Relations, Value Assignments	
Unit – II	09 Hrs
Fuzzification and Defuzzification – Features of membership functions, Various forms, Fuzzification, Defuzzification to crisp sets, λ - cuts for fuzzy relations, Defuzzification to scalars	
Logic and Fuzzy Systems – Classical Logic, Fuzzy Logic, Other forms of implication operation	
Unit – III	09 Hrs
Methods of developing Membership Functions – Membership value assignments, Intuition, Inference, Rank ordering, Neural Networks, Genetic Algorithm, Inductive Reasoning.	
Automated Methods for Fuzzy Systems – Batch Least Squares Algorithm, Clustering Method, Learning from Examples.	
Unit – IV	09 Hrs
Fuzzy decision making : Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions	
Unit – V	09 Hrs
Fuzzy Classification : Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand and realize the need of fuzz logic systems in real- world applications
CO2	Explain and apply fuzzy logic concepts to address various requirements of real-world problems
CO3	Analyse and review fuzzy systems used in real world applications
CO4	Assess and comprehend the use of fuzzy principles as a member of team to manage projects in multidisciplinary environments
CO5	Exhibit effective communication through team presentation and reports

Reference Books	
1.	Introduction to Fuzzy Loigic,James.K.Peckol, ^{1st} Edition,Wiley,2021,ISBN:9781119772613, 9781119772620 ,9781119772637
2.	Fuzzy logic with engineering applications ,Timothy J.Ross, 4 th Edition, Wiley, 2010, ISBN: 9781119235866 ,9781119235859 ,9781119235842
3.	Fuzzy Topsis-Logic, Approaches and case studies, Mohammed EL Alaqui, ,1 st Edition, CRC Press, ISBN: 9780367767488,9781003168416



4.	Fuzzy sets and Fuzzy logic Theory and applications ,George J.Klir and Bu Yuan, 1 st Edition, Pearson Education India, 2015, ISBN-:10- 9789332549425
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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)		
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			
ETHICAL ARTIFICIAL INTELLIGENCE			
Category: Professional Core Elective			
(Theory)			
Course Code	:	21AI73GD	CIE : 100 Marks
Credits: L: T: P	:	3:0:0	SEE : 100 Marks
Total Hours	:	45L	SEE Duration : 3 Hours

Unit-I	7 Hrs
Introduction to AI and ethics: Strong and weak AI, Types of ethics---Descriptive, Normative, Meta, Relationship between ethics and law, Machine ethics examples, Moral Diversity and Testing, Need of ethics, Normative Ethical Theories, Ethics and Empirical Evidence, Four Domains of Ethics: Self, Friend, Stranger, World, What Counts as Adequate Justification and Argument in Ethics?, Moral Relativism, Moral Justification and AI, Moral Agents, Moral Motivation, AI, Codes of Ethics and the Law.	
Unit – II	10 Hrs
Trust and Fairness in AI systems: User acceptance and trust, functional elements of trust, ethical principles of trustworthy and fair AI, Responsibility, and liability in the case of AI systems, case studies: crash of an autonomous vehicle, mistargeting by an autonomous weapon	
Unit –III	10 Hrs
Privacy issues of AI: what is privacy, Cases of Privacy Violations Through AI, Case Studies: Use of Personal Data by Authoritarian Regimes, Genetic Privacy, Biometric Surveillance, Data Protection and Privacy, Responses to AI-Related Privacy Threats.	
Unit -IV	10 Hrs
Ethical initiatives in the field of AI: International ethical initiatives, ethical harms and concerns tackled by these initiatives, case study: healthcare robots, AI standards and regulation, National and International strategies on AI - Europe, Asia, Africa, North America, and Australia, International AI initiatives in addition to the EU.	
Unit -V	8 Hrs
AI for good and the Sustainable Development Goals: cases of AI for good or not---Seasonal climate forecasting, Helicopter research, Ethical questions concerning AI for good and SDGs, The Data Desert or the Uneven Distribution of Data Availability, The Application of Double Standards, Ignoring the Social Determinants of the Problems the SDGs Try to Solve, The Elephant in the Room: The Digital Divide and the Shortage of AI Talent.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the societal impacts of AI adoption and contribute to discussions on AI governance and policy development.
CO2	Identify and address ethical issues arising from developing and deploying AI technologies.
CO3	Critically assess the moral agency and responsibility of AI systems and their creators.
CO4	Demonstrate the use of modern tools in solving ethical issues by exhibiting teamwork through oral presentations and reports
CO5	Evaluate the implications of AI on privacy, surveillance, and data ethics in contemporary society, thereby contributing to life-long learning.



Reference Books	
1	An introduction to ethics in robotics and AI , Bartneck, Christoph, Christoph Lütge, Alan Wagner, and Sean Welsh. Springer Nature, 2021,1 st edition, ISBN 978-3-030-51109-8.
2	Towards a code of ethics for artificial intelligence, Boddington, Paula. Cham: Springer, 2017,1 st edition, ISBN 978-3-319-60648-4.
3	Ethics of Artificial Intelligence: Case Studies and Options for Addressing Ethical Challenges, Stahl, Bernd Carsten, Doris Schroeder, and Rowena Rodrigues, Springer Nature, 2023,1 st edition, ISBN 978-3-031-17039-3.
4	The ethics of Artificial Intelligence: Issues and initiatives , Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, , European Parliamentary Research Service, ISBN: 978-92-846-5799-5, doi: 10.2861/6644
5	The Oxford handbook of ethics of AI. Oxford Handbooks, Dubber, Markus Dirk, Frank Pasquale, and Sunit Das, eds,2020,1st edition, ISBN 9780190067427

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			
GENERATIVE ARTIFICIAL INTELLIGENCE			
Category: Professional Core Elective			
(Common to AI,CS,IS)			
(Theory)			
Course Code	:	21AI74HA	CIE : 100 Marks
Credits: L: T: P	:	3:0:0	SEE : 100 Marks
Total Hours	:	45L	SEE Duration : 3.00 Hours

Unit-I	9Hrs
Introduction to Generative Deep Learning , Generative Modeling What Is Generative Modeling? Historical perspective on Generative AI, Generative Versus Discriminative Modeling, Introduction to Large Language Models (LLMs), Applications of Large Language Models, Limitations and Risks of Large Language Models	
Unit – II	9Hrs
Variational Autoencoders Introduction, Autoencoders, The Autoencoder Architecture the Encoder, The Decoder, Joining the Encoder to the Decoder, Analysis of the Autoencoder Building a Variational Autoencoder The Encoder The Loss Function Analysis of the Variational Autoencoder Using VAEs to Generate Faces, Training the VAE, Analysis of the VAE, Generating New Faces, Latent Space Arithmetic, Morphing Between Faces	
Unit –III	9Hrs
Generative Adversarial Networks Introduction to GAN (GAN), The Discriminator, The Generator Cycle GAN Overview, The Generators (U-Net) The Discriminators Compiling the Cycle GAN Training the Cycle GAN Analysis of the Cycle GAN Creating a Cycle GAN to Paint Like Monet the Generators (ResNet) Analysis of the Cycle GAN. Neural Style Transfer Content Loss Style Loss Total Variance Loss Running the Neural Style Transfer Analysis of the Neural Style Transfer Model	
Unit -IV	9Hrs
Diffusion Models Introduction Denoising Diffusion Models (DDM), The Flowers Dataset, The Forward Diffusion Process, The Reparameterization Trick, Diffusion Schedules, the Reverse Diffusion Process. Energy-Based Models Introduction Energy-Based Models, The MNIST Dataset, The Energy Function Sampling, Using Langevin Dynamics	
Unit -V	9Hrs
Bias and Fairness in Generative AI: Understanding Bias in AI Types of biases (algorithmic, data, societal) Fairness Metrics Statistical parity, equal opportunity, disparate impact Mitigation Strategies Pre-processing, in-processing, and post-processing techniques Ethical Design and Deployment of Generative AI Ethical AI Design Principles Human-centered design, ethical by design Deployment Challenges Real-world implementation, monitoring, and feedback loops Responsible AI Frameworks Guidelines and best practices for ethical deployment	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the concepts and principles of Generative Artificial Intelligence to engineering requirements.
CO2	Design and demonstrate proficiency in implementing and training various generative AI models using modern tools.
CO3	Investigate the need for Generative AI techniques to solve real-world problems in diverse domains.
CO4	Explore advanced topics and research directions in Generative AI and critically evaluate their potential applications.
CO5	Equip students with the knowledge to identify and address ethical issues in Generative AI, focusing on fairness, accountability, transparency, and human rights.

Reference Books	
1	“Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play” by David



	Foster, 2 nd Edition, 2023. ISBN: 978-1492041948. Publisher: O'Reilly Media.
2	'Deep Learning" by Ian Good fellow, Yoshua Bengio, and Aaron Courville. 2 nd Edition 2016, ISBN: 978-0262035613. Publisher: MIT Press.
3	"Fairness and Machine Learning: Limitations and Opportunities"; Author(s) Solon Barocas, Moritz Hardt, Arvind Narayanan, 2023, ISBN-10/ASIN: 0262048612, Publisher: MIT Press
4	"Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" by Virginia Dignum , 1st Edition, 2021, ISBN 9783030303716, Publisher: MIT Press

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			
INTELLIGENT SOFTWARE DEFINED NETWORKS			
Category: Professional Core Elective			
(Common to CS, IS & AI)			
(Theory)			
Course Code	:	21CS74HB	CIE : 100 Marks
Credits: L:T:P	:	3:0:0	SEE : 100 Marks
Total Hours	:	40L	SEE Duration : 3.00 Hours
Unit-I			8 Hrs
The Genesis of SDN: The Evolution of Networking Technology, Forerunners of SDN, and Software Defined Networking is Born, Sustaining SDN Interoperability, Legacy Mechanisms Evolve Toward SDN, and Network Virtualization.			
How SDN Works: Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods			
Unit – II			8 Hrs
The OpenFlow Specification - OpenFlow Overview, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations.			
Unit –III			8 Hrs
Alternative Definition of SDN: Potential drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor based overlays, SDN via Opening up the Device. Network function virtualization. Alternative overlap and ranking.			
Unit –IV			8 Hrs
SDN in the Data Center- Data Center Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations.			
SDN in Other Environments - Consistent Policy Configuration, Global Network View, Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks.			
Unit –V			8 Hrs
Intelligent Software Defined Network: Artificial intelligence enabled software, defined networking: a comprehensive overview, Network AI: An Intelligent Network Architecture for Self-Learning Control Strategies in Software Defined Networks, Intelligent Routing based on Reinforcement Learning for Software-Defined Networking			

Reference Books	
1.	Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844
2.	SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.
3.	Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.
4.	Software defined networks: Design and Deployment, Patricia A. Morreale and James M. Anderson. CRC Press, First edition, December 2014, ISBN: 9781482238631
5.	Latah, Majd, and Levent Toker. "Artificial intelligence enabled software-defined networking: a comprehensive overview." IET networks 8.2 (2019): 79-99. (UNIT 5)
6.	Yao, Haipeng, et al. "NetworkAI: An intelligent network architecture for self-learning control strategies in software defined networks." IEEE Internet of Things Journal 5.6 (2018): 4319-4327. (UNIT 5)
7.	Casas-Velasco, Daniela M., Oscar Mauricio Caicedo Rendon, and Nelson LS da Fonseca. "Intelligent routing based on reinforcement learning for software-defined networking." IEEE Transactions on Network and Service Management 18.1 (2020): 870-881. (UNIT 5)



Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental definitions, standards and protocols for Software defined Networks (SDN)
CO2	Explore network programmability through different components such as network programming switches and controller that develop into SDN framework
CO3	Design network programmable applications using SDN frameworks
CO4	Analyze the applicability of SDN for future network programmability.

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			
ROBOTIC PROCESS AUTOMATION			
Category: Professional Elective			
(Common to CS, IS & AI)			
(Theory)			
Course Code	:	21CS74HC	CIE : 100 Marks
Credits: L:T:P	:	3:0:0	SEE : 100 Marks
Total Hours	:	40L	SEE Duration : 3.00 Hours
Unit-I			7 Hrs
PROGRAMMING BASICS & RECAP: Programming Concepts Basics, Software applications, Data and Data Structures, Algorithms, Sequence and Flow, Software Development guidelines Software Processes, Software Design, Scripting and Macros, .Net Framework, .Net Fundamentals , Information sharing mechanism, Variables & Arguments, Files and file types, Access Control, XML, HTML.			
Unit – II			9 Hrs
RPA Concepts: RPA Basics, History of Automation, What is RPA? RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated? Types of Bots, Workloads which can be automated. RPA Advanced Concepts: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem			
Unit –III			8 Hrs
RPA TOOL INTRODUCTION & BASICS: Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, The Variables Panel, Managing Arguments, Naming Best Practices, The Arguments Panel, Namespaces. Control Flow Introduction, Basic Control flow statements, Control flow statements in UiPath, Advanced Control Flow – Sequences and Flowcharts, Control Flow Activities Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation , main string methods			
Unit –IV			9 Hrs
ADVANCED AUTOMATION CONCEPTS AND TECHNIQUES : UiPath Recording (Basic, Desktop, Web Recording), Input/output Methods, Data Scraping, Advanced Scraping techniques, Selectors, Types of Selectors (Full, partial, dynamic), Defining and Assessing Selectors, Customization, Debugging Image, Text & Advanced Citrix Automation – Introduction, Keyboard based automation, Information Retrieval, Best Practices Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table, Extracting Data from Data Table, Anchors, Using anchors in PDF			
Unit –V			7 Hrs
EMAIL AUTOMATION, EXCEPTIONS and Project organization: Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors. Project organization, qualities of a successful project, process, library, Robotic Enterprise Framework.			

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand RPA principles, its features and applications
CO2	Demonstrate proficiency in handling several types of variables inside a workflow and data manipulation techniques
CO3	Gain insights into Desktop, Web, Citrix, Email Automation and exception handling
CO4	Analyze and design a real-world automation project and debug the workflows.



Reference Books:	
1.	Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN: 9781788470940
2.	UiPath pdf manuals
3.	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
4.	Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation
5.	https://www.uipath.com/rpa/robotic-process-automation

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			
ARTIFICIAL INTELLIGENCE PRODUCT MANAGEMENT			
Category: Professional Core Elective			
(Theory)			
Course Code	:	21AI74HD	CIE : 100 Marks
Credits: L:T:P	:	3:0:0	SEE : 100 Marks
Total Hours	:	45L	SEE Duration : 3Hours
Unit-I			09 Hrs
Introduction: Product Management, Product Management Lifecycle, Concept validation to Go to Market cycle. Understanding the Infrastructure and Tools for Building AI Products: Order of Optimal Process Flow, Deployment Strategies, Model Development and Maintenance for AI Products			
Unit – II			09 Hrs
Building an AI-Native Product: Stages of AI product development, AI/ML product dream team, Productizing AI-powered outputs, how AI product management is different, AI customization; Customization for Verticals, Customers, and Peer Groups, Benchmarking Performance, Growth Hacking, and Cost			
Unit –III			09 Hrs
Integrating AI into Existing Non-AI Products: The Rising Tide of AI, Trends in AI adoption- Embedded AI, Ethical AI, Creative AI, Autonomous AI, Evolving Products into AI Products			
Unit –IV			09 Hrs
AI Product Strategy: Product Vision, Strategy, Roadmap, understanding customer needs, Product prioritization, Collaborators and Tools for Need Discovery, Translating Needs to Requirements, Requirement categorization, Case study			
Unit –V			09 Hrs
Human Centered AI Developer Experience Design: AI Products for Developers, AI as a Service, AI as an Engine, AI Platform as a Service, Principles of AI DX Design Case Studies - Deep dives into Successful and Unsuccessful AI Product Launches, Lessons Learned and Best Practices.			

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand and realize the need of AI in Product Management
CO2	Identify AI Product Management concepts for building AI products for various applications
CO3	Explain and apply Product Management concepts to address various requirements of real-world problems
CO4	Analyse and summarize the concepts of Product Management as a member of team to manage projects in multidisciplinary environments
CO5	Exhibit effective communication through writing effective reports and presentations.
Reference Books	
1.	The AI Product Manager's Handbook, Irene Bratsis, Packt Publisher, 1 st Edition, February 2023, ISBN 9781804612934.
2.	Product Management for AI, Justin Norman, Peter Skomoroch, Mike Louides, 1 st Edition, O'Reilly Media, Inc, 2021, ISBN: 9781098104191
3.	AI Product Management: A practical Guide for Building, Launching and Scaling AI Products, Kumar Vishwesh, 1st Edition, Notion Press, 2023, ISBN:- 13- 979-8890022400
4.	Phill Akinwale, Artificial Intelligence for Product Managers, 1 st Edition, Praizion Media, 2023, ISBN-10: 1934579289



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

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

Reference Books	
1	Unmanned Aircraft Systems UAV design, development and deployment, Reg Austin, 1 st Edition, 2010, Wiley, ISBN 9780470058190.
2	Flight Stability and Automatic Control, Robert C. Nelson, 2 nd 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, 1 st Edition,2007, Springer ISBN 9781402061141
4	Introduction to UAV Systems, Paul G Fahlstrom, Thomas J Gleason, 4 th Edition, 2012, Wiley, ISBN: 978-1-119-97866-4
5	Design of Unmanned Air Vehicle Systems, Dr. Armand J. Chapt, 3 rd 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	: 45 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 scientific research, applied science, social and economic issues.

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



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

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



Semester: VII					
ADVANCES IN CORROSION SCIENCE AND MANAGEMENT					
Category: Institutional Elective-II – 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

Unit-I	08Hrs
<p>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.</p>	
Unit-II	08Hrs
<p>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.</p>	
Unit- III	08 Hrs
<p>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.</p>	
Unit-IV	09 Hrs
<p>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.</p>	
Unit-V	09 Hrs
<p>Corrosion Control: Principlesofcorrosionprevention,materialselection,designconsiderations,controlofenvironment-decreaseinvelocity,passivity,removaloxidizer,Inhibitorsandpassivators, coatings- organic, electroplating of Copper, Nickel and Chromium, physical vapor deposition-sputtering, Electroless plating of Nickel.</p>	



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, 3rdEdition, 2005,Tata McGraw Hill, ISBN: 978- 0070214637.
2	Principles and Prevention of Corrosion,D. A Jones,2ndEdition,1996,PrenticeHall, ISBN: 978-133599930.
3	Design and corrosion prevention, Pludek, 1978,McMillan,ISBN:978-1349027897
4	Introduction to metal corrosion,RajNarain,1983,Oxford&IBH,ISBN:8120402995.

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

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



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

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



Reference Books	
1	Unlocking the Secrets of Prompt Engineering: Master the art of creative language generation to accelerate your journey from novice to pro , Gilbert Mizrahi, Jan 2024, 1st Edition, Packt Publishing, ISBN-13:978-1835083833
2.	Prompt Engineering for Generative AI, James Phoenix, Mike Taylor, May 2024, O'Reilly Media, Inc.,ISBN: 9781098153434
3.	Prompt Engineering for LLMs, John Berryman, Albert Ziegler, O'Reilly Media, Inc. Dec 2024, ISBN: 9781098156152
4.	The Art of Asking ChatGPT for High-Quality Answers_ A Complete Guide to Prompt Engineering, Ibrahim John , Nzunda Technologies Limited, 2023, ISBN-13: 9781234567890
5	Programming Large Language Models with Azure Open AI: Conversational programming and prompt engineering with LLMs, Francesco Esposito, Microsoft Pr, 1 st 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 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					
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	:	40L		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		
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	Wearable Sensors: Fundamentals, Implementation and Applications, Edward Sazonov, Michael R. Neuman Academic Press, 1 st 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 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 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					
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

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

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

Reference Books	
1	Wearable Sensors: Fundamentals, Implementation and Applications, Edward Sazonov, Michael R. Neuman Academic Press, 1 st 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) Realtime 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	06 Hrs
E-Mobility: A Brief History of the Electric Powertrain, Energy Sources for Propulsion and Emissions, The Advent of Regulations, Drive Cycles, BEV Fuel Consumption, Range, Carbon Emissions for Conventional and Electric Powertrains, An Overview of Conventional, Battery, Hybrid, and Fuel Cell Electric Systems, A Comparison of Automotive and Other Transportation Technologies. Vehicle Dynamics: Vehicle Load Forces, Vehicle Acceleration, Simple Drive Cycle for Vehicle Comparisons	
Unit – II	09 Hrs
Batteries: Batteries Types and Battery Pack, Lifetime and Sizing Considerations, Battery Charging, Protection, and Management Systems, Battery Models, Determining the Cell/Pack Voltage for a Given Output/Input Power, Cell Energy and Discharge Rate. Battery Charging: Basic Requirements for Charging System, Charger Architectures, Grid Voltages, Frequencies, and Wiring, Charging Standards and Technologies, SAE J1772, Wireless Charging, The Boost Converter for Power Factor Correction.	
Unit –III	09 Hrs
Battery Management System: BMS Definition, Li-Ion Cells, Li-Ion BMSs, Li-Ion Batteries, BMS Options: Functionality, CCCV Chargers, Regulators, Balancers, Protectors, Functionality Comparison, Technology, Topology. Measurement: Voltage, Temperature, Current, Management: Protection, Thermal Management, Balancing, Distributed Charging, Evaluation, External Communication: Dedicated analog and digital wires.	
Unit –IV	09 Hrs
Electric Drivetrain: Overview of Electric Machines, classification of electric machines used in automobile drivetrains, modelling of electric machines, Power Electronics, controlling electric machines, electric machine and power electronics integration Constraints. Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, Classification of different energy management strategies, Comparison of different energy management strategies and implementation issues of energy management strategies.	
Unit –V	09 Hrs
Charger Classification and standards: classification based on charging, levels (region-wise), modes, plug types, standards related to: connectors, communication, supply equipments, EMI/EMC. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems Communications, Supporting Subsystems: In vehicle networks- CAN	

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



Reference Books	
	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. AbasGoodarzi, 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 CONTROLLERS 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 : 3.00 Hours

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

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

Reference Books	
1.	Programmable Logic controllers, Frank D. Petruzella, Mc Graw hill, 4 th 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)			
Course Code	:	21ET75IK	CIE : 100 Marks
Credits: L:T:P	:	3:0:0	SEE : 100 Marks
Total Hours	:	45 L	SEE Duration : 3.00 Hours
Unit-I			9 Hrs
Earth's environment: Atmosphere, ionosphere, Magnetosphere, Van Allen 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			9 Hrs
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			9 Hrs
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			9 Hrs
Remote Sensing: Visual bands, Agricultural, Crop vegetation, Forestry, water Resources, Land use, Land mapping, geology, Urban development resource Management, and image processing techniques. Metrology: Weather forecast (Long term and Short term), weather modelling, Cyclone predictions, Disaster and flood warning, rainfall predictions using satellites.			
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
Reference Books	
1.	Atmosphere, weather and climate, R G Barry, Routledge publications, 2009, ISBN-10:0415465702.
2.	Fundamentals of Satellite Communication, K N Raja Rao, PHI, 2012, ISBN: 9788120324015.
3.	Satellite Communication, Timothy pratt, John Wiley, 1986 ISBN: 978-0- 471- 37007 -9, ISBN 10: 047137007X.
4	Remote sensing and applications, B C Panda, VIVA books Pvt. Ltd., 2009, ISBN: 108176496308.



RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	20
2.	TESTS: Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50Marks , adding upto 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	40
3.	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS.	40
4.	LAB: Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	50
MAXIMUM MARKS FOR THE CIE THEORY		150

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	CONTENTS	MARKS
PART A		
1	Objective type of questions covering the 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			
MOBILE APPLICATION DEVELOPMENT			
Category: Institutional Electives-II - Group I			
(Theory)			
Course Code	: 21IS75IL	CIE	: 100Marks
Credits:L:T:P	: 3:0:0	SEE	: 100Marks
Total Hours	: 45L	SEE Duration:	03Hours

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, RecyclerView, 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. Firebase and Ad Mob, 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 o the app market place by offering The applications for download.



Reference Books	
1	Android Programming, Phillips, Stewart, Hardy and Marsicano, Big Nerd Ranch Guide, 2 nd Edition, 2015, ISBN-13 978-0134171494
2	Android Studio Development Essentials-Android 6, Neil Smyth, 2015, Create Space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming—Pushing the limits, Eric Hellman, 2013, Wiley, ISBN-13:978-1118717370
4	Professional Android 2 Application Development, Reto Meier, Wiley India Pvt. Ltd, 1 st Edition, 2012, ISBN-13:9788126525898
5	Beginning Android 3, Mark Murphy, Apress Springer India Pvt Ltd, 1 st Edition, 2011, ISBN-13:978-1-4302-3297-1
6	Android Developer Training- https://developers.google.com/training/android/ Android Testing Support Library- 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 : 3.00 Hours

Unit-I	06 Hrs
<p>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.</p> <p>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.</p>	
Unit – II	09 Hrs
<p>Project Scope Management: Project scope management, collect requirements define scope, create WBS, validate scope, control scope.</p> <p>Organizational influences & Project life cycle: Organizational influences on project management, project state holders & governance, project team, project life cycle.</p>	
Unit –III	09 Hrs
<p>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.</p> <p>Project Quality management: Plan quality management, perform quality assurance, and control quality.</p>	
Unit –IV	09 Hrs
<p>Project Risk Management: Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk.</p> <p>Project Scheduling: Project implementation scheduling, Effective time management, Different scheduling techniques, Resources allocation method, PLM concepts. Project life cycle costing.</p>	
Unit –V	09 Hrs
<p>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.</p>	

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)”, 5 th Edition, 2013, ISBN: 978-1-935589-67-9
2.	Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John Wiley & Sons Inc., 11 th Edition, 2013, ISBN 978-1-118-02227-6.
3.	Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw



	Hill Publication, 7 th Edition, 2010, ISBN 0-07-007793-2.
4.	Rory Burke, “Project Management – Planning and Controlling Techniques”, John Wiley & Sons, 4 th 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 : 100Marks
Credits: L:T:P	:	3:0:0	SEE : 100 Marks
Total Hours	:	45 L	SEE Duration : 3.00 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 Date time 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: -	
CO 1	Understand supply chain concepts, systemic and strategic role of SCM in global competitive environment.
CO 2	Evaluate alternative supply and distribution network structures using optimization models.
CO 3	Develop optimal sourcing and inventory policies in the supply chain context.
CO 4	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, 6 th 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, 1 st 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	:	45L		SEE Duration	: 3.00 Hours
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-II					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 - III					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-IV					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-V					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: After completing the course, the students will be able to:					
CO1	Understand nuclear physics: grasp atomic structure, nuclear models, and the forces driving nuclear interactions				
CO2	Evaluate various reactor types and advanced concepts, applying kinetics and controls to ensure safe and efficient nuclear reactor analysis and design.				
CO3	Examine the nuclear fuel cycle from mining to recycling, assess environmental impact and safety, and				



	promote responsible, sustainable practices throughout.
CO4	Apply ionizing radiation principles for safety measures; integrate communication and regulatory compliance into emergency response plans effectively.

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

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

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



Semester: VII			
COGNITIVE PSYCHOLOGY			
Category: Institutional Electives-II - Group I			
(Theory)			
Course Code	:	21HS75IQ	CIE : 100 Marks
Credits: L:T:P	:	03:0:0	SEE : 100 Marks
Total Hours	:	42 Hrs	SEE Duration : 3.00 Hours

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

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

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



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

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



Semester: VII					
PRINCIPLES AND PRACTICES OF CYBER LAW					
Category: Institutional Electives-II - Group I					
(Theory)					
Course Code	:	21HS751R		CIE	: 100 Marks
Credits: L:T:P	:	03:00:00		SEE	: 100 Marks
Total Hours	:	47L		SEE Duration	: 3 Hours

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



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

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

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

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



Semester: VII					
SUMMER INTERNSHIP - III					
Course Code	:	21AI76I		CIE	: 50 Marks
Credits: L:T:P	:	0:0:2		SEE	: 50 Marks
Hours/Week	:	04		SEE Duration	: 2 Hours
GUIDELINES					
<ol style="list-style-type: none">1. The duration of the internship shall be for a period of <i>6/8 weeks</i> 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<ul style="list-style-type: none">● 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	:	21AI77P		CIE	:	50 Marks
Credits: L:T:P	:	0:0:2		SEE	:	50 Marks
Hours/Week	:	04		SEE Duration	:	2 Hours
GUIDELINES						
<p>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).</p> <p>2. Each student in a team must contribute equally in the tasks mentioned below.</p> <p>3. Each group has to select a current topic that will use the technical knowledge of their program of study after detailed literature survey.</p> <p>4. The project should result in system/module which can be demonstrated, using the available resources in the college.</p> <p>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.</p> <p>6. The final copy of the report should be submitted after incorporation of any modifications suggested by the evaluation committee.</p>						
<u>The minor-project tasks would involve:</u>						
<ol style="list-style-type: none"> 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. 9. 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: Applying 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:

Review Phase	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	:	21AI81P		CIE	:	100 Marks
Credits: L:T:P	:	0:0:12		SEE	:	100 Marks
Hours/Week	:	24		SEE Duration	:	03 Hours
GUIDELINES						
<ol style="list-style-type: none"> The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the 8th semester. The detailed Synopsis (approved by the department Project Review Committee) has to be submitted during the 1st week after the commencement of 8th semester. 						
<u>Batch Formation:</u>						
<ul style="list-style-type: none"> Students are free to choose their project partners from within the program or any other program. Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house / Industry / R & D Institution. The project work is to be carried out by a team of two to four students, in exceptional cases where a student is placed in a company and offered an internship through the competitive process or student is selected for internship at national or international level through competitive process, the student can work independently. The students are allowed to do either a project for full 5 days in the industry or full 5 days in the college. In case the project work is carried out outside Bengaluru, such students must be available during Project Evaluation process scheduled by the respective departments and they must also interact with their guide regularly through Email / Webinar / Skype etc. 						
<u>Project Topic Selection:</u>						
<p>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.</p> <p>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 enroll 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.</p>						
<u>Project Evaluation:</u>						
<ul style="list-style-type: none"> Continuous monitoring of project work will be carried out and cumulative evaluation will be done. The students are required to meet their internal guides once in a week to report their progress in project work. Weekly Activity Report (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Internal Guide regularly. In case of Industry project, during the course of project work, the internal guides will have continuous interaction with external guides and will visit the industry at least twice during the project period. For CIE assessment the project groups must give a final seminar with the draft copy of the project report. 						



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

Course Outcomes:

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

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

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

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

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

Scheme of Continuous Internal Evaluation (CIE):

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

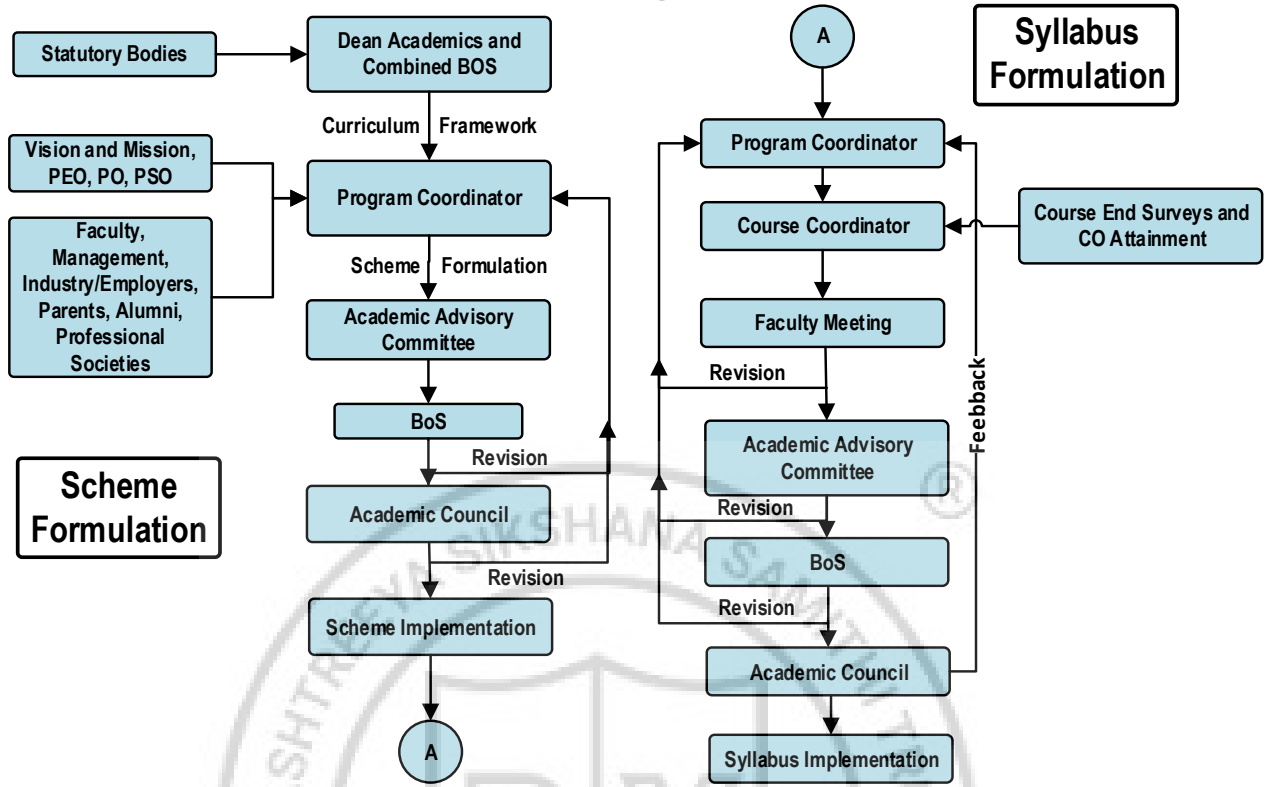
1.Selection of the topic and formulation of objectives	10%
2.Design and Development of Project methodology	25%
3.Execution of Project	25%
4.Presentation,Demonstration and Results Discussion	30%
5.Report Writing & Publication	10%

Scheme for Semester End Evaluation (SEE):

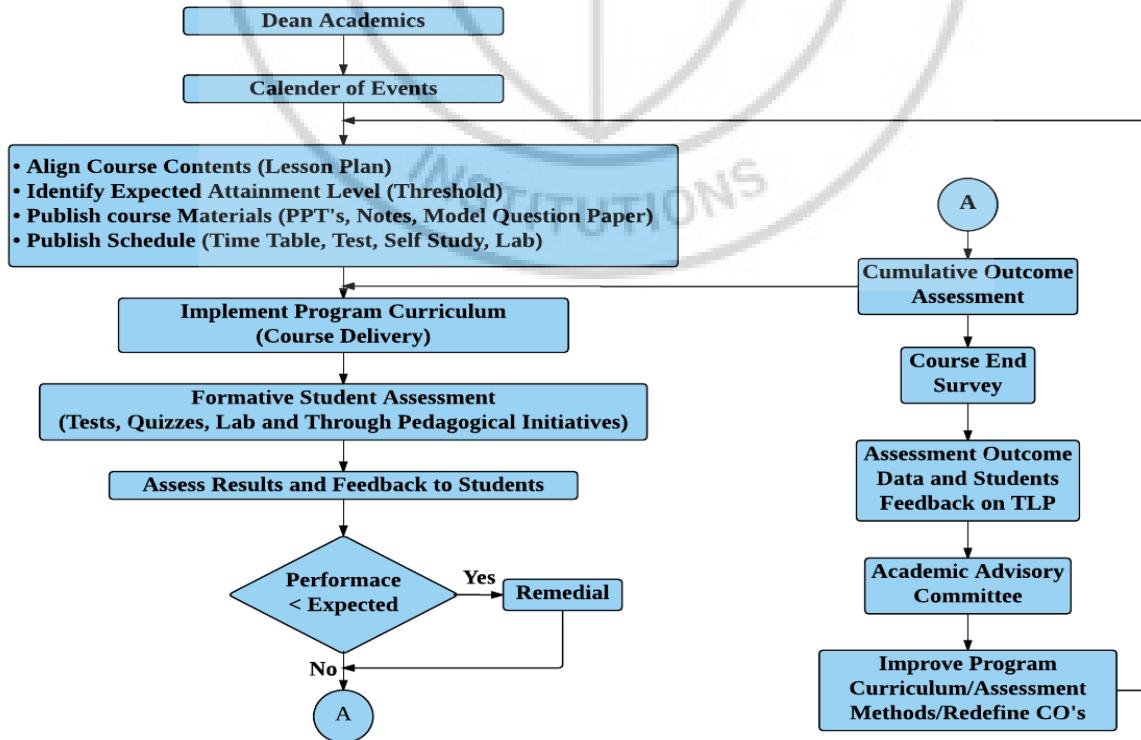
The following are the weightages given during Viva Examination.

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%

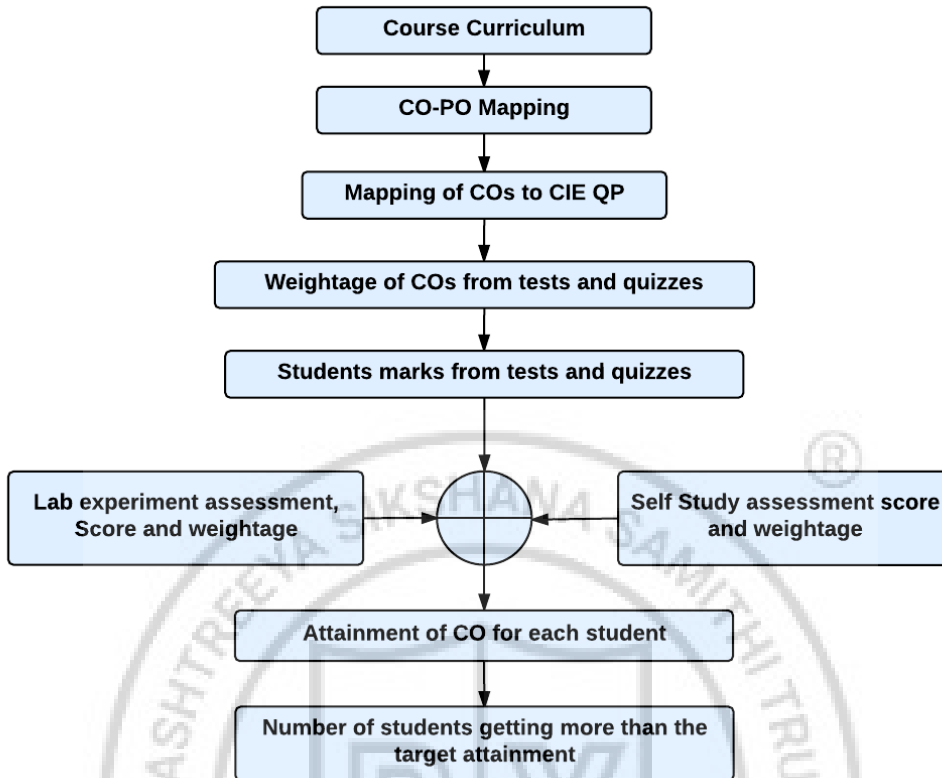
Curriculum Design Process



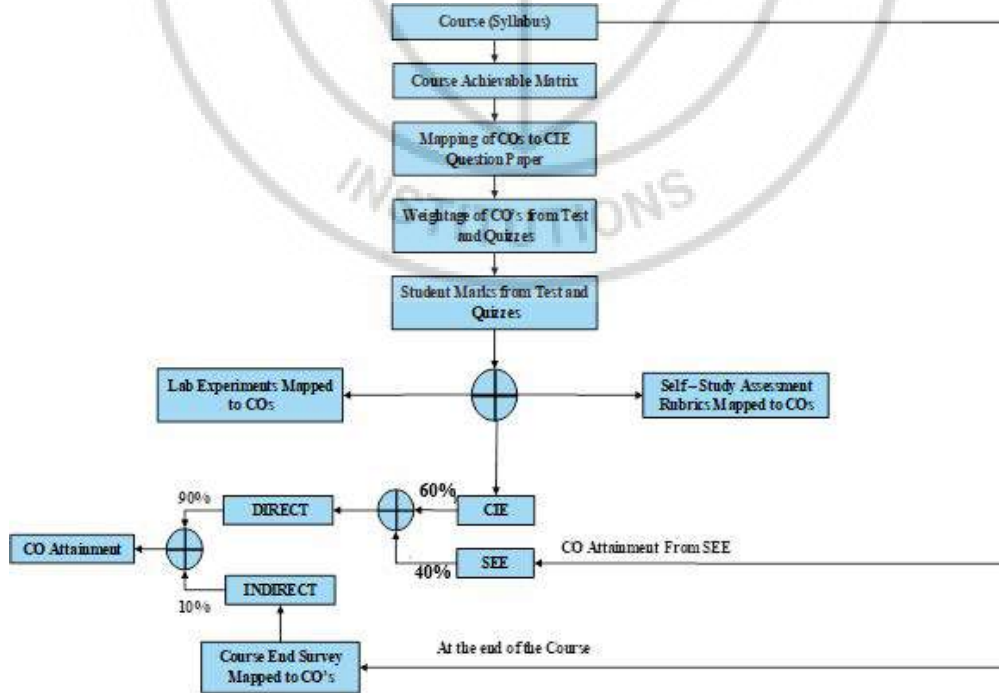
Academic Planning and Implementation



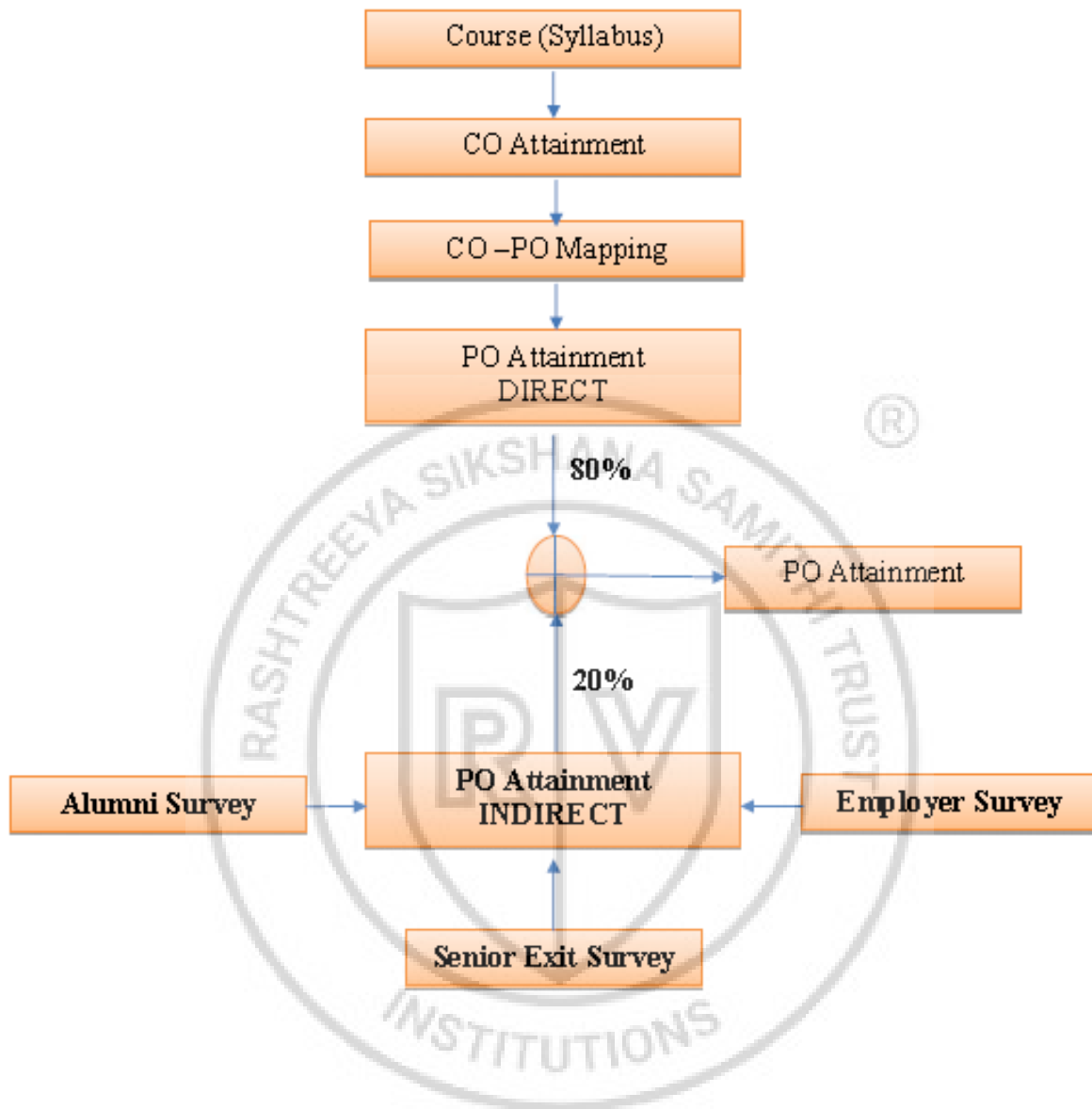
Process For Course Outcome Attainment



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



QUALITY POLICY

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



CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation



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