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-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

## CURRICULUM STRUCTURE

**61** CREDITS PROFESSIONAL CORES (PC)

**23** CREDITS BASIC SCIENCE

**22** CREDITS ENGINEERING SCIENCE

**18** CREDITS PROJECT WORK / INTERNSHIP

**12** CREDITS* OTHER ELECTIVES & AEC

**12** CREDITS PROFESSIONAL ELECTIVES

**12** CREDITS HUMANITIES & SOCIAL SCIENCE

**160** CREDITS TOTAL

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

**17**
Centers of Excellence

**11**
Centers of Competence

**212**
Publications On Web Of Science

**669**
Publications Scopus (2023 - 24)

**1093**
Citations

**70**
Patents Filed

**39**
Patents Granted

**61**
Published Patents

**11**
Skill Based Laboratories Across Four Semesters

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

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

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# Artificial Intelligence & Machine Learning

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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) |

# INDEX

# 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 | 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 | 21AI74HX | Professional Core Elective-IV– **Group - H** | 3 | 0 | 0 | **3** | Resp. Board | Theory | **100** | *** | **3** | **100** | *** |
| 5 | 21AI75IX | Institutional Electives – II **Group - I** | 3 | 0 | 0 | **3** | Resp. Board | Theory | **100** | *** | **3** | **100** | *** |
| 6 | 21AI76I | Summer Internship | 0 | 0 | 2 | **2** | AI | Internship | *** | **50** | **2** | *** | **50** |
| 7 | 21AI77 | Minor Project | 0 | 0 | 2 | **2** | AI | Project | *** | **50** | **3** | *** | **50** |
| | | **Total** | | | | **20** | | | | | | | |

| Professional Core Elective-III<br>Group - G | | | |
|---|---|---|---|
| **Sl. No.** | **COURSE CODE** | **COURSE TITLE** | **CREDITS** |
| 1 | 21AI73G1 | Artificial Intelligence in Autonomous Vehicles | **03** |
| 2 | 21AI73G2 | Hardware Architectures for Artificial Intelligence | **03** |
| 3 | 21AI73G3 | Fuzzy Logic in Artificial Intelligence | **03** |
| 4 | 21AI73G4 | Ethical Artificial Intelligence | **03** |

| Professional Core Elective-IV<br>Group - H | | | |
|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **CREDITS** |
| 1 | 21AI74H1 | Generative Artificial Intelligence<br>(Common to **AI**,CS,IS) | **03** |
| 2 | 21CS74H2 | Intelligent Software Defined Networks<br>(Common to AI,**CS**,IS) | **03** |
| 3 | 21CS74H3 | Robotics Process Automation<br>(Common to **CS**,IS,AI) | **03** |
| 4 | 21AI74H4 | Artificial Intelligence Product Management | **03** |

| INSTITUTIONAL ELECTIVE - II<br>GROUP - E | | | |
|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **Credits** |
| 1 | 21AS75IA | Unmanned Aerial Vehicles | **02** |
| 2 | 21BT75IB | Bioinformatics | **02** |
| 3 | 21CH75IC | Sustainability and Life Cycle Analysis | **02** |
| 4 | 21CM75ID | Advances in Corrosion Science & Management | **02** |
| 5 | 21CS75IE | Prompt Engineering | **02** |
| 6 | 21CV75IF | Integrated Health Monitoring of Structures | **02** |
| 7 | 21EC75IG | Wearable Electronics | **02** |
| 8 | 21EE75IH | E-Mobility | **02** |
| 9 | 21XEI75IJ | Programmable Logic Controllers & its applications | **02** |
| 10 | 21ET75IK | Space Technology and Applications | **02** |
| 11 | 21IS75IL | Mobile Applications Development | **02** |
| 12 | 21IM75IM | Project Management | **02** |
| 13 | 21IM75IN | Supply Chain Analytics | **02** |
| 14 | 21ME75IO | Nuclear Engineering | **02** |
| 15 | 21HS75IQ | Cognitive Psychology | **02** |
| 16 | 21HS75IR | Principle and Practices of Cyber Law | **02** |

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



# 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 | 21AI81 | Major Project | 0 | 0 | 12 | **12** | AI | Lab | *** | **50** | **3** | *** | **50** |

| Semester: VII | | | | | | |
|---|---|---|---|---|---|---|
| **CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS**<br>**Category: Professional Core Course**<br>**(Common to All Branches)**<br>**(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 ,<br>**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**.<br>**Statutory Provision regarding prohibition and prevention of Ragging,**<br>**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, 5th 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**<br>(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**<br>**Category: Professional Core Course**<br>**(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<br>**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<br>**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<br>**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<br>**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<br>**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, 1st 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, 2nd Edition, November 2021, ISBN: 978-1-492-08736-6 |
| 3. | Streaming Systems ,Tyler Akidau, Slava Chernyak, and Reuven Lax, , O'Reilly Media , 1st 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 , 1st 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**<br>(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**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI73G1** | | **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<br>**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<br>**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<br>**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<br>**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<br>**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 ,2nd Edition, September 2020, ISBN: ISBN: 9781681739366 |
| 2. | George Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Autonomous Vehicles Technologies, Regulations, and Societal Impacts, 1st Edition,Elsevier Publications, 2021 , ISBN-10 1681730073 |
| 3. | Hanky Sjafrie, "Introduction to Self-Driving Vehicle Technology", 1st 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**<br>(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**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI73G2** | | **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**<br>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**<br>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<br>**Introduction to Hardware Accelerator Systems for Artificial Intelligence and Machine Learning - II**<br>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**<br>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**<br>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**<br>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.<br>**Architecture of Neural Processing Unit for Deep Neural Networks**<br>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**<br>(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**<br>**Category : Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI73G3** | | **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<br>**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<br>**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, Inducive Reasoning.<br>**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, 4th Edition, Wiley, 2010, ISBN: 9781119235866 ,9781119235859 ,9781119235842 |
| 3. | Fuzzy Topsis-Logic, Approaches and case studies, Mohammed EL Alaqui, ,1st Edition, CRC Press, ISBN: 9780367767488,9781003168416 |

| | |
|---|---|
| 4. | Fuzzy sets and Fuzzy logic Theory and applications ,George J.Klir and Bu Yuan, 1st Edition, Pearson Education India, 2015, ISBN-:10- 9789332549425 |

| 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**<br>(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**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI73G4** | | **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, 2021,1st edition, ISBN 978-3-030-51109-8. |
| 2 | Towards a code of ethics for artificial intelligence, Boddington, Paula. Cham: Springer, 2017,1st 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, 2023,1st 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** |
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| 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**<br>**Category: Professional Core Elective**<br>**(Common to AI,CS,IS)**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI74H1** | | **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<br>**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<br>**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.<br>**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.<br>**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<br>**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,2nd Edition, 2023. ISBN: 978-1492041948. Publisher: O'Reilly Media. |
| 2 | 'Deep Learning" by Ian Good fellow, Yoshua Bengio, and Aaron Courville.2nd 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**<br>(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**<br>**Category: Professional Core Elective**<br>**(Common to CS, IS & AI)**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21CS74H2** | | **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.<br>**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.<br>**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, Particia 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**<br>(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**<br>**Category: Professional Elective**<br>**(Common to CS, IS & AI)**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21CS74H3** | | **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<br>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.<br>**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.<br>Control Flow Introduction, Basic Control flow statements, Control flow statements in UiPath, Advanced Control Flow – Sequences and Flowcharts, Control Flow Activities<br>Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables,<br>Text Manipulation , main string methods | |
| **Unit –IV** | **9 Hrs** |
| **ADVANCED AUTOMATION CONCEPTS AND TECHNIQUES :**<br>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<br>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**<br>(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**<br>**Category: Professional Core Elective**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21AI74H4** | | **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<br>**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, 1st Edition, February 2023, ISBN 9781804612934. |
| **2.** | Product Management for AI,Justin Norman,Peter Skomoroch, Mike Louides,1st Edition,O;Reilly Media, Inc,2021,ISBN:9781098104191 |
| **3.** | AI Product Management:Apractical Guide for Building,Launching and Scaling AI Prodcts,Kumar Vishwesh,1st Edition, Notion Press, 2023, ISBN-:13- 979-8890022400 |
| **4.** | Phill Akinwale,Artificial Intelligence for Product Managers,1st 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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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: B**asic Aerodynamic Equations, Air foils, lift, drag, moments, Aircraft Polar, The Real Wing and Airplane, Induced Drag, Total Air-Vehicle Drag, Flapping Wings, Rotary wings.<br>**Propulsion:**Thrust Generation and basic thrust equation, Sources of Power for UAVs- Piston, Rotary, Gas turbine engines, electric or battery powered UAVs. | |
| **Unit –III** | **08Hrs** |
| **Airframe of UAVs:** Mechanic loading, basics of types of load calculation and structural engineering, Material used for UAV (general introduction), FRP and methods of usage in UAV, Testing of FRP specimens for UAV, selection criteria for structure, Types of structural elements used in UAV their significance and characteristics, Methods of manufacturing UAV structure. | |
| **Unit –IV** | **10Hrs** |
| **Payloads for UAVs:** Barometers, Accelerometer, Magnetometer, RADAR and range finder, Non-dispensable and dispensable Payloads-Optical, electrical, weapon, imaging payloads. | |
| **Unit –V** | **08Hrs** |
| **Mission Planning and Control:** Air Vehicle and Payload Control, Reconnaissance/Surveillance Payloads, Weapon Payloads, Other Payloads, Data-Link Functions and Attributes, Data-Link Margin, Data-Rate Reduction, Launch Systems, Recovery Systems, Launch and Recovery Trade-offs. | |

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

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

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| # | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks 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**<br>(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** | | | | | | |
|---|---|---|---|---|---|---|
| **BIOINFORMATICS**<br>**Category: Institutional Electives-II - Group I**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21BT75IB** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **42 Hrs** | | **SEE Duration** | **:** | **3 Hours** |

| **Unit-I** | **09 Hrs** |
|---|---|
| **Introduction to tools and databases:** Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases, Applications of these databases, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method | |
| **Unit – II** | **09 Hrs** |
| **Sequence Analysis:** Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM<br>**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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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:**<br>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:**<br>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.<br>**Wet Biomass Gasifiers:**<br>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:**<br>Green Sustainable Materials, Environmental Design for Sustainability.<br>**Dry Biomass Gasifiers:**<br>Biomass energy conversion routes, Thermal gasification of biomass, Classification of gasifiers, Fixed bed systems: |
| **Unit –V** **09Hrs** |
| **Case Studies:**<br>Odor Removal for Organics Treatment Plant, Bio-methanation, Bioethanol production. Bio fuel from water hyacinth. |

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

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

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

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(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 | | | | | | |
|---|---|---|---|---|---|---|
| **ADVANCESINCORROSIONSCIENCEANDMANAGEMENT**<br>**Category: Institutional Elective-II – Group I**<br>**(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** |
|---|---|
| **Basics of corrosion:**<br>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.<br>**Corrosion in different engineering materials**: Concrete structures, duplex, stainless steels, ceramics, composites. | |
| **Unit-II** | **08Hrs** |
| **Corrosion mechanism:**<br>Electrochemical theory of corrosion**,** Crevice corrosion-mechanism of differential aeration corrosion, mixed potential theory for understanding common corrosion of metals and alloys.<br>**Thermodynamics of Corrosion:** Pourbaix diagram and its importance in metal corrosion and its calculation for Al, Cu, Ni and Fe. | |
| **Unit– III** | **08 Hrs** |
| **Effects of corrosion:**<br>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.<br>Corrosion issues in specific industries-power generation, chemical processing industries, oil and gas Industries, corrosion effect in electronic industry. | |
| **Unit–IV** | **09 Hrs** |
| **Corrosion Testing and monitoring**:<br>Introduction, classification. Purpose of corrosion testing, materials, specimen. Surface preparation, measuring and weighing. Types of testing, lab, pilot plant and field tests. Measurement of corrosion rate, weight loss method, CPR numericals, Electrochemical methods, Tafel extrapolation. Linear polarization method. | |
| **Unit–V** | **09 Hrs** |
| **Corrosion Control:**<br>Principlesofcorrosionprevention,materialselection,designconsiderations,controlofenvironment-decreaseinvelocity,passivity,removaloxidizer,Inhibitorsandpassivators, coatings- organic, electroplating of Copper, Nickel and Chromium, physical vapor deposition-sputtering, Electroless plating of Nickel. | |

| Course Outcomes :After completing the course, the students will be able to | |
|---|---|
| **CO1** | Understand the causes and mechanism of various types of corrosion |
| **CO2** | Apply the knowledge of chemistry in solving issues related to corrosion. |
| **CO3** | Analyse and interpret corrosion with respect to practical situations. |
| **CO4** | Develop practical solutions for problems related to corrosion. |
| **Reference Books** | |
| **1** | Corrosion Engineering, M.G, Fontana, 3rdEdition, 2005,Tata McGraw Hill, ISBN: 978- 0070214637. |
| **2** | Principles and Prevention of Corrosion,D. A Jones,2ndEdition,1996,PrenticeHall, ISBN: 978-0133599930. |
| **3** | Design and corrosion prevention, Pludek, 1978,McMillan,ISBN:978-1349027897 |
| **4** | Introductiontometalcorrosion,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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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**<br>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**<br>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**<br>**Tools & IDEs**<br>Capabilities include: Developing and experimenting with prompts, Evaluating prompts. Versioning and deploying prompts; Advanced prompting techniques: advanced applications with LLMs<br>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:**<br>**LLM Applications:** Function Calling with LLMs - Getting Started with Function Calling, Function Calling with GPT-4, Function Calling with Open-Source LLMs,<br>**Function Calling Use Cases: Conversational Agents, Natural Language Understanding, Math Problem Solving, API Integration, Information Extraction** | |
| **Unit –V** | **08 Hrs** |
| **Opportunities and Future Directions**<br>Model safety, Prompt Injection, Prompt Leaking, Jail Breaking;<br>Reinforcement Learning from Human Feedback (RLHF) -- Popular examples: aClaude (Anthropic), ChatGPT (OpenAI),<br>**Future directions:** Augmented LMs, Emergent ability of LMs, Acting / Planning - Reinforcement Learning, Multimodal Prompting, Graph Prompting | |

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

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

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| # | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10**)** Real time 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**<br>(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 OFSTRUCTURES**<br>**Category: Institutional Electives-II - Group I**<br>**(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** | **07 Hrs** |
|---|---|
| **Structural Health**: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance<br>**Structural Health Monitoring**: Concepts, Various Measures, Analysis ofbehavior of structures using remote structural health monitoring, Structural Safety in Alteration. | |
| **Unit – II** | **Unit – II** |
| **Materials:** Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM<br>**Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence | |
| **Unit –III** | **Unit –III** |
| **Static Field Testing:** Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. | |
| **Unit –IV** | **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** | **Unit –V** |
| **Remote Structural Health Monitoring**: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring<br>**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, 1st Edition, 2014, ISBN-13: 978-0124186620. |
| **2** | Electronic Textiles: Smart Fabrics and Wearable Technology, Tilak Dias, Woodhead Publishing; 1 edition,**ISBN-13:** 978-0081002018. |
| **3** | Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, 1st Edition, ISBN-13: 978-1260116151. |
| **4** | Flexible and Wearable Electronics for Smart Clothing: Aimed to Smart Clothing, Gang Wang, Chengyi Hou, Hongzhi Wang , Wiley, 1st Edition, ISBN-13: 978-3527345342 |
| **5** | Printed Batteries: Materials, Technologies and Applications, Senentxu Lanceros-Méndez, Carlos Miguel Costa, Wiley, 1 edition , ISBN-13: 978-1119287421 |

| RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY) | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.** | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21EC75IG** | | **CIE** | **:** | **100 Marks** |
| **Credits: L:T:P** | **:** | **3:0:0** | | **SEE** | **:** | **100 Marks** |
| **Total Hours** | **:** | **39L** | | **SEE Duration** | **:** | **03 Hours** |

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

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

| **Reference Books** | |
|---|---|
| **1** | Wearable Sensors: Fundamentals, Implementation and Applications, Edward Sazonov, Michael R. Neuman Academic Press, 1st Edition, 2014, ISBN-13: 978-0124186620. |
| **2** | Electronic Textiles: Smart Fabrics and Wearable Technology, Tilak Dias, Woodhead Publishing; 1 edition,**ISBN-13:** 978-0081002018. |
| **3** | Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers, McGraw-Hill Education, 1st Edition, ISBN-13: 978-1260116151. |
| **4** | Flexible and Wearable Electronics for Smart Clothing: Aimed to Smart Clothing, Gang Wang, Chengyi |

| | |
|---|---|
| | Hou, Hongzhi Wang , Wiley, 1st Edition, ISBN-13: 978-3527345342 |
| **5** | Printed Batteries: Materials, Technologies and Applications, Senentxu Lanceros-Méndez, Carlos Miguel Costa, Wiley, 1 edition , ISBN-13: 978-1119287421 |

| **RUBRICFORTHECONTINUOUSINTERNALEVALUATION(THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluatedfor10Marks.**THESUMOFTWOQUIZZES WILLBETHEFINALQUIZ 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 evaluatedfor**50Marks**,addingupto100Marks.**FINALTESTMARKSWILLBE REDUCEDTO40MARKS.** | **40** |
| 3. | **EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practicalimplementationoftheproblem.Casestudy-basedteachinglearning(10),Program specificrequirements(10),Videobasedseminar/presentation/demonstration(10)**)**Realtime problemsolving(10)**ADDINGUPTO40MARKS**. | **40** |
| | **MAXIMUMMARKSFORTHECIETHEORY** | **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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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.<br>**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.<br>**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.<br>**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<br>**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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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:**<br>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:**<br>The I/O section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O specifications<br>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:**<br>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.<br>**Program Control &Data manipulation Instructions**: Data handling instructions, Sequencer instructions, Programming sequence output instructions. | |
| **UNIT V** | **09 Hrs** |
| **SCADA & DCS**<br>Building Block of SCADA System, Hardware structure of Remote Terminal Unit, Block diagram of Distributive Control System<br>**Case Studies**: Bottle filling system, Material Sorter. Elevator, Traffic control, Motor sequencers, Piston extraction and retraction using timers and counters. | |

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

| **Reference Books** | |
|---|---|
| 1. | Programmable Logic controllers, Frank D. Petruzella, Mc Graw hill, 4th Edition, ISBN:9780073510880, 2017 |
| 2. | Introduction to Programmable Logic Controllers, Garry Dunning, CENGAGE Learning, 3rd Edition, 2017, ISBN: 978-8131503027 |
| 3. | Industrial Control and Instrumentation, Bolton W, Universities Press, 6th Edition, 2006. ISBN |

| | |
|---|---|
| | 978-0128029299 |
| 4. | Computer Based Industrial control, Krishna Kant, PHI Publishers, 2nd Edition, 2010. ISBN 978-8120339880. |

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

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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. |

| RUBRICFOR 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**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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:**<br>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.<br>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**:<br>User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Testing app UI, Testing the User Interface | |
| **Unit–III** | **09 Hrs** |
| **Working in the background:**<br>Async Taska 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:**<br>Preferences and Settings, Storing Data, Shared Preferences. Storing data using SQLite, SQLite Database. Sharing data with content providers.<br>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:**<br>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, 2nd Edition, 2015, ISBN-13 978-0134171494 |
| **2** | AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089 |
| **3** | Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370 |
| **4** | Professional Android2ApplicationDevelopment,RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898 |
| **5** | BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1 |
| **6** | AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/ |

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
| **#** | **COMPONENTS** | **MARKS** |
| 1. | **QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS | **20** |
| 2. | **TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **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** |
| | **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**<br>**Category: Institutional Electives-II - Group I**<br>**(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** |
|---|---|
| **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.<br>**Generation and Screening of Project Ideas:** Generation of ideas, monitoring the environment, corporate appraisal, scouting for project ideas, preliminary screening, project rating index, sources of positive net present value. | |
| **Unit – II** | **09 Hrs** |
| **Project Scope Management:** Project scope management, collect requirements define scope, create WBS, validate scope, control scope.<br>**Organizational influences & Project life cycle:** Organizational influences on project management, project state holders & governance, project team, project life cycle. | |
| **Unit –III** | **09 Hrs** |
| **Project Integration Management:** Develop project charter, develop project management plan, direct & manage project work, monitor & control project work, perform integrated change control, close project or phase.<br>**Project Quality management:** Plan quality management, perform quality assurance, and control quality. | |
| **Unit –IV** | **09 Hrs** |
| **Project Risk Management:** Plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk resources, control risk.<br>**Project Scheduling:** Project implementation scheduling, Effective time management, Different scheduling techniques, Resources allocation method, PLM concepts. Project life cycle costing. | |
| **Unit –V** | **09 Hrs** |
| **Tools & Techniques of Project Management**: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management. | |

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

| **Reference Books** | |
|---|---|
| | Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", 5th Edition, 2013, ISBN: 978-1-935589-67-9 |
| 2. | Harold Kerzner, Project Management A System approach to Planning Scheduling & Controlling, John |

| | |
|---|---|
| | Wiley & Sons Inc., 11th Edition, 2013, ISBN 978-1-118-02227-6. |
| 3. | Prasanna Chandra, Project Planning Analysis Selection Financing Implementation & Review, Tata McGraw Hill Publication, 7th Edition, 2010, ISBN 0-07-007793-2. |
| 4. | Rory Burke, "Project Management – Planning and Controlling Techniques", John Wiley & Sons, 4th Edition, 2004, ISBN: 9812-53-121-1 |


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

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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.<br>Data-Driven Supply Chains and Intro to Python: Data and Its Value in SCM, Data Source in Supply Chains, Big Data, Introduction to Python | |
| **Unit – II** | **09 Hrs** |
| Data Manipulation: Data Manipulation, Data Loading and Writing, Data Indexing and Selection, Data Merging and Combination, Data Cleaning and Preparation, Data Computation and Aggregation, Working with Text and Datetime Data,<br>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 | |
| **Unit –III** | **09 Hrs** |
| Customer Management: Customers in Supply Chains, Understanding Customers, Building a Customer-Centric SC, Cohort Analysis, RFM Analysis, Clustering Algorithms.<br>Supply Management: Procurement in Supply Chains, Supplier Selection, Supplier Evaluation, Supplier Relationship Management, Supply Risk Management, Regression Algorithms. | |
| **Unit –IV** | **09 Hrs** |
| Warehouse and Inventory Management: Warehouse Management, Inventory Management, Warehouse Optimization, Classification Algorithms.<br>Demand Management: Demand Management, Demand Forecasting, Time Series Forecasting, Machine Learning Methods. | |
| **Unit –V** | **09 Hrs** |
| Logistics Management: Logistics Management, Modes of Transport in Logistics, Logistics Service Providers, Global Logistics Management, Logistics Network Design, Route Optimization. | |

| **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, 6th Edition, 2016, Pearson Education Asia; ISBN: 978-0-13-274395-2. |
| 4. | Supply Chain Management – Creating Linkages for Faster Business Turnaround, Sarika Kulkarni & Ashok Sharma, 1st Edition, 2004, TATA Mc Graw Hill, ISBN: 0-07-058135–5 |


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

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q.NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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**<br>**Category: Institutional Electives-II - Group I**<br>**(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 6th Edition Woods worth Cenguage Learning |
| 2. | Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co. |
| 3. | Psychology Robert A. Baron, III edition (1995) Prentice Hall India. |
| 4. | Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India |

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

| RUBRIC FOR SEMESTER END EXAMINATION (THEORY) | | |
|---|---|---|
| **Q. NO.** | **CONTENTS** | **MARKS** |
| | **PART A** | |
| 1 | Objective type questions covering entire syllabus | 20 |
| | **PART B**<br>(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**<br>**Category: Institutional Electives-II - Group I**<br>**(Theory)** | | | | | | |
| **Course Code** | **:** | **21HS75IR** | | **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.<br>**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.<br>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.<br>**Electronic Signature and Digital Signature**- Meaning &Concept of Relevance of Signature, Handwritten signature vs Digital Signature, Technological Advancement and development of signature, Digital Signature: IT Act, 2000, Cryptography, Public Key and Private Key, Public Key Infrastructure Electronic Signature vs. Digital Signature, E-Commerce under IT Act2000, Issues and challenges of E-Commerce.<br>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.<br>**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.<br>Activities: Case Studies and Practical Applications | |
| **Unit –IV** | **08 Hrs** |
| **IP Protection Issues in Cyberspace**<br>**Copyright Issues in Cyberspace**- Copyright infringement in digital environment. Indian legal protection of copyright in cyberspace.<br>**Trademark Issues in Cyberspace** -Domain Name Vs Trademark, Domain Name dispute and Related Laws, Different Form of Domain in Cyberspace.<br>**Patent Issues in Cyberspace**-Legal position on Computer related Patents - Indian Position on Patents.<br>Activities: Case Studies and Practical Applications | |
| **Unit –V** | **07 Hrs** |
| **Digital Forensics**- Computer Forensics, Mobile Forensics ,Forensic Tools ,Anti-Forensics<br>**Cyber Crime & Criminal Justice Agencies** -Cyber Crime Cells, Cyber Crime Appellate- Cyber Crime Investigation, Investigation Procedure- FIR -Charge Sheet | |

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

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

| **RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)** | | |
|---|---|---|
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| | **MAXIMUM MARKS FOR THE CIE THEORY** | **100** |

| **RUBRIC FOR SEMESTER END EXAMINATION (THEORY)** | | |
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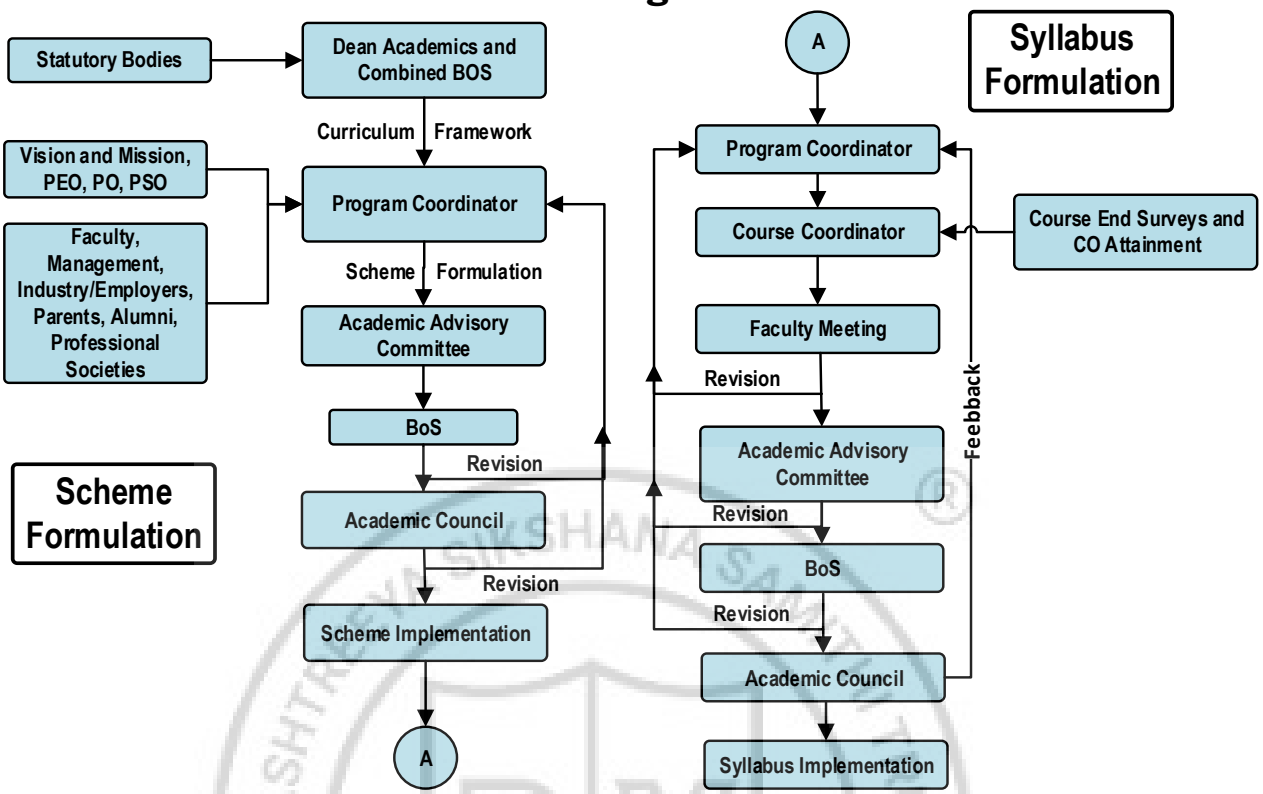
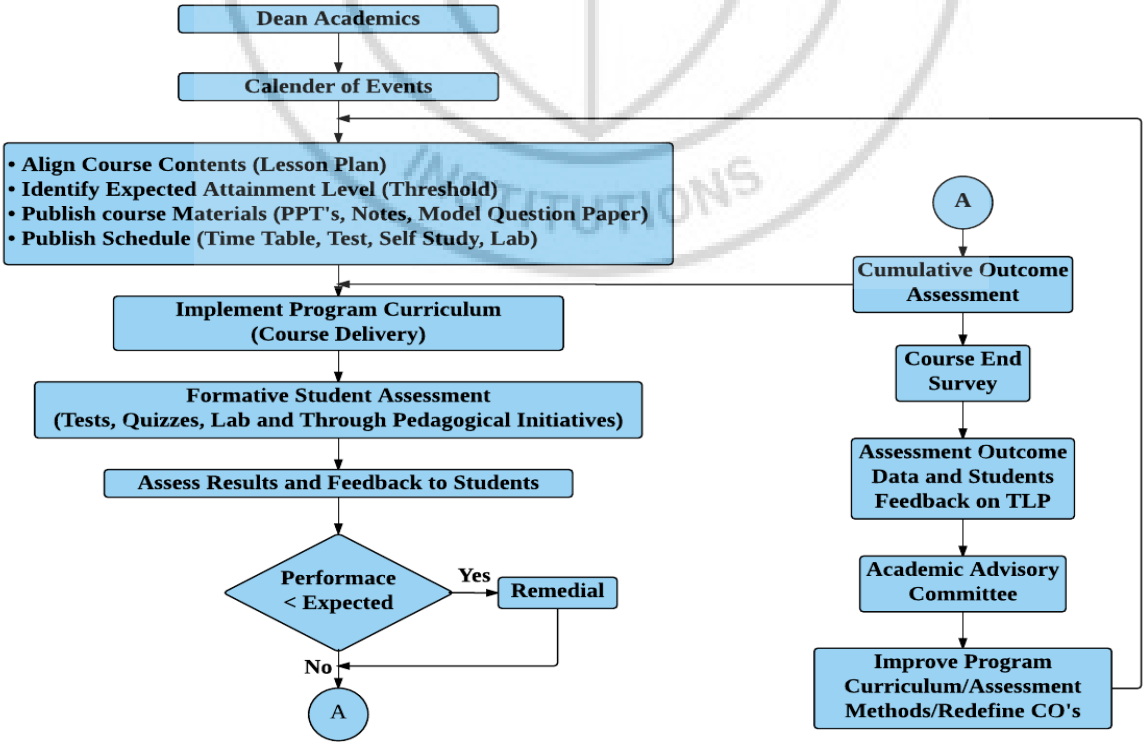
| 7 & 8 | Unit 4 : Question 7 or 8 | 16 |
| 9 & 10 | Unit 5: Question 9 or 10 | 16 |
| | **TOTAL** | **100** |

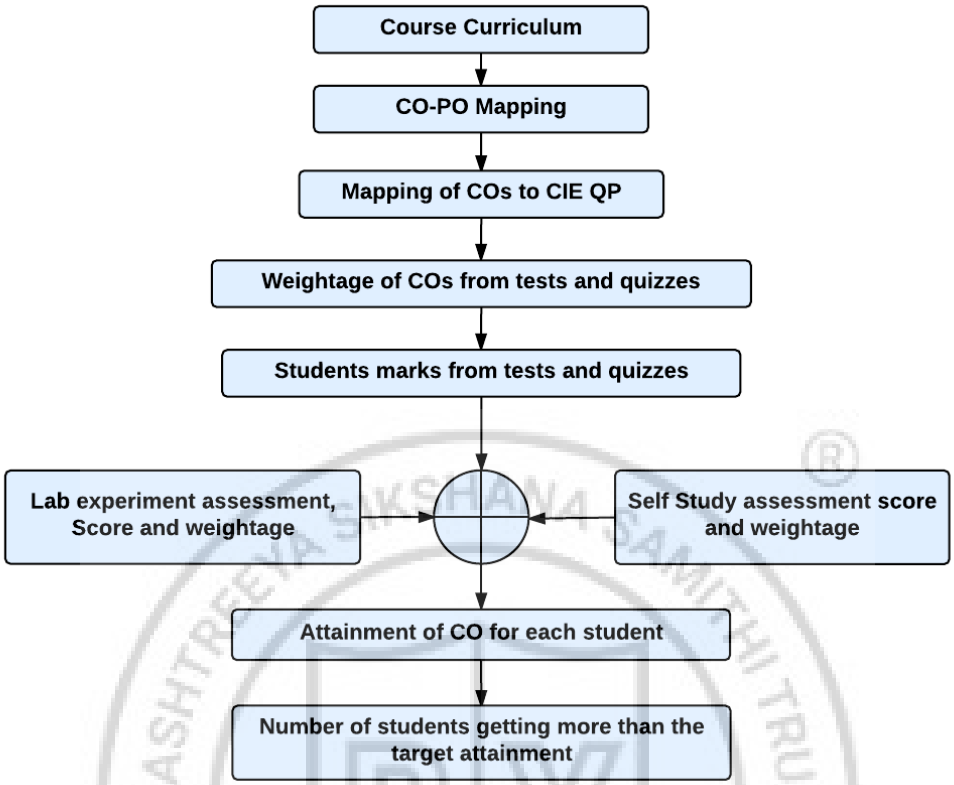
## Curriculum Design Process



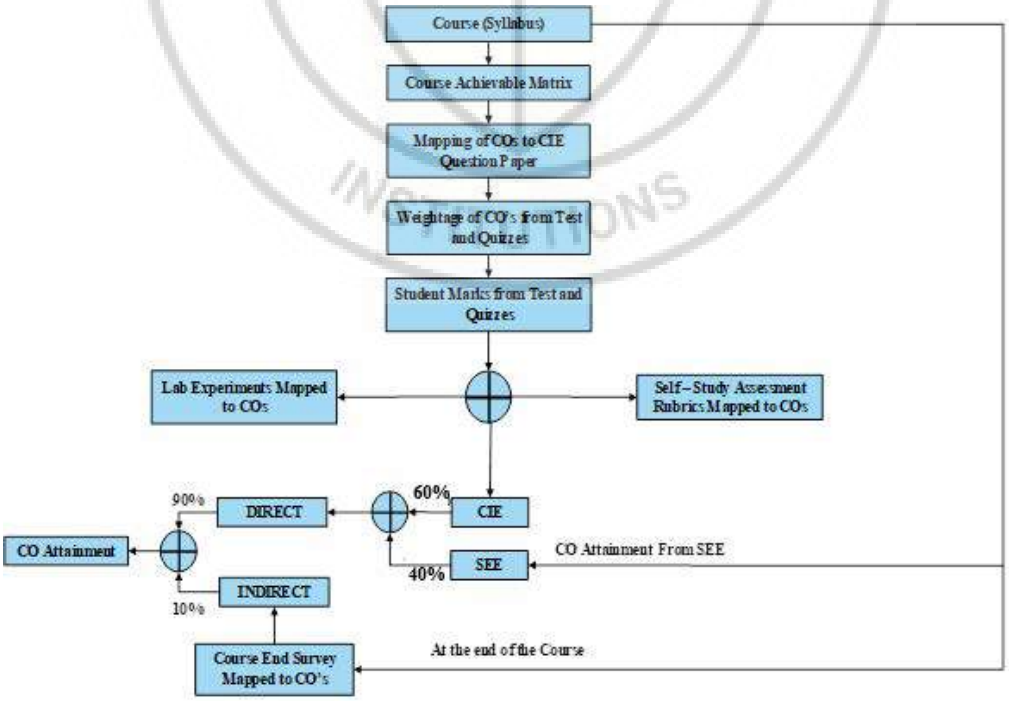

## Academic Planning and Implementation



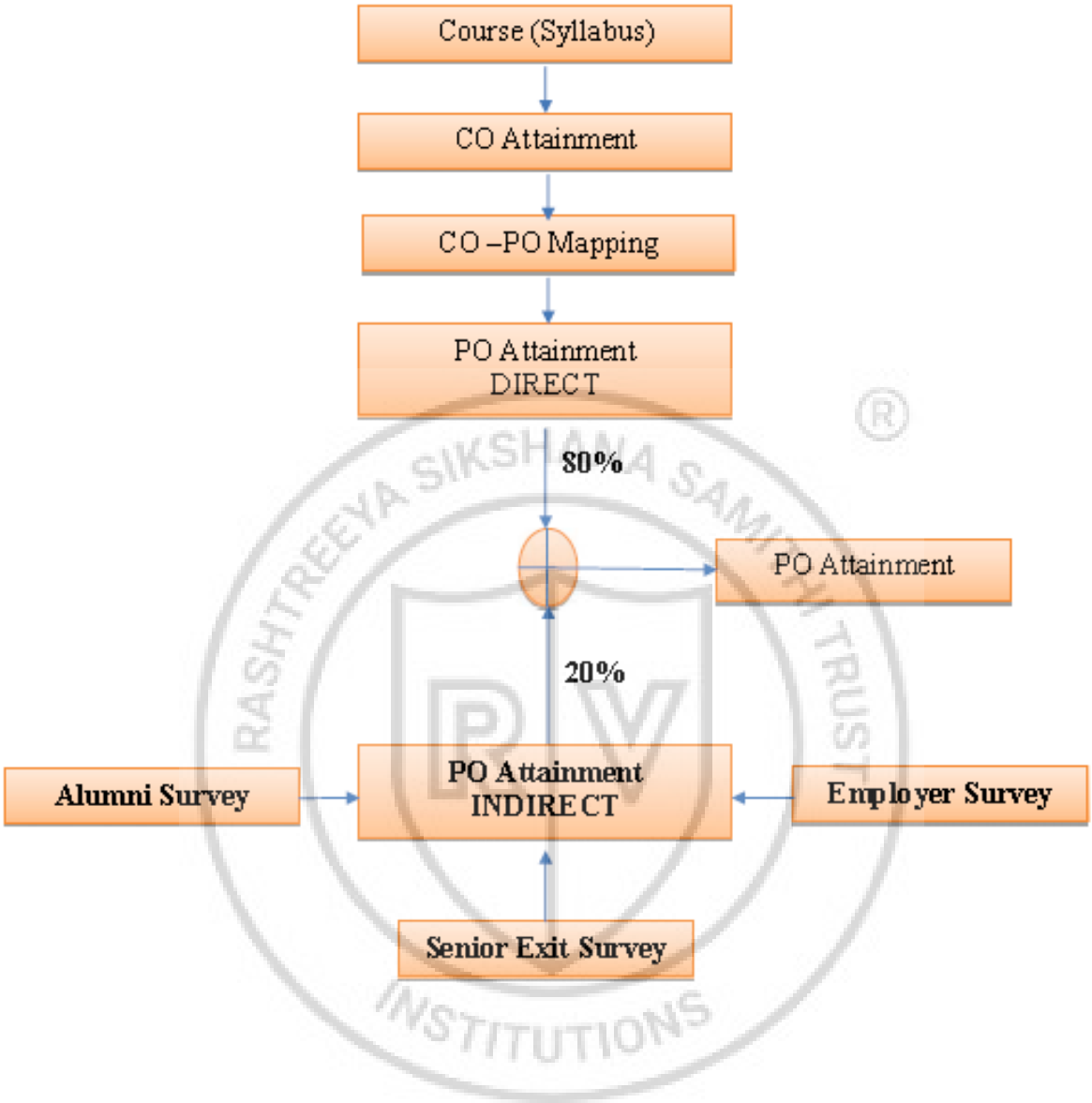
# Process For Course Outcome Attainment




# Final CO Attainment Process



## Program Outcome Attainment Process



# KNOWLEDGE & ATTITUDE PROFILE

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

# PROGRAM OUTCOMES (POs)

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

# INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

## VISION

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

## MISSION

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

## QUALITY POLICY

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

## CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation