RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

Computer Science & Engineering (Data Science)

Scheme And Syllabus Of V & VI Semester
(2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, 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)

1501+
501-600

BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
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

RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

Computer Science & Engineering (Data Science)

Scheme And Syllabus Of V & VI Semester
(2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, 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

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT VISION

To achieve leadership in the field of Computer Science & Engineering by strengthening fundamentals and facilitating interdisciplinary sustainable research to meet the ever growing needs of the society.

DEPARTMENT MISSION

- To evolve continually as a centre of excellence in quality education in computers and allied fields.
- To develop state-of-the-art infrastructure and create environment capable for interdisciplinary research and skill enhancement.
- To collaborate with industries and institutions at national and international levels to enhance research in emerging areas.
- To develop professionals having social concern to become leaders in top-notch industries and/or become entrepreneurs with good ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop Graduates capable of applying the principles of mathematics, science, core engineering and Computer Science to solve real-world problems in interdisciplinary domains.

PEO2: To develop the ability among graduates to analyze and understand current pedagogical techniques, industry accepted computing practices and state-of-art technology.

PEO3: To develop graduates who will exhibit cultural awareness, teamwork with professional ethics, effective communication skills and appropriately apply knowledge of societal impacts of computing technology.

PEO4: To prepare graduates with a capability to successfully get employed in the right role /become entrepreneurs to achieve higher career goals or take up higher education in pursuit of lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	**System Analysis and Design** The student will be able to: 1. Recognize and appreciate the need of change in computer architecture, data organization and analytical methods in the evolving technology. 2. Learn the applicability of various systems software elements for solving design problems. 3. Identify the various analysis & design methodologies for facilitating development of high quality system software products with focus on performance optimization. 4. Display team participation, good communication, project management and document skills.
PSO2	**Product Development** The student will be able to: 1. Demonstrate the use of knowledge and ability to write programs and integrate them with the hardware/software products in the domains of embedded systems, databases/data analytics, network/web systems and mobile products. 2. Participate in planning and implement solutions to cater to business – specific requirements displaying team dynamics and professional ethics. 3. Employ state-of-art methodologies for product development and testing / validation with focus on optimization and quality related aspects.

Lead Society: Institute of Electrical and Electronics Engineers (IEEE)

ABBREVIATIONS

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

INDEX

Computer Science & Engineering [Data Science]

FIFTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	HS	HS251TA	Principles of Management and Economics	3	0	0	3	Theory	**100**	***	**3**	**100**	***
2	CD	CD252IA	Database Management Systems (Common to CS & IS, AI, CD) (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	IS	IS353IA	Artificial Intelligence and Machine Learning Common to CS, CY, CD & IS) (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	CS	CS354TA	Theory of Computation (Common to CS, CY, CD & IS)	3	1	0	4	Theory	**100**	***	**3**	**100**	***
5	CD	XX355TBX	Professional Core Elective-I (Group-B)	3	0	0	3	Theory	**100**	***	**3**	**100**	***
6	CS	XX256TCX	Professional Core Elective-II (Group C)	2	0	0	2	**NPTEL**	***	***	**2**	**50**	***
				Total			**20**						

Group B: Professional Core Elective – I Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
5	CD	CD355TBA	Soft and Evolutionary Computing	3
	CD	CD355TBB	Data Mining	3
	IS	IS355TBC	Natural Language Processing (Common to CS, CD & IS)	3
	IS	IS355TBD	Cloud Computing (Common to CS, CD & IS)	3

Group C: NPTEL COURSES (Professional Core Elective – II Courses)					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	AI	AI256TCA	Information Security - 5 - Secure Systems Engineering (Common to CS, CY, CD, IS & AI)	NPTEL	2
	CS	CS256TCB	AI: Constraint Satisfaction (Common to CS, CD & CY)	NPTEL	2
	CS	CS256TCC	Foundation of Cloud IoT Edge ML (Common to CS, IS, CD & CY)	NPTEL	2
	CS	CS256TCD	Edge Computing (Common to CS, CY, CD & AI)	NPTEL	2
	IS	IS256TCE	Introduction To Soft Computing (Common to CS, IS, CD & CY)	NPTEL	2

Computer Science & Engineering [Data Science]

SIXTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	HS	HS361TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	Theory	**100**	***	**3**	**100**	***
2	CD	CD362IA	Big Data Systems (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	CD	CD363IA	Data Analytics & Visualization (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	IS	IS364TA	Software Engineering with Agile Technologies (Common to CS, IS, CD & CY)	4	0	0	4	Theory	**100**	***	**3**	**100**	***
5	CD	XX365TDX	Professional Core Elective-III **(Group- D)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
6	XX	XX366TEX	Institutional Electives – I **(Group E)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
7	CD	CD367P	Interdisciplinary Project	0	0	3	3	Project	***	**100**	**3**	***	**100**
			Total				**24**						

Group D: Professional Core Elective – III Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
5	CS	CS365TDA	Computer Vision (Common to CS & CD)	3
	CD	CD365TDB	Semantic Web and Social Network Analysis	3
	CD	CD365TDC	Deep Learning (Common to CD & CY)	3
	AI	AI365TDD	Generative Artificial Intelligence (Common to AI, CS, CD & IS)	3
	CD	CD365TDE	Data Security and Privacy	3

Group E: Institutional Electives-I Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
6	AS	AS266TEA	Fundamentals of Aerospace Engineering	3
	BT	BT266TEB	Bioinformatics	3
	CH	CH266TEC	Industrial Safety Engineering	3
	CS	CS266TED	Robotics Process Automation	3
	CV	CV266TEE	Intelligent Transport Systems	3
	CV	CV266TEF	Integrated Health Monitoring of Structures	3
	CM	CM266TEG	Advanced Energy Storage for E-Mobility	3
	EC	EC266TEH	Human Machine Interface(HMI)	3
	EE	EE266TEJ	Energy Auditing and Standards	3
	EI	EI266TEK	Biomedical Instrumentation	3
	ET	ET266TEM	Telecommunication Systems	3
	ET	ET266TEN	Mobile Communication Networks and Standards	3
	IS	IS266TEO	Mobile Application Development	3
	IM	IM266TEQ	Elements of Financial Management	3
	IM	IM266TER	Optimization Techniques	3
	ME	ME266TES	Automotive Mechatronics	3
	MA	MA266TEU	Mathematical Modelling	3
	MA	MA266TEV	Mathematics of Quantum Computing	3
	HS	HS266TEW	Applied Psychology for Engineers	3
	HS	HS266TEY	Universal Human Values	3

Semester: V						
PRINCIPLES OF MANAGEMENT AND ECONOMICS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to All Programs)**						
Course Code	**:**	**HS251TA**		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Introduction to Management: Management Functions – POSDCORB – an overview, Management levels & Skills, Management History - **Classical Approach:** Scientific Management, Administrative Theory, **Quantitative Approach:** Operations Research, **Behavioral Approach:** Hawthorne Studies, **Contemporary Approach:** Systems Theory, Contingency Theory. **Caselets / Case studies**	
Unit – II	**10 Hrs**
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate strategies – types of corporate strategies, BCG matrix, Competitive Strategies – Porters Five force Model, types of Competitive Strategies. **Caselets / Case studies** **Organizational Structure & Design:** Overview of Designing Organizational Structure - Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures. **Caselets / Case studies**	
Unit –III	**10 Hrs**
Motivation: Early Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory. Contemporary Theories of Motivation: Adam's Equitytheory, Vroom's Expectancy Theory. **Caselets / Case studies** **Leadership:** Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. **Caselets / Case studies**	
Unit –IV	**10 Hrs**
Introduction to Economics: Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems. **Essentials of Microeconomics:** Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly.	
Unit –V	**09 Hrs**
Macroeconomic Indicators: Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations, ESG an overview. **Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Elucidate the principles of management theory & recognize the characteristics of an organization.
CO2:	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO3:	Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation.
CO4:	Demonstrate an understanding on the usage and application of basic economic principles.
CO5:	Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation.

Reference Books	
1	Management, Stephen Robbins, Mary Coulter &NeharikaVohra, 15th Edition, 2021, Pearson Education Publications, ISBN: 13: 978-0-13-558185-8
2	Management, James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 2009, PHI, ISBN: 81-203-0981-2.
3	Principles of Microeconomics, Steven A. Greenlaw, David Shapiro, 2nd Edition, 2017, ISBN:978-1-947172-34-0
4	Macroeconomics: Theory and Policy, Dwivedi D.N, 5th Edition, 2021, McGraw Hill Education; ISBN : 9789353163334

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 (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: V						
DATABASE MANAGEMENT SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to CS & IS, AI, CD)**						
Course Code	**:**	**CD252IA**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 +3 Hours**

Unit-I	**09 Hrs**
Introduction to Database Systems -Databases and Database users: Introduction, An example, Characteristics of Database Approach, Data Models, Schemas and Instances, Three-schema Architecture and Data Independence, The Database System Environment. **Data Modeling Using the Entity-Relationship Model-** High-Level Conceptual Data Models for Database Design; A Sample Database Application; Entity Types, Entity Sets, Attributes and Keys; Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types.	
Unit – II	**09 Hrs**
Refining the ER Design for the COMPANY Database; ER Diagrams, Naming Conventions and Design Issues, ER- to-Relational Mapping. **Relational Model and Relational Algebra-**Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations and Dealing with Constraint Violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION ; Examples of Queries in Relational Algebra.	
Unit –III	**09 Hrs**
Introduction to SQL- SQL Data Definition, Specifying Constraints in SQL, Basic Queries in SQL; Insert, Delete and Update Statements in SQL More Complex SQL Retrieval Queries. **Relational Database Design -** Functional Dependencies – Definition, Inference Rules, Equivalence of sets of FD's, Minimal Set of FD's ; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form; Properties of Relational Decompositions.	
Unit –IV	**09 Hrs**
Transaction Processing Concepts- Introduction to transaction processing, Transaction states and additional operations, Desirable properties of transaction, Schedules of transactions. Characterizing schedules based on Serializability: Serial, Non serial and Conflict- Serializable schedules, Testing for Conflict serializability of schedule **Concurrency Control Techniques:** Two phase locking techniques for concurrency control, types of locks and system lock tables	
Unit –V	**09 Hrs**
Introduction to NoSQL: Aggregate data models: aggregates, key-value and document data models. Distribution models: sharding, master-slave replication, peer-peer replication – combining sharding and replication. Big Data: Types of data: Structured, semi structured, unstructured. Distributed Architectures : Hadoop, Map Reduce Programming Model	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand and explore the needs and concepts of relational, NoSQL database and Distributed Architecture
CO2	Apply the knowledge of logical database design principles to real time issues.
CO3	Analyze and design data base systems using relational, NoSQL and Big Data concepts
CO4	Develop applications using relational and NoSQL database
CO5	Demonstrate database applications using various technologies.

Reference Books	
1.	Elmasri and Navathe: Fundamentals of Database Systems, 6 th Edition, Pearson Education, 2011, ISBN-13: 978-0136086208.
2.	Pramod J Sdalage, Martin Fowler: NoSQL A brief guide to the emerging world of Polyglot Persistence, Addison-Wesley, 2012, ISBN 978-0-321-82662-6,
3.	Raghu Ramakrishnan and Johannes Gehrke : Database Management Systems, 3thEdition, McGraw-Hill, 2003 ISBN : 978-0072465631.
4.	Seema Acharya and Subhashini Chellappan. *Big Data and Analytics*. Wiley India Pvt. Ltd. Second Edition

LABORATORY COMPONENT

PART – A

Open Ended Mini Project should be implemented and shall be carried out in a batch of two students. The students will finalize a topic in consultation with the faculty. The mini project must be carried out in the college only.

The Mini Project tasks would involve:

- Understand the complete domain knowledge of application and derive the complete data requirement specification of the Mini Project
- Design of the project with Integrated database solution (SQL and NOSQL)
- Normalization of the Relational design up to 3NF.
- Appreciate the importance of security for database systems.
- Documentation and submission of report.
- Recent Trends used (Blockchain, NLP, AI, ML, AR, VR etc) and Societal Concern issues addressed

General Guidelines :

- Database management for the project- MySQL, DB2, Oracle, SQL Server, MongoDB (Any NoSQL DB) server or any database management tool.
- Front End for the project – Java , VC++, C#, Python , Web Interface (HTML, Java Script)
    - Use database Programming such as Embedded SQL,/Dynamic SQL/SQLJ.

RUBRICFOR 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) **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 (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 AND PRACTICE)		**150**

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

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

Semester: V						
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING **Category: PROFESSIONAL CORE COURSE** **(Theory and Lab)** (Common to CS, CD, CY & **IS**)						
Course Code	**:**	**IS353IA**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L + 30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**09 Hrs**
Introduction: What is AI? Intelligent agents: Intelligent Agents: Agents and environment; Rationality; the nature of environments; the structure of agents **Problem Solving & Uninformed Search Strategies:** Problem-solving agents, Breadth-first Search, Depth-first Search, Depth-limited Search and Iterative Deepening Depth First Search.	
Unit – II	**09 Hrs**
Informed (Heuristic) Search Strategies: A*Search, Heuristic Functions **Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Hill-climbing Search, Simulated Annealing, Local-beam Search, Genetic Algorithms **Adversarial search:** Games, Optimal decision in games, Alpha-Beta Pruning	
Unit –III	**09 Hrs**
Supervised Learning: Basic Concepts, General Framework for Classification **Decision Tree Classifier**-A Basic Algorithm to Build a Decision Tree, Methods for Expressing Attribute Test Conditions, Measures for Selecting an Attribute Test Condition, Algorithm for Decision Tree Induction, Characteristics of Decision Tree Classifiers, **Model Overfitting-** Reasons for Model Overfitting **Model Selection -** Using a Validation Set, Incorporating Model Complexity, Estimating Statistical Bounds, Model Selection for Decision Trees, Model Evaluation	
Unit –IV	**09 Hrs**
Nearest Neighbor Classifiers-Characteristics of Nearest Neighbor Classifiers **Naive Bayes Classifier**-Basics of Probability Theory, Naive Bayes assumption **Logistic Regression**-Logistic Regression as a Generalized Linear Model, Learning Model Parameters, Characteristics of Logistic Regression **Ensemble Methods** – Methods for constructing Ensemble classifier, Bagging, Boosting, Random Forests	
Unit –V	**09 Hrs**
Unsupervised Learning- Overview, What Is Cluster Analysis, Different Types of Clustering's, Different Types of Clusters **K-means**-The Basic K-means Algorithm, Additional Issues, Bisecting K-means, K-means and Different Types of Clusters, Strengths and Weaknesses, K-means as an Optimization Problem **Cluster Evaluation**-Overview, Unsupervised Cluster Evaluation Using Cohesion and Separation, Unsupervised Cluster Evaluation Using the Proximity Matrix, Determining the Correct Number of Clusters, Supervised Measures of Cluster Validity, Assessing the Significance of Cluster Validity Measures, Choosing a Cluster Validity Measure	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain and apply AI and ML algorithms to address various requirements of real-world problems
CO 2	Design and develop AI and ML solutions to benefit society, science, and industry.
CO 3	Use modern tools to create AI and ML solutions.
CO 4	Demonstrate effective communication through team presentations and reports to analyze the impact of AI and ML solutions on society and nature.
CO 5	Conduct performance evaluation, modeling, and validation of AI and ML solutions benefiting lifelong learning

Reference Books	
1.	AI – A Modern Approach ,Stuart Russel, Peter Norvig, 3rd Edition, 2010, Pearson, ISBN-13: 978-0136042594
2.	Artificial Intelligence Basics: A Self Teaching Introduction, Neeru Gupta and Ramita Mangla, Mercury Learning and Information, 1st Edition, 2020, ISBN: 978-1-68392-516-3
3.	Machine Learning ,Tom M. Mitchell, Indian Edition, 2013, McGraw Hill Education, ISBN – 10 – 1259096955
4.	Introduction to Data Mining ,Pang-Ning Tan, Michael Steinbach, Vipin Kumar,2nd edition, 2019,Pearson , ISBN-10-9332571406, ISBN-13 -978-9332571402

LABORATORY COMPONENT

PART – A	
Sl. No.	• Implement the following algorithms (5 to 8) using required statistical formulae and do not use direct API's. • Demonstrate the working of the algorithms by considering appropriate datasets • Display the values of all the model parameters
1	Solve the Tic-Tac-Toe problem using the Depth First Search technique
2	Demonstrate the working of Alpha-Beta Pruning.
3	Solve the 8-Puzzle problem using the A* algorithm
4	Implement a Hill-climbing search algorithm to maximize a single variable function f(x).
5	Logistic regression algorithm.
6	Naïve Bayes Classifier
7	KNN algorithm.
8	K- means algorithm

PART – B

Two students from the same batch must develop a Machine Learning model on the problem statements chosen from Agriculture, Health Care, Manufacturing, Automobiles and Process Control/Automation Domains preferably for Indian Scenarios. (Point No. 3 and 4 are optional)

1. The data collected should be cleansed and pre-processed.
2. The complete EDA process has to be demonstrated
3. Selection of the suitable algorithms and model-building
4. Model evaluation has to be carried out by selecting the proper metrics
    a) Prediction/classification results have to be obtained
    b) GUI should be created for demonstrating the results

RUBRICFOR 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) **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 (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 AND PRACTICE)	**150**

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

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

Semester: V						
THEORY OF COMPUTATION **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to CS, CD, CY & IS)**						
Course Code	**:**	**CS354TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L + 30T**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Regular Languages and Regular Expressions, Memory Required to Recognize a Language, Deterministic Finite Automata (DFA), Non Deterministic Finite Automata (NFA), Non Deterministic Finite Automata with ϵ -transitions (NFA-ϵ), Equivalence, Regular Expressions and Finite Automata, Applications of Regular Expressions, Algebraic laws of Regular Expressions, Minimization of Finite Automata.	
Unit – II	**09 Hrs**
Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision properties of Regular languages. Context-free grammars (CFG), Parse trees, Applications, Ambiguity in grammars & languages, Simplification of CFG, Normal forms of CFGs. Regular Grammars, Equivalence of Regular Grammars and Finite Automata.	
Unit –III	**09 Hrs**
Push Down Automata (PDA): Definition, the languages of a PDA, Equivalence of PDA's & CFG's, Deterministic PDA. The Pumping Lemma for Context Free Languages (CFL), Closure properties of CFLs, Decision properties of CFLs	
Unit –IV	**09 Hrs**
Context Sensitive Languages (CSL) and Linear Bounded Automata (LBA), Turing Machines (TM): Definitions and Examples, TM as a Language Accepter, Computing Partial Functions with Turing Machine, Variations of Turing Machines, Combining Turing Machines, Non Deterministic TM, Universal TM.	
Unit –V	**09 Hrs**
Recursively Enumerable Languages (REL) and Recursive Languages. Properties of REL and Recursive Languages. More General Grammars: Context Sensitive Grammar and Unrestricted Grammar, Chomsky Hierarchy, Not all languages are Recursively Enumerable, Unsolvable Problem, Reducing One problem to another, The halting problem of TM, Post's Correspondence Problem (PCP), Time and Space Complexity of TM.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the fundamental concepts of theory of computations.
CO 2	Analyze the tools of finite automata to various fields of computer science.
CO 3	Design solution model for complex problems, using the appropriate skills of automata theory for better results.
CO 4	Apply automata skills in situations that describe computation effectively and efficiently.

Reference Books	
1.	Introduction to Languages & Theory of Computation, John C Martin, Tata McGraw-Hill, 4th Edition, 2011 ISBN: 978-0-07-319146-1.
2.	Introduction to Automata Theory, Languages & Computation, J.P.Hopcroft, Rajeev Motwani, J.D.Ullman, Pearson Education., 3rd Edition, 2008,ISBN:81-3172-047-0.
3.	An Introduction To Formal Languages & Automata, Peter Linz, Narosa Publishing House, 6th Edition, 2007, ISBN: 07-6371-422-4.

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

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

Semester: V						
SOFT AND EVOLUTIONARY COMPUTING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)**						
Course Code	**:**	**CD355TBA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction to soft computing: Introduction, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing. **Introduction to Fuzzy logic:** Introduction, Fuzzy membership functions, Operations on Fuzzy sets, Membership value Assignments, Intuition, Inference, Features of the Membership Function.	
Unit – II	**09 Hrs**
Fuzzy Relations and Defuzzification: Fuzzy Relations, Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian product and Composition, Fuzzy Tolerance and equivalence Relations. Value Assignments - Cosine Amplitude, Max-min Method **Fuzzification and Defuzzification:** Fuzzification, defuzzification to crisp sets, Lambda-cuts for fuzzy relations, Defuzzification to Scalars	
Unit –III	**09 Hrs**
Fundamentals of Artificial Neural Networks: Introduction, learning & acquisition of knowledge, features of artificial neural networks (ANN), Back Propagation networks, fundamentals of connectionist modelling. **Major classes of Neural Networks:** Introduction, the multilayer perceptron, radial basis function network, Kohonen's self-organizing network, the Hopfield network, Industrial and commercial applications of ANN	
Unit –IV	**09 Hrs**
Evolutionary computing: Introduction, overview of evolutionary computing, genetic algorithms (GA) and optimization, the schema theorem, GA operators, Problem solving using GA, Integration of GA with neural networks, integration of GA with fuzzy logic, known issues in GA, Population based incremental learning, Applications of Genetic Algorithm; Hybrid Systems, Evolutionary strategies, ES applications.	
Unit –V	**09 Hrs**
Tools of soft computing in real world applications: Soft computing tools for solving a class of facilities layout planning problem, mobile position estimation using an RBF network in CDMA cellular systems, learning-based resource optimization in ATM networks. **Optimization problems**- Exhaustive vs Heuristic approaches, Typical problems, Heuristic vs Meta heuristics, Local Search, Tabu search, Simulated Annealing, Ant Colony Optimisation.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply the principles and components of soft computing in solving problems.
CO 2	Explore and understand basic concepts of of fuzzy sets and relations, fuzzy logic extension principle in the field of computer science and Engineering.
CO 3	Develop program systems using approaches of these theories for solving various real-world problems.
CO 4	Evaluate the concepts of optimization theory genetic computing, and evolutionary computing.
CO 5	Develop intelligent systems through case studies, simulation examples and experimental results.

Reference Books	
1.	Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
2.	Soft Computing and Intelligent Systems Design – Theory Tools and Applications, Fakhreddine O Karray & Clarence De Silva, 2009, PEARSON Education, ISBN: 978-81-317-2324-1.
3.	Neural Networks and Learning Machines Simon Haykin (PHI)
4.	Fuzzy and Soft Computing; A Computational Approach to Learning and Machine Intelligence, J S R Jang, C-T Sun, E Mizatani, Neurp, 1997, Prentice Hall, ISBN: 10:0132610663.
5.	Soft Computing and its Applications, K A Thev & RR Aliev, 2001, World Scientific Publishing Co., Inc. River Edge, NJ, USA, ISBN: 98102 47001.

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

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

Semester: V						
DATA MINING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)**						
Course Code	**:**	**CD355TBB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Data Warehousing: Introduction to Datawarehouse, Data Warehousing: A Multitiered Architecture, Data Warehousing: A Multitiered Architecture, Data Warehouse Models: Enterprise Warehouse, Data Mart, and Virtual Warehouse, Data Cube: A Multidimensional Data Model, Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models, Typical OLAP Operations, A Starnet Query Model for Querying Multidimensional Databases, A Business Analysis Framework for Data Warehouse Design, Data Warehouse Design Process, Data Warehouse Usage for Information Processing, From Online Analytical Processing to Multidimensional Data Mining	
Unit – II	**09 Hrs**
Introduction to Data Mining: Introduction to data mining - Data mining functionalities - Steps in data mining process Classification of data mining systems - Major issues in data mining. **Data Pre-processing:** Data Pre-processing: An overview - Data cleaning - Data integration -Data reduction - Data transformation	
Unit –III	**09 Hrs**
Frequent Pattern Mining: Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods: Apriori algorithm, FP-Growth algorithm - Mining frequent item sets using vertical data format **Advanced Pattern Mining:** Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns, Mining Compressed or Approximate Patterns, Pattern Exploration and Application	
Unit –IV	**09 Hrs**
Classification Techniques: General approach to classification - Classification by decision tree induction - Bayes classification methods - Model evaluation and selection - Techniques to improve classification accuracy **Classification: Advanced Methods:** Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, Classification Using Frequent Patterns, advanced classification methods: Bayesian belief networks-Lazy learners	
Unit –V	**09 Hrs**
Data Mining Trends and Research Frontiers: Overview of Web Mining-Temporal and Spatial Mining-Other methodologies of data mining: Statistical data mining- Data mining applications, Data Mining and Society, Ubiquitous and Invisible Data Mining, Privacy, Security, and Social Impacts of Data Mining	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Interpret the contribution of data warehousing and data mining to the decision support systems
CO 2	Construct the data needed for data mining using pre-processing techniques.
CO 3	Discover interesting patterns from large amounts of data using Association Rule Mining.
CO 4	Extract useful information from the labelled data using various classifiers and Compile unlabelled data into clusters applying various clustering algorithms.
CO 5	Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

Reference Books	
1.	Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition, 2013.
2.	Parteek Bhatia, Data Mining and Data Warehousing: Principles and Practical Techniques, Cambridge University Press, 2019.
3.	Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, Pearson, 2nd Edition, 2019.

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

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

Semester: V						
NATURAL LANGUAGE PROCESSING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)** **(Common to CS, CD & IS)**						
Course Code	**:**	**IS355TBC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**39L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	08 Hrs
Introduction to NLP: NLP in the Real-world, NLP Tasks, what is Language: Building Blocks of Language, Why NLP is Challenging, Machine Learning, Deep Learning, and NLP: An Overview, Approaches to NLP: Heuristic based NLP, Machine Learning for NLP, Deep Learning for NLP, Why Deep Learning is not Yet the Silver Bullet for NLP, An NLP Walkthrough: Conversational Agents **NLP Pipeline:** Data Acquisition, Text Extraction and Cleanup: HTML Parsing and Cleanup, Unicode Normalization, Spelling Correction, System-Specific Error Correction, Pre-Processing: Preliminaries, Frequent Steps, Other Pre-Processing Steps	
Unit – II	**08 Hrs**
Accessing Text Corpora Accessing Text Corpora, Brown Corpus, Loading your own corpus, Annotated text corpus, Conditional Frequency Distributions, WordNet. **Processing Raw Text** : Regular Expressions for Detecting Word Patterns, Useful Applications of Regular Expressions, Normalizing Text ,Regular Expressions for Tokenizing Text **Extracting Information from the text :** Information Extraction, Chunking, Developing, Named Entity Recognition, Term weighting, Inverse document frequency	
Unit –III	**07 Hrs**
Analyzing Sentence Structure: Some Grammatical Dilemmas, What's the Use of Syntax?, Context-Free Grammar, Parsing with Context-Free Grammar. **Analyzing the Meaning of words and Sentences :** The semantics of English sentences, Representing Meaning, Semantic Analysis, Lexical semantics, Word- sense disambiguation.	
Unit –IV	**08 Hrs**
Transformers Basics The Encoder-Decoder Framework, Attention Mechanisms, Transfer Learning in NLP, Hugging Face Transformers: Bridging the Gap, A Tour of Transformer Applications: Text Classification, Named Entity Recognition, Question Answering, Summarization, Translation, Text Generation, The Hugging Face Ecosystem: The Hugging Face Hub, Hugging Face Tokenizers, Hugging Face Datasets, Hugging Face Accelerate, Main Challenges with Transformers. **Text Classification** The Dataset: A First Look at Hugging Face Datasets, From Datasets to Data Frames, looking at the Class Distribution, How Long Are Our Tweets? From Text to Tokens: Character Tokenization, Word Tokenization, Subword Tokenization, Tokenizing the Whole Dataset, Training a Text Classifier: Transformers as Feature Extractors, Fine-Tuning Transformers	

Unit –V	08 Hrs
NLP Applications: Machine translation, Basic issues in MT. Statistical translation, Sentiment Analysis, Chat-Bot, Question Answering System, Text Classification, Spell Checking and Market Intelligence. **Information Retrieval:** Vector space model, term weighting	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the approaches to syntax and semantics in Natural Language Processing, the various types of language processors, the elements of formal language theory, the types of grammar, and the computational morphology.
CO 2	Understand the basic parsing technique for context-free grammars, the data structures and algorithms for parsing, and the approaches to ambiguity resolution.
CO 3	Design and Develop agents that use Transformers for natural language understanding and generation
CO 4	Comprehend and compare different natural language models.

Reference Books	
1.	Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana , 1st Edition, 2020, O'Reilly, ISBN: 978-1-492-05405-4
2.	Steven Bird, Ewan Klein, Edward Loper, ―Natural Language Processing with Python,‖ Publisher: O'Reilly Media, June 2009, ISBN : 9780596516499
3.	Python 3 Text Processing with NLTK 3 Cookbook, Jacob Perkins 2014, 1st Edition, Packt Publishing, ISBN 978-1-78216-785-3
4.	Natural Language Processing with Transformers: Building Language Applications with Hugging Fac,Lewis Tunstall, Leandro von Werra, and Thomas Wolf, 2022, 1st Edition, O'Reilly Media, ISBN: 978-1-098-10324-8

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

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

Semester: V						
CLOUD COMPUTING **Category: PROFESSIONAL CORE COURSE ELECTIVE-I** **(Group-B)** **(Theory)- (Common to CS, CD & IS)**						
Course Code	**:**	**IS355TBD**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Defining Cloud Computing Cloud Types, Examining the Characteristics of Cloud Computing, Assessing the Role of Open Standards **Understanding Services and Applications by Type** Defining Infrastructure as a Service (IaaS), Defining Platform as a Service (PaaS), Defining Software as a Service (SaaS), Defining Identity as a Service (IDaaS), Defining Compliance as a Service (CaaS).	
Unit – II	**08 Hrs**
Understanding Cloud Architecture Exploring the Cloud Computing Stack, Connecting to the Cloud **Understanding Service Oriented Architecture** Introducing Service Oriented Architecture, Defining SOA Communications, Managing and Monitoring SOA, Relating SOA and Cloud Computing	
Unit –III	**09 Hrs**
Cloud Computing Technology Hardware and Infrastructure: Clients, Security, Network, Services Accessing the Cloud: Platforms, Web Applications, Web APIs, Web Browsers Cloud Storage: Overview, Cloud Storage Providers Standards: Application, Client, Infrastructure, Service	
Unit –IV	**09 Hrs**
Understanding Abstraction and Virtualization Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging, Porting Applications **Capacity Planning** Capacity Planning, Defining Baseline and Metrics, Network Capacity, Scaling	
Unit –V	**08 Hrs**
Developing Applications Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Troubleshooting, Application Management	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the basics of cloud computing models and virtualization.
CO 2	Analyse the issues related to the development of cloud applications.
CO 3	Apply the concepts to design cloud based simple applications.
CO 4	Identify solutions through cloud based software for real world case studies.

Reference Books	
1.	Barrie Sosinsky,"Cloud computing bible", CRC Press, 2010, ISBN: 978-0-470-90356-8.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A practical Approach", Wiley India, 2011, ISBN: 0071626948.
3.	George Reese, "Cloud Application Architectures", Wiley India 2011, ISBN: 978-0596156367.
4.	Eugene Ciurana, "Developing with Google App Engine" Wiley India 2011 ISBN: 978-1430218319.

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

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

Computer Science & Engineering [Data Science]

SIXTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	HS	HS361TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	Theory	**100**	***	**3**	**100**	***
2	CD	CD362IA	Big Data Systems (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
3	CD	CD363IA	Data Analytics & Visualization Systems (Theory & Practice)	3	0	1	4	Theory + Practice	**100**	**50**	**3**	**100**	**50**
4	IS	IS364TA	Software Engineering with Agile Technologies (Common to CS, IS, CD & CY)	4	0	0	4	Theory	**100**	***	**3**	**100**	***
5	CD	XX365TDX	Professional Core Elective-III **(Group- D)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
6	XX	XX366TEX	Institutional Electives – I **(Group E)**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
7	CD	CD367P	Interdisciplinary Project	0	0	3	3	Project	***	**100**	**3**	***	**100**
			Total				**24**						

Group D: Professional Elective – III Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
5	CS	CS365TDA	Computer Vision (Common to CS & CD)	3
	CD	CD365TDB	Semantic Web and Social Network Analysis	3
	CD	CD365TDC	Deep Learning (Common to CD & CY)	3
	AI	AI365TDD	Generative Artificial Intelligence (Common to AI, CS, CD & IS)	3
	CD	CD365TDE	Data Security and Privacy	3

Group E: Institutional Electives-I Courses				
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Credits**
6	AS	AS266TEA	Fundamentals of Aerospace Engineering	3
	BT	BT266TEB	Bioinformatics	3
	CH	CH266TEC	Industrial Safety Engineering	3
	CS	CS266TED	Robotics Process Automation	3
	CV	CV266TEE	Intelligent Transport Systems	3
	CV	CV266TEF	Integrated Health Monitoring of Structures	3
	CM	CM266TEG	Advanced Energy Storage for E-Mobility	3
	EC	EC266TEH	Human Machine Interface(HMI)	3
	EE	EE266TEJ	Energy Auditing and Standards	3
	EI	EI266TEK	Biomedical Instrumentation	3
	ET	ET266TEM	Telecommunication Systems	3
	ET	ET266TEN	Mobile Communication Networks and Standards	3
	IS	IS266TEO	Mobile Application Development	3
	IM	IM266TEQ	Elements of Financial Management	3
	IM	IM266TER	Optimization Techniques	3
	ME	ME266TES	Automotive Mechatronics	3
	MA	MA266TEU	Mathematical Modelling	3
	MA	MA266TEV	Mathematics of Quantum Computing	3
	HS	HS266TEW	Applied Psychology for Engineers	3
	HS	HS266TEY	Universal Human Values	3

Semester: VI						
ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS (Theory)						
Course Code	**:**	**HS361TA**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08Hrs**
Introduction to Entrepreneurship: Definition and Scope of Entrepreneurship, Importance of Entrepreneurship in Engineering Innovation and Economic Growth, Techniques for Identifying Entrepreneurial Opportunities, Types of Entrepreneurs: Innovative, Imitative, Fabian, Characteristics and Traits of Successful Entrepreneurs. **Role in economic development**- Emerging Trends in Entrepreneurship, Entrepreneur and Entrepreneurship, characteristics of Entrepreneur, Myths about Entrepreneurship, Entrepreneur vs Intrapreneur, Role of Entrepreneurial Teams **Activities**: Case study on Entrepreneurship in Indian Scenario, Ideation Workshops and Hackathons,	
Unit – II	**08 Hrs**
Entrepreneurial Opportunity Evaluation: Identifying Market Opportunities and Trends, Integration of Engineering Principles in Ideation Process, Cross-Disciplinary Collaboration for Technological Innovation, Assessing Market Feasibility and Demand Analysis, Evaluating Technical Feasibility: Prototype Development, Proof of Concept, Financial Feasibility Analysis: Cost Estimation, Revenue Projection, Break-Even Analysis**.** **Business Planning and Strategy Development**: Elements of a Business Plan, Executive Summary, Company Description, Market Analysis, writing a Business Plan: Structure and Components, Strategic Planning: Vision, Mission, Goals, Objectives, SWOC Analysis, Competitive Strategy: Porter's Generic Strategies, Differentiation, Cost Leadership, Focus Strategy, Growth Strategies: Organic Growth, Mergers and Acquisitions, Strategic Alliances **Activities**: Writing a Business Plan on given templates, Developing Business Models and Prototypes Based on Generated Ideas	
Unit –III	**08Hrs**
Entrepreneurial Marketing and Sales: Basics of Marketing: Product, Price, Place, Promotion (4Ps), Market Segmentation, Targeting, and Positioning (STP), Branding and Product Development Strategies, Creating a Unique Value Proposition (UVP) Digital Marketing: Social Media Marketing, Content Marketing, SEO, SEM, Sales Techniques and Customer Relationship Management (CRM). Entrepreneurial Finance and Resource Management: Sources of Financing: Equity Financing, Debt Financing, Venture Capital, Angel Investors, Crowdfunding, Financial Management: Budgeting, Cash Flow Management, Financial Statements Analysis, Risk Management and Insurance, Human Resource Management: Recruitment, Training, Performance Evaluation, Legal and Ethical Issues in Entrepreneurship: Intellectual Property Rights, Contracts, Corporate Governance Activities:Case Studies and Practical Applications	
Unit –IV	**09Hrs**
Introduction to IP : Types of Intellectual Property **Patents:** Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; protection of traditional knowledge, Infringement of patents and remedy, Case studies, Patent Search and Patent Drafting, Commercialization and Valuation of IP. **Trade Marks:** Concept, function and different kinds and forms of Trade marks, Registrable and non- registrable marks. Registration of Trade Mark; Deceptive similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies.	
Unit –V	**09 Hrs**
Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India. **Industrial Design:** Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies. **Copy Right:** Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies.	

Course Outcomes: After going through this course, the student will be able to	
CO1	Understand the concepts of entrepreneurship and cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership.
CO2	Comprehend the process of opportunity identification of market potential and customers while developing a compelling value proposition solutions.
CO3	Analyse and refine business models to ensure sustainability and profitability and build a validated MVP of their practice venture idea and prepare business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture.
CO4	Apply insights into the strategies and methods employed to attain a range of benefits from these IPs and deliver an investible pitch deck of their practice venture to attr act stakeholders
CO5	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.

Reference Books	
1.	Donald F. Kuratko ,"Entrepreneurship: Theory, Process, and Practice", South-Western Pub publishers, 10th edition, 2016,978-ISBN-13: 1305576247
2.	Eric Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Currency Publishers,1st Edition, 2011, ISBN-13: 978-0307887894.
3.	Dr B L Wadehra, Law Relating to Intellectual Property, universa Law publishers 05th edition, ISBN : 9789350350300 .
4.	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.

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 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: VI						
BIG DATA SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)**						
Course Code	**:**	**CD362IA**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**09 Hrs**
Different Types of Data and Storage for Data: Structured Data (Relational Databases), Semi-structured data (Object Stores), and Unstructured Data (File systems), Characteristics of Big Data. Systems perspective - Processing: In-memory vs. (from) secondary storage vs. (over the) network. **Locality of Reference:** Principle, examples **Impact of Latency:** Algorithms and data structures that leverage locality, data organization on disk for better locality	
Unit – II	**09 Hrs**
Parallel and Distributed Processing: Motivation (Size of data and complexity of processing); Storing data in parallel and distributed systems: Shared Memory vs. Message Passing; Strategies for data access: Partition, Replication, and Messaging. **Distributed Systems**: Motivation (size, scalability, cost-benefit), Client-Server vs. Peer-to-Peer models, Cluster Computing: Components and Architecture **Big Data Analytics**: Requirements, constraints, approaches, and technologies. **Big Data Systems** – Characteristics: Failures; Reliability and Availability; Consistency – Notions of Consistency. CAP Theorem and implications for Big data Analytics	
Unit –III	**09 Hrs**
Hadoop: Introduction, Architecture, and Map-reduce Programming on Hadoop, Hadoop Distributed File System (HDFS), Scheduling in Hadoop (using YARN). Example – Hadoop application, **Hadoop Ecosystem:** Databases and Querying (HBASE, Pig, and Hive) **Hadoop Ecosystem:** Integration and coordination (Sqoop, Flume, Zookeeper & Oozie)	
Unit –IV	**09 Hrs**
Distributed Architecture and Computing-HPCC Systems HPCC System functions, Data Lake Architecture, The HPCC Systems design, Thor Vs ROXIE, Hadoop V/s HPCC Systems, ECL programming An activity Declaration, A Record Declaration, Schema on Read (RECORD) explained, A Function Declaration, A MODULE, ECL File(s), Importing files, Spraying and Reading a file Data Shaping (Transforming) : Function, Module and Project, Iterate and Rollup ,Sort, Join and Dedup ,Normalize and Denormalize ,Distribute and Reading The Execution Graph, GROUP and functions (SUM, AVE, COUNT…), TABLE and AGGREGATE	
Unit –V	**09 Hrs**
Spark: Introduction, Architecture and Features, **Programming on Spark:** Resilient Distributed Datasets, Transformation, Examples, **Machine Learning (on Spark):** Regression, Classification, Collaborative Filtering, and Clustering,**Streaming on Spark:** Architecture of Spark Streaming, Stream Processing Model, Example.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Interpret/explore popular distributed systems architectures, emphasizing their significance in addressing Big Data challenges through scalable, fault-tolerant, and efficient data processing solutions.
CO 2	Apply distributed computing principles using Hadoop, MapReduce, or HPCC Systems to design and implement scalable solutions for real-world Big Data challenges.
CO 3	Identify and use suitable tools and techniques for efficient Big Data storage and database management, leveraging advanced querying mechanisms and interfaces to enable optimized data retrieval, analysis, and performance.
CO 4	Demonstrate in-memory processing and stream processing techniques for building Big Data systems.
CO 5	Demonstrate skills in investigation, effective communication, teamwork/individual work, and ethical practices by implementing Big Data solutions for diverse applications.

Reference Books	
1.	Seema Acharya and Subhashini Chellappan. *Big Data and Analytics*. Wiley India Pvt. Ltd. Second Edition, ISBN-13 978-8126579518.
2.	Kai Hwang, Jack Dongarra, and Geoffrey C. Fox. *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*. Morgan Kauffman 2011, ISBN-13 978-0123858801
3.	Tom White , The Definitive Guide , 4th edition, 2012, O'reilly Publications, ISBN: 9780596521974
4.	https://cdn.hpccsystems.com/releases/CE-Candidate9.0.10/docs/EN_US/ECLLanguageReference_EN_US-9.0.10-1.pdf

LABORATORY COMPONENT

PART – A

1.
   a. Exercises on Distributed Systems – Hadoop;
   b. Exercises using Map-reduce model: Map only and reduce only jobs, Standard patterns in map reduce models.
2.
   a. Exercises on NoSQL;
   b. Exercises on NoSQL database – Simple CRUD operations and Failure / Consistency tests;
   c. Exercises to implement a Web based application that uses NoSQL databases
3.
   a. Exercises with Pig queries to perform Map-reduce job and understand how to build queries and underlying principles;
   b. Exercises on creating Hive databases and operations on Hive, exploring built in functions, partitioning, data analysis
4.
   a. Exercises on Spark to demonstrate RDD, and operations such as Map, FlatMap, Filter, PairRDD;
   b. Typical Spark Programming idioms such as : Selecting Top N, Sorting, and Joins;
   c. Exercises on Spark SQL and DataFrames
5. Exercises using Spark MLLib: Regression, Classification, Collaborative Filtering, Clustering
6. Exercises on Analytics on the Cloud – using AWS, AWS Map-Reduce, AWS data stores/databases.

PART – B
Open Ended Project

Students are required to implement a mini project using Big Data Tools and Technologies to solve real-world problems. This project aims to provide students with practical experience in applying their knowledge of big data concepts to address challenges encountered in various domains.

RUBRICFOR 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) **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 (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 AND PRATICE)	**150**

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

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

Semester: VI						
DATA ANALYTICS & VISUALIZATION **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)**						
Course Code	**:**	**CD363IA**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**9Hrs**
Introduction to Data Science Data science, Terminology associated with Data Science, Types of Data, Data Science workflow, Popular data science toolkits, Automated methods for Data collection. **Introduction to Data visualisation** Data visualisation, importance of data visualisation, conventional data visualisation methods	
Unit – II	**9Hrs**
Data Collection Collecting the data: Hunting, scrapping, logging Cleaning Data: Error vs Artifacts, Data Compatibility, Dealing with missing values, outlier detection Crowdsourcing: Mechanisms for aggregation, crowdsourcing services, gamification	
Unit –III	**9Hrs**
Data Analysis Introduction to applied statistical techniques, types of the statistical data, types of the bigdata analytics, collecting the data for sampling and distribution, probability, frequency distribution, population and parameters, problems of estimation. Exploratory Data analysis	
Unit –IV	**9Hrs**
Visualising Data Developing a Visualization Aesthetic: Maximising the Data - lnk ratio, Maximising the Lie factor, minimising the chart junk, scaling and labelling Chart Types: Tabular data, dot and line plots, scatter plots, Bar plots and pie charts, Histograms and Data maps Great visualisations, Interactive visualisation	
Unit –V	**09 Hrs**
Data Modelling Philosophies of modelling, A taxonmy of models Baseline models: Baseline models for classification, Baseline models for value prediction Evaluating Models: Evaluating classifiers, receiver -operator characteristic curves, evaluating multi class systems, evaluating value prediction models Evaluation environments, simulation models	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	To demonstrate various techniques for automatic data collection, data cleaning and exploration using visualizations.
CO 2	To implement data collection, data cleaning and exploration techniques in a programming language.
CO 3	To Understand and apply modelling and analysis techniques for various types of datasets including e-commerce transactions, review datasets, time series datasets, text documents etc.
CO 4	To Select methods and create effective visualizations to explain the artifacts in the data, distributions of attributes, relationships between the attributes, efficacy of the models and predictions generated by it.
CO 5	Evaluate different models and their strengths and weakness for a given dataset and task.

Reference Books	
1.	Skiena, Steven S, The Data Science Design Manual, Published by Springer Nature 2017
2.	V.K Jain, Data Science and Analytics (with python, R and SPSS programming), Khanna Book Publishing Company.
3.	Matthew O.Ward , Georges Grinstein, Daniel Keim, "Interactive Data Visualisation : Foundations, Techniques And applications " , 2nd Edition , CRC Press, 2015

LABORATORY COMPONENT

PART A
Implement the following programs using Tableau / R programming

1. Learn how to collect data via web-scraping, APIs and data connectors from suitable sources as specified by the instructor.
2. Perform various types of data cleaning operations on the data collected in previous lab using data exploration, imputation etc.
3. Perform dimensionality reduction on a given dataset and create various visualizations like histograms, scatter-plots, etc.
4. Perform association analysis on a given dataset and evaluate its accuracy.
5. Build a recommendation system on a given dataset and evaluate its accuracy.
6. Build a time-series model on a given dataset and evaluate its accuracy.
7. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc.
8. Perform text mining on a set of documents and visualise the most important words in visualisation such as word cloud.

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) **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 (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 AND PRATICE)		**150**

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

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

Semester: VI						
SOFTWARE ENGINEERING WITH AGILE TECHNOLOGIES **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to CS, IS, CD & CY)**						
Course Code	**:**	**IS364TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**4:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**60L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**12 Hrs**
Overview: Introduction: Professional Software Development, Software Engineering Ethics, Case studies. **Software Processes**: Models, Process activities, Coping with Change, Process improvement. **Requirements Engineering and System Modeling**: Software Requirements: Functional and Non-functional requirements. Requirements Elicitation, Specification, Validation and Change	
Unit – II	**12 Hrs**
System Modeling: Context models, Interaction models, Structural models, Behavioural models, Model driven architecture. Architectural Design: Design decisions, Architectural views, Architectural patterns and architectures Design and implementation: Object oriented design using UML, Design patterns, Implementation issues, Open-source development	
Unit –III	**12 Hrs**
Software Testing: Development testing, Test-driven development, Release testing, User testing. **Software Evolution**: Evolution processes. Legacy system evolution, Software maintenance Component based software engineering: Components and component models, CBSE processes, component composition	
Unit –IV	**12 Hrs**
Project Management: Risk Management, Managing People, Teamwork, Project Planning: Software Pricing, Plan driven development, Project Scheduling, Agile planning, Estimation Techniques, COCOMO cost modeling	
Unit –V	**12 Hrs**
Agile Software Development: Introduction to agile methods, Agile development techniques, Agile project management and scaling agile methods. **Kanban, Flow, and Constantly Improving:** The Principles of Kanban, Improving Your Process with Kanban, Measure and Manage Flow , Emergent Behavior with Kanban **The Agile Coach :** Coaches Understand Why People Don't Always Want to Change , Coaches Understand How People Learn , Coaches Understand What Makes a Methodology Work , The Principles of Coaching	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand and apply key concepts and stages of the software development lifecycle, including requirements analysis, design, implementation, testing, deployment, and maintenance.
CO2	Demonstrate an ability to use the techniques and tools in the area of software engineering necessary for engineering practice
CO3	Examine the various software design and development solutions using appropriate techniques
CO4	Students will be able to apply various Agile methodologies such as Scrum, Kanban, or XP effectively in software development projects.

Reference Books	
1.	Ian Sommerville, "Software Engineering", 9th Edition, Pearson Education, 2013, ISBN: 9788131762165
2.	Learning Agile- Understanding Scrum, XP, Lean and Kanban, Andrew Stellman& Jennifer Greene, O'Reilly Media, 2015, ISBN 978-1-449-33192-4
3.	Roger.S.Pressman," Software Engineering-A Practitioners Approach", 7th Edition, Tata McGraw Hill, 2007, ISBN: 9780071267823
4.	Pankaj Jalote," An Integrated Approach to Software Engineering", 3rd Edition, Narosa Publishing House, 2013, ISBN: 9788173197024
5	Rajib Mall, Fundamentals of Software Engineering, 3rd Edition, Prentice-hall Of India Pvt Ltd., 2012, ISBN: 9788120348981.

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

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

Semester: VI						
COMPUTER VISION **Category: PROFESSIONAL CORE ELECTIVE-III** **(Group-D)** **(Theory)** **(Common to CS & CD)**						
Course Code	**:**	**CS365TDA**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction to Digital Image Fundamentals What is Digital Image Processing? The origin of Digital Image processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sampling and Quantization, Some Basic Relationships between Pixels. **Histogram Processing:** Histogram Equalization, Histogram Matching (Specification Local Histogram Processing. Fundamentals Of Spatial Filtering the Mechanics of Linear Spatial Filtering, Spatial Correlation and Convolution, Separable Filter Kernels.	
Unit – II	**09 Hrs**
Image Segmentation: Fundamentals, Thresholding: The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding, The Role of Illumination and Reflectance in Image Thresholding. Basic Global Thresholding Optimum Global Thresholding Using Otsu's Method Segmentation by Region Growing and By Region Splitting and Merging Region Growing Region Splitting and Merging.	
Unit –III	**09 Hrs**
Region Segmentation Using Clustering and Super pixels: Region Segmentation Using K-Means Clustering, Region Segmentation Using Super pixels, Slic Superpixel Algorithm. **Object Recognition:** Image Pattern Classification: Priori by A Human Designer, Patterns and Pattern Classes, Pattern Vectors, Structural Patterns, Pattern Classification by Prototype Matching.	
Unit –IV	**09 Hrs**
Object Recognition: Minimum-Distance Classifier Using Correlation for 2-D Prototype Matching Sift Feature Matching Structural Prototypes. **Tracking:** Tracking as an Abstract Inference Problem, Independence Assumptions, Tracking as Inference. **Data Association**: Choosing the Nearest- Global Nearest Neighbours, Gating and Probabilistic Data Association, Applications and Examples, Vehicle Tracking, Finding and Tracking People.	
Unit –V	**09 Hrs**
Applications: Finding Faces Using Frame Invariance, Multilocal Visual Events, finding: Annotation and segmentation, Template matching, Shape and correspondence, Video I**mage-Based Rendering:** Constructing 3D Models from Image Sequences, Scene Modelling from Registered Images, Scene Modelling from Unregistered Images Transfer-Based Approaches to Image-Based Rendering Affine View Synthesis.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the fundamental concepts such as image acquisition, pre-processing and post processing operations and fundamentals of Computer Vision.
CO 2	Analyze the difficulties of the pattern recognition problems which include classification techniques, Feature detection and Histogram equalization process. in feature extraction methods, which help identify meaningful patterns and structures in images.
CO 3	Apply appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation.
CO 4	Designing and implement a Computer Vision system as part of an experiential learning initiative in teams to solve societal and environmental problems using pattern recognition in images and videos
CO 5	Evaluation of the performances of different CV algorithms and its limitation, study of ethical issues related to CV applications including privacy concerns and bias in algorithms.

Reference Books	
1.	David Forsyth and Jean Ponce, “Computer Vision: A Modern Approach", Prime student, 2nd edition, ISBN-13: 978-0136085928
2.	Rafael C. Gonzalez, Richard E. Woods;” Digital Image Processing”; Pearson Education; 3rd Edition; 2012; ISBN 978-93-325-7032-0.
3.	Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”. 3rd edition, CL Engineering, ISBN-13: 978-0495082521.
4.	Richard Szeliski, “Computer Vision: Algorithms and Applications", Springer Verlag : http://szeliski.org/Book/.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom’s Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
SEMANTIC WEB AND SOCIAL NETWORK ANALYSIS **Category: PROFESSIONAL CORE ELECTIVE-III** **(Group-D)** **(Theory)**						
Course Code	**:**	**CD365TDB**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Introduction Introduction to the Semantic Web and Social Networks: The Semantic Web- Limitations of the current Web, The semantic solution, Development of the Semantic Web, The emergence of the social web. **Social Network Analysis** What is network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis.	
Unit – II	**09 Hrs**
Electronic sources for network analysis Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis. **Knowledge Representation on the Semantic Web** Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web(RDF, OWL).	
Unit –III	**09 Hrs**
Modelling and aggregating social network data State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations. **Developing social-semantic applications:** Building Semantic Web applications with social network features, Flink: the social networks of the Semantic Web community, open academia: distributed, semantic-based publication management	
Unit –IV	**09 Hrs**
Evaluation of web-based social networ extraction and Ontologies are us Differences between survey methods and electronic data extraction, Context of the empirical study, Data collection, Preparing the data, Optimizing goodness of fit, Comparison across methods and networks, Predicting the goodness of fit, Evaluation through analysis. Ontologies are us: A tripartite model of ontologies, Case studies, Evaluation.	
Unit –V	**09 Hrs**
Predicting Human Behavior And Privacy Issues Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences. Security and Privacy in Online Social Networks Introduction, Security Objectives: Privacy, Integrity, and Availability	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Analyze and understand the basics of Semantic Web and Social Networks.
CO 2	Ability to represent knowledge using ontology and Electronic sources for network analysis
CO 3	Modeling and aggregating social network data.
CO 4	Develop social-semantic applications and visualise
CO 5	Evaluate Web- based social network and Ontology

Reference Books	
1.	Social Networks and the Semantic Web, Peter Mika, Springer, 2007
2.	Borko Furht, ―Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.
3.	Semantic Web and Semantic Web Services -Liyang Lu Chapman and Hall/CRC Publishers, (Taylor & Francis Group)
4.	Information Sharing on the semantic Web – Heiner Stuckenschmidt; Frank Van Harmelen, Springer Publications.

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

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

Semester: VI						
DEEP LEARNING **Category: PROFESSIONAL CORE ELECTIVE-III** **(Group-D) (Theory)** **(Common to CD and CY)**						
Course Code	**:**	**CD365TDC**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3**

Unit-I	**09 Hrs**
Neural Networks: What is a neural network, Models of a Neuron, Activation functions, Network Architectures, Knowledge representation, Learning Process. **Deep Feedforward Networks:** Multilayer Perceptron, Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation Algorithm	
Unit – II	**09 Hrs**
Convolutional Networks: Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the basic convolution function, Structured Outputs, Data types, Efficient Convolution Algorithms, Random or Unsupervised features, The Neuroscientific basis for convolutional networks.	
Unit –III	**09 Hrs**
Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, The Long Short-Term Memory and Other Gated RNNs.	
Unit –IV	**09 Hrs**
Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Contractive Auto encoders, Applications of Autoencoders	
Unit –V	**09 Hrs**
Pretrained models: Lenet, AlexNet, VGGNet, Densenet, Resnet, Improving Deep Neural Networks- Hyperparameter Tuning, Regularization and Optimization. Data Augmentation techniques. **Other Architectures:** Generative Adversarial Networks, Reinforcement Learning	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the key theoretical concepts like the Universal Approximation Theorem, vanishing / exploding gradients, and optimization methods.
CO 2	Analyse the fundamental concepts of Deep Learning, and its various architecture learning models, including Neural Networks, backpropagation, gradient descent, and different Network Architectures (feedforward, convolutional, recurrent) Learning tasks for various applications.
CO 3	Apply the Deep learning model approaches to know the strengths and weaknesses of the architecture by empirical results. Apply appropriate concepts like Recurrent, Recursive Nets and Auto-encoder models to specific real time projects and analyse the Optimization techniques.
CO 4	Designing and implement a Deep Learning model as part of an experiential learning initiative in teams to solve societal and environmental problems.
CO 5	Ability to fine tune the model parameters to improve performance, explore and understand the ethical implications and societal impact of deploying deep learning systems in real-world scenarios, addressing issues like bias, fairness, and explainability.

Reference Books	
1.	Deep Learning (Adaptive Computation and Machine Learning Series), Ian Good Fellow, Yoshua Bengio and Aaron Courville, MIT Press (3 January 2017), ISBN-13: 978-0262035613.
2.	Neural Networks and Learning Machines, Simon S. Haykin, 3rd Edition 2010, PHI Learning, ISBN- 9789332586253, 933258625X.
3.	Introduction to Artificial Neural Networks, Gunjan Goswami, S.K. Kataria & Sons; 2012 Edition, ISBN-13: 978-9350142967.
4.	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nikhil Buduma, by O'Reilly Publications, 2016 Edition, ISBN-13: 978-1491925614.

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

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

Semester: VI						
Generative Artificial Intelligence (Common to AI, CS, CD & IS)						
Course Code	**:**	**AI365TDD**		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

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

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

CO5	Equip students with the knowledge to identify and address ethical issues in Generative AI, focusing on fairness, accountability, transparency, and human rights.
Reference Books	
1	"Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by David Foster,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 (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: VI						
DATA SECURITY & PRIVACY **(Category: PROFESSIONAL CORE ELECTIVE-III)** **(Group-D)** **(Theory)**						
Course Code	**:**	**CD365TDE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**9Hrs**
Introduction to Information Security Introduction, The History of Information Security, Principles of security , CNSS Security Model, Components of an Information System, Approaches to Information Security Implementation, Security in the Systems Development Life Cycle, Security Professionals and the Organization **The Need for Security** Threats and Attacks, Compromises to Intellectual Property, Human Error or Failure, Information Extortion.	
Unit – II	**9Hrs**
Legal, Ethical, and Professional Issues in Information Security Introduction, Law and Ethics in Information Security, Relevant U.S. Laws, International Laws and Legal Bodies, Ethics and Information Security, Codes of Ethics of Professional Organizations, Key U.S. Federal Agencies	
Unit –III	**9Hrs**
Planning for Security Introduction, Information Security Planning and Governance, Information Security Policy, Standards, and Practices, The Information Security Blueprint, Security Education, Training, and Awareness Program **Risk Management** Introduction, An Overview of Risk Management, Risk Identification, Risk Assessment, Risk Control, Quantitative Versus Qualitative Risk Management Practices, Recommended Risk Control Practices	
Unit –IV	**9Hrs**
Cryptography Introduction, Foundations of Cryptology, Cipher Methods, Cryptographic Algorithms, Cryptographic Tools, Protocols for Secure Communication, Public-key Cryptography and RSA, Principles of public key cryptosystems, The RSA Algorithm	
Unit-V	**9Hrs**
Security Technology: Firewalls and VPN Introduction, Access Control: Identification, authentication, authorization, accountability, Firewalls: Firewall processing Modes, Firewalls categorized by Generation, structure, Architecture, selection, configuration and management, content filters. **Protecting Remote Connection** Remote Access, Virtual Private Networks	

Course Outcomes: After completing the course, the students will be able to :-	
CO 1	Analyse legal and ethical issues related to information security and privacy
CO 2	Identify common security threats and vulnerabilities in computer systems and networks.
CO 3	Implement security measures to protect data integrity, confidentiality, and availability.
CO 4	Evaluate security risks and develop risk management strategies.
CO5	Apply privacy-enhancing techniques to protect sensitive information.

Reference Books	
1.	Principles of Information Security, Sixth Edition Michael E. Whitman and Herbert J. Mattord
2.	Cryptography and network security principles and practice seventh edition global edition william stallings
3.	Information Security Policy Development for Compliance, Barry L. Williams, CRC Press

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

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

FUNDAMENTALS OF AEROSPACE ENGINEERING Category: INSTITUTIONAL ELECTIVES-I (Group-E) (Theory)						
Course Code	**:**	**AS266TEA**		**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**
Basics of Flight Vehicles: History of aviation, International Standard atmosphere (ISA), Temperature, pressure and altitude relationships, Simple Problems on Standard Atmospheric Properties, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions.	
Unit – II	**10 Hrs**
Aircraft Aerodynamics: Bernoulli's theorem, Centre of Pressure, Lift and Drag, Types of Drag, Aerodynamic Coefficients, Aerodynamic Centre, Wing Planform Geometry, Airfoil Nomenclature, Basic Aerodynamic characteristics of Airfoil, Simple Numericals on Lift and Drag.	
Unit –III	**12 Hrs**
Aerospace Propulsion: Introduction, Turbine Engines: Brayton Cycle, Operation of Turbojet, Turboprop, Turbofan, Turboshaft, RAMJET and SCRAMJET Engines, Rocket Engines: Principles of operation of Solid, Liquid, Hybrid, Nuclear and Electric Rockets. **Introduction to Space Mechanics:** Basic Orbital Mechanics-Types of Trajectories, Escape and Orbital Velocities, Kepler's Laws of Planetary Motion, Simple Numericals.	
Unit –IV	**06 Hrs**
Aerospace Structures and Materials: General types of construction-Monocoque, Semi-Monocoque & Geodesic, Structure of Wing and Fuselage, Metallic and Composite Materials.	
Unit –V	**08 Hrs**
Aircraft Systems & Instruments: Instrument Displays, Basic Air data systems & Pitot Probes- Mach meter, Air speed indicator, Vertical speed indicator, Altimeter. **Basics of Aircraft Systems:** Hydraulic and pneumatic systems, Electrical System, Aircraft Fuel System, Environmental Control System.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Identify the fundamental nuances of Aerospace Engineering and appreciate their significance on the Flight Vehicles design and performance
CO2:	Interpret the design parameters that influence the design of the Aerospace Vehicles systems and its sub-systems
CO3:	Evaluate critically the design strategy involved in the development of Aerospace vehicles
CO4:	Categorically appraise the operation of the Aerospace Vehicles for different operating conditions

Reference Books	
1	Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
3	Rocket Propulsion Elements, Sutton G.P., 8th Edition, 2011, John Wiley, New York, ISBN: 1118174208, 9781118174203.
4	Aircraft structural Analysis, T.H.G Megson, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4
5	Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206

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

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

Semester: VI						
BIOINFORMATICS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**BT266TEB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Introduction to tools and databases: Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases – genome and microarray, Applications of these databases, examples, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method	
Unit – II	**09 Hrs**
Sequence Analysis: Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation.	
Unit –III	**09 Hrs**
Introduction to Next-Generation Sequencing (NGS) analysis: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads, automation in NGS analysis and advantages (shell scripting)	
Unit –IV	**09 Hrs**
Structural analysis & Systems Biology: Gene prediction programs – ab initio and homology-based approaches. ORFs for gene prediction. 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. Structure prediction - Prediction of secondary structure, tertiary structure prediction methods, Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology, Flux Balance analysis.	
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, AI/ML in Drug discovery	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Gain proficiency in utilizing a range of bioinformatics tools and databases for comprehensive sequence and structural 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	Demonstrate expertise in NGS technologies, including performing data quality assessments, read processing, and managing large-scale data.
CO4	Apply bioinformatics tools for modeling and simulating biological processes, with a focus on gene prediction using both ab initio and homology-based approaches.

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

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

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

Semester: VI						
INDUSTRIAL SAFETY ENGINEERING **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**CH266TEC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Introduction Safety: Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, problems on OSHA	
Unit – II	**09 Hrs**
Risk assessment and control: Risk assessment, Risk perception, acceptable risk, problems on net present value, internal rate of return, payback period concepts including real life examples. **Hazard Identification Methods:** Preliminary Hazard List (PHL), worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analysis. Design and development of fault tree and event tree for high pressure reactor system.	
Unit –III	**09 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Guide words, HAZOP matrix, Procedure, HAZOP studies on reactors, heat exchanger, design of HAZOP table, Failure Modes and Effects Analysis (FMEA) concept, methodology, problems of FMEA, examples.	
Unit –IV	**09 Hrs**
Risk analysis on capital budgeting: Risk adjusted discount rate (RADAR) method, certainty equivalent approach, scenario analysis, probability distribution, quantification of risk using statistical parameters and associated problems.	
Unit –V	**09 Hrs**
Safety in process industries and case studies: Personnel Protection Equipment (PPE): Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the risk assessment techniques used in process industry
CO2	Interpret the various risk assessment tools.
CO3	Use hazard identification tools for safety management.
CO4	Analyze tools and safety procedures for protection in process industries.

Reference Books	
1.	Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North corolina,Lulu publication, ISBN:1291187235.
2.	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X.
3.	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003,The University of alberta press,Canada, ISBN: 0888643942.
4.	Industrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102.

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

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

Semester: VI						
ROBOTIC PROCESS AUTOMATION **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**CS266TED**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Duration	**:**	**45L**		**SEE Duration**	**:**	**3 Hrs**
Unit – I						**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 that can be automated. **RPA Advanced Concepts**: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.						
Unit – II						**9 Hrs**
RPA Tool Introduction: Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, Managing Arguments, The Arguments Panel, Namespaces; Control flow statements in UiPath, Sequences and Flowcharts, Control Flow Activities Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation, main string methods. **UiPath Recording:** Basic, Desktop and Web Recording, Image and Native Citrix Recording, Input/output methods, Types of OCR, Data Scraping, Advanced Scraping techniques.						
Unit – III						**9 Hrs**
Advanced Automation Concepts: 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 – IV						**9 Hrs**
Email Automation, Exceptions and Deploying Bots: Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output. Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors. Overview of orchestration Server, orchestrator functionalities, Connecting Bot to orchestrator						
Unit – V						**9 Hrs**
Hyperautomation: Components and application of Hyperautomation, Automation versus hyperautomation, Benefits and challenges of hyperautomation, use cases, Phases (Integration, Discover, Orchestration and Governance), Trends in Hyperautomation (low-code/no-code platform, HaaS)						

	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 variables and decision making inside a workflow and data manipulation techniques
CO3	Gain insights into recording, Email Automation and exception handling and orchestrator.
CO4	Analyze the trends in automation and chose business strategy to design a real-world automation workflow.

Reference Books:	
1.	Alok Mani Tripathi, "Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN: 9781788470940
2.	PASCAL BORNET, Intelligent automation: Welcome to the world of hyperautomation, World Scientific Publishing Company, ISBN-13: 978-9811235481 December 2020
3.	UiPath pdf manuals
4.	https://www.uipath.com/rpa/robotic-process-automation
5.	https://www.ibm.com/topics/hyperautomation
6.	https://www.pega.com/hyperautomation

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

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

Semester: VI						
INTELLIGENT TRANSPORTATION SYSTEMS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**CV266TEE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Introduction to Intelligent Transportation Systems **(**ITS): Historical background, Urbanisation, Motorisation, Transport system characteristics, Transport problems and issues, Challenges and opportunities in ITS: ITS-Today and tomorrow, ITS training and education needs, Role and importance of ITS in context of Indian Transport system and opportunity for sector growth of ITS.	
Unit – II	**09 Hrs**
ITS Architecture: introduction, Functionalities required for User service, Logical architecture, Physical architecture, Equipment and Market packages, Need of ITS Architecture to solve problems in Urban area. Technology building blocks for ITS: Introduction, Data acquisition, Communication tools, Data analysis and Traveller information. Various detection, Identification and collection methods for ITS.	
Unit –III	**09 Hrs**
Traffic management system components and ITS: Introduction, objectives, traffic management measures, ITS for traffic management, Development of traffic management system, Traffic Management Centre, Advance Traffic Management System, Advanced Traveller Information System, Advance Vehicle Control Systems, Advance Public Transport System, Commercial Vehicle Operations, ITS For Intermodal Freight Transport.	
Unit –IV	**09 Hrs**
ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options.	
Unit –V	**09 Hrs**
ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing. ITS for smart cities and Case studies.	

Reference Books	
1.	Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068
2.	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601
3.	Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3
4.	Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781,
5	R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004, ISBN-13: 978-0-13-459971-7.

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: VI						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**CV266TEF**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration.	
Unit – II	**09 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence	
Unit –III	**09 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	
Unit –IV	**09 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	
Unit –V	**09 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components	

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

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

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

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

Semester: VI						
ADVANCED ENERGY STORAGE FOR E-MOBILITY **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**CM266TEG**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the fundamentals and technologies of energy storage in electric vehicles
2	Analyze and compare advanced battery technologies for e-mobility
3	Impart the principles of electrochemistry for analyzing issues in electric/hybrid vehicles.
4	Develop solutions for battery management systems and recycling of advanced storage devices.

Unit-I	**09 Hrs**

Energy storage in electric vehicles

Introduction to E-mobility, background of alternative energy sources and sustainability. Types of electric vehicles and their salient features along with their energy requirement. Fundamentals of advanced battery technology. Battery characteristics. Specification of advanced battery for e mobility.

Unit – II	**09 Hrs**

Advanced lithium-ion batteries

Basic concepts of lithium batteries. Types of advanced cathode and anode materials employed in lithium batteries. Construction, working and future applications of lithium cobalt oxide, lithium iron phosphate, Lithium air, lithium sulfur and lithium polymer batteries with their advancement in vehicle electrification.

Unit –III	**09 Hrs**

Non lithium batteries for e mobility

Limitations of lithium batteries. Overview of non-lithium battery technology. Construction and working of advanced non-Lithium batteries such as Lead acid, Nickel Metal Hydride, Redox flow, Zebra, Sodium and Magnesium batteries. Electrode materials and electrolyte considerations in non lithium batteries. Performance comparison with lithium-ion batteries. Battery requirement in charging infrastructure.

Unit –IV	**09 Hrs**

Chemistry of alternative storage devices

Introduction to super capacitor. Construction, working and applications of supercapacitors along with the materials used in electrodes. Types of advanced supercapacitors. Application of supercapacitors in regenerative braking. Advancement in battery-supercapacitor hybrid, Battery-fuel cell hybrid, and Battery-solar cell hybrid electric vehicles with their advantages and limitations.

Unit –V	**09 Hrs**

Battery management and recycling:

Battery management systems (BMS): Fundamentals of battery management systems and controls, State-of-charge (SoC), state-of-health (SoH) and Cell balancing techniques.

Battery Thermal Management: Passive and active cooling systems. Safety mechanisms, thermal runaway and thermal management.

Battery recycling: Economic aspects, environmental safety and process of recycling of advanced batteries.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Implement the fundamentals of chemistry in advanced energy storage and conversion devices.
CO2	Apply the chemistry knowledge used for hybridization of various energy storage and conversion devices.
CO3	Analyze the different battery system for achieving maximum energy storage for vehicle electrification
CO4	Evaluation of efficiency of a battery with respect to cost, environmental safety, material, energy consumption and recycling.

Reference Books	
1	Battery reference book, T. R. Crompton., 3rd edition, NEWNES Reed Educational and Professional Publishing Ltd 2000, ISBN: 07506 4625 X.
2	Batteries for Electric Vehicles, D. A. J. Rand, R. Woods, and R. M. Dell, Society of Automotive Engineers, Warrendale PA, 2003. ISBN 10: 0768001277.
3	Lithium Batteries, Science and Technology, GA. Nazri and G. Pistoa, Kluwer Academic Publisher, 2003, ISBN 978-0-387-92675-9.
4	Battery Technology Handbook, H. A. Kiehne, Marcel Dekker, NYC, 2003. ISBN: 0824742494 9780824742492.
5	Electric Vehicle Technology Explained, James Larminie and John Lowry. 2nd Edition, Wiley, ISBN-13: 978-1118505429.
6	Electric Vehicle Technology and Design, Antoni Gandia. CRC Press, ISBN-13: 978-1138551912.
7	Sustainable Transportation: Problems and Solutions. William R. Black, The Guilford Press, ISBN-13: 978-1462532072.

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

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

Semester: VI						
HUMAN MACHINE INTERFACE (HMI) **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)** **Industry Assisted Elective-BOSCH**						
Course Code	**:**	**EC266TEH**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**03 Hrs**

Unit-I	**09 Hrs**
Foundations of HMI: The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, Processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms. **Introduction to HMI and Domains**: Automotive, Industrial, CE, Medical, ECUs within car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN, LIN, Most, FlexRay, Ethernet etc)	
Unit – II	**09 Hrs**
Automotive Human-Machine Interfaces: Automotive infotainment system - Evolution road map, Feature sets, System architecture, Trends, Human factors and ergonomics in automotive design, Automotive User Experience (UX) Design Principles, In-Vehicle Information Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touchscreen Interfaces and Controls, Usability Testing and Evaluation in Automotive HMIs, Safety Considerations and Regulations in Automotive HMIs, Emerging Technologies in Automotive HMIs, Human-Machine Interfaces for Autonomous Vehicles	
Unit –III	**09 Hrs**
UX and Guidelines: Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts, Graphic design tools - Adobe Photoshop, Adobe XD, Blender, GIMP, Asset Design - Overview, Guidelines and norms, 2D/3D rendering, OpenGL, OSG.	
Unit –IV	**09 Hrs**
HMI User Interface: User-centered HMI development process, Basics of Web-Server. Web-based HMI: Basics of TwinCAT and HTML, CSS, JavaScript. **HMI on Mobile**: Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites.	
Unit –V	**09 Hrs**
HMI Control Systems: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UI controls. **Haptics in Automotive HMI**: Kinesthetic Feedback Systems, Tactile Feedback Systems, Haptics in Multimodal HMI, Automotive Use-Cases **HMI Testing**: Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - Graphics Test Systems (GTS). **UI analytics**: Usage patterns, Debugging, Performance Profiling, Use Cases.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understanding the application of HMIs in various domain.
CO2	Comparison of various communication protocols used in HMI development.
CO3	Apply and analyse the car multimedia system free software and hardware evolution.
CO4	Design and evaluate the graphic tools and advanced techniques for creating car dashboard multimedia systems.

Reference Books	
1.	Touch based HMI; Principles and Applications, Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan, Springer Nature Switzerland AG, 1st Edition.
2.	Unity 2020 by Example: A Project based guide to building 2D, 3D augmented reality and Virtual reality games from sratch, Robert Wells, Packt Publishing ltd, 2020.
3.	GUI Design and Android Apps, Ryan Cohen, Tao Wang, Apress, Berkley, CA,2014.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding 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**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**100**

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

Semester: VI						
ENERGY AUDITING & STANDARDS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**EE266TEJ**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
Types of Energy Audit and Energy-Audit Methodology: Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training. **Survey Instrumentation:** Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data Acquisition System, **Energy Audit of a Power Plant:** Indian Power Plant Scenario, Benefit of Audit, Types of Power Plants, Energy Audit of Power Plant.	
Unit – II	**10 Hrs**
Electrical-Load Management: Electrical Basics, Electrical Load Management, Variable Frequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor, Transmission and Distribution Losses. **Energy Audit of Motors:** Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling. **Energy Audit of Pumps, Blowers and Cooling Towers:** Pumps, Fans and Blowers, Cooling Towers	
Unit –III	**09 Hrs**
Communication & Standards: **Wireless technologies:** WPANs, LAN, Wireless metropolitan area network, cellular network, satellite communication, Zigbee, Bluetooth, LAN, NAN **Wireline communication:** Phone line technology, powerline technology, coaxial cable technology; Optical communication, TCP/IP networks	
Unit –IV	**10 Hrs**
Energy Audit of Boilers: Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods. **Energy Audit of Furnaces:** Parts of a Furnace, classification of Furnaces, Energy saving Measures in Furnaces, Furnace Efficiency **Energy Audit of Steam-Distribution Systems :** S team as Heating Fluid, Steam Basics, Requirement of Steam, Pressure, Piping, Losses in Steam Distribution Systems, Energy Conservation Methods	
Unit-V	**10 Hrs**
Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities. **Energy Audit Applied to Buildings:** Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the need for energy audit, prepare a flow for audit and identify the instruments needed.
CO 2	Design and perform the energy audit process for electrical systems.
CO 3	Design and perform the energy audit process for mechanical systems
CO 4	Propose energy management scheme for a building

Reference Books	
1.	Handbook of energy audit, Sonal Desai, Kindle Edition, 2015, McGraw Hill Education, ISBN: 9339221346, 9789339221348.
2.	Energy management handbook, Wayne C Turner and Steve Doty, 6th Edition, 2015, CRC Press, ISBN: 0-88173-542-6.
3.	Energy management, Sanjeev Singh and Umesh Rathore, 1st Edition, 2016, Katson Books, ISBN 10: 9350141019, ISBN 13: 9789350141014.
4.	Energy audit of building systems, Moncef Krarti, 2nd Edition, 2010, CRC Press ISBN: 9781439828717

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

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

Semester: VI						
BIOMEDICAL INSTRUMENTATION **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**EI266TEK**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**03:00:00**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**03 Hrs**

Unit-I	**09 Hrs**
Fundamentals: Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	
Unit – II	**09 Hrs**
Electrocardiograph: Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG), Block diagram description of an Electrocardiograph, ECG lead systems, Multi-channel ECG machine. **Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG.	
Unit –III	**09 Hrs**
Patient Monitoring System: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement, Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method. **Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter.	
Unit –IV	**09 Hrs**
Blood Flow Meters: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **Cardiac Pacemakers and Defibrillators:** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator, Defibrillator electrodes, DC defibrillator with synchronizer.	
Unit –V	**09 Hrs**
Advances in Radiological Imaging: X-rays-principles of generation, Conventional X-ray radiography, Fluoroscopy, Angiography, Digital radiography, Digital subtraction angiography (DSA). Basic principle of computed tomography, magnetic resonance imaging system and Ultrasonic imaging system.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the sources of biomedical signals and basic biomedical instruments.
CO2	Apply concepts for the design of biomedical devices
CO3	Analyze the methods of acquisition and signal conditioning to be applied to the physiological parameters.
CO4	Develop instrumentation for measuring and monitoring biomedical parameters.

Reference Books	
1.	Handbook of Biomedical Instrumentation, R. S. Khandpur,3rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553.
2.	Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2nd Edition, Reprint 2015, ISBN: 9780130771315.
3.	Medical instrumentation: Application and Design, J. G. Webster, 3rd Edition, Reprint 2015, Wiley Publications, ISBN: 9788126511068.
4.	Principles of Medical Imaging, K.Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 2016, ISBN: 978-0126409703.

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

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

Semester: VI						
TELECOMMUNICATION SYSTEMS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**ET266TEM**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**8 Hrs**
Introduction to Electronic Communication: The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications. **The Fundamentals of Electronics:** Gain, Attenuation, and Decibels. **Radio Receivers:** Super heterodyne receiver.	
Unit – II	**10 Hrs**
Modulation Schemes: Analog Modulation: AM, FM and PM- brief review. **Digital Modulation:** PCM, Line Codes, ASK, FSK, PSK & QAM (Architecture). **Wideband Modulation:** Spread spectrum, FHSS, DSSS.	
Unit –III	**10 Hrs**
Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.	
Unit –IV	**9 Hrs**
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	
Unit –V	**8 Hrs**
Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse, Internet Telephony. **Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee, Mesh Wireless Networks, WiMax, and Wireless Metropolitan Area Networks.	

Course Outcomes: After completing the course, the students will be able to :-	
CO1	Describe the basics of communication systems.
CO2	Analyze the importance of modulation and multiple access schemes for communication systems.
CO3	Analyze the operational concept of cell phone and other wireless technologies.
CO4	Justify the use of different components and sub-system in advanced communication systems.

Reference Books	
1.	Principles of Electronic Communication Systems, Louis E. Frenzel, 4th Edition, 2016, Tata McGraw Hill, ISBN: 978-0-07-337385-0.
2.	Electronic Communication Systems, George Kennedy,3rd Edition, 2008, Tata McGraw Hill, ISBN: 0-02-800592-9.
3.	Introduction to Telecommunications, Anu A. Gokhale, 2nd Edition, 2008, Cengage Learning ISBN: 981-240-081-8

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**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: VI						
MOBILE COMMUNICATION NETWORKS AND STANDARDS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**ET266TEN**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**9 Hrs**
Principle of Cellular Communication: Cellular Terminology, Cell Structure and Cluster, Frequency Reuse Concept, Cluster size and System Capacity, Method of Locating Co-channel cells, Frequency Reuse distance, Co-channel Interference and Signal Quality, Co-channel interference Reduction Methods.	
Unit – II	**9 Hrs**
Basic Cellular system: Consideration of components of a cellular system- A basic cellular system connected to PSTN, Main parts of a basic cellular system, Operation of a Cellular system, Performance criteria- Voice quality, Trunking and Grade of Service, Spectral Efficiency of FDMA and TDMA systems	
Unit –III	**9 Hrs**
Second generation Cellular Technology: GSM: GSM Network Architecture, Identifiers used in GSM System, GSM channels, Authentication and Security in GSM, GSM Call Procedure, GSM Hand-off Procedures.	
Unit –IV	**9 Hrs**
3G Digital Cellular Technology: GPRS: GPRS technology, GPRS NetworkArchitecture, GPRS signalling, Mobility Management in GPRS. **UMTS:** UMTS Network Architecture, UMTS Interfaces, UMTS Air Interface Specifications, UMTS Channels**.**	
Unit –V	**9 Hrs**
Wireless Personal Area Networks: Network architecture, components, Bluetooth, Zigbee, Applications. **Wireless Local Area networks:** Network Architecture, Standards, Applications. Wireless Metropolitan Area Networks: IEEE 802.16 standards, advantages, WMAN Network architecture, Protocol stack	

Course Outcomes: After completing the course, the students will be able to :-	
CO1	Describe the concepts and terminologies for Cellular Communication.
CO2	Analyze the Architecture, Hand-off and Security aspects in 2G and 3G Networks.
CO3	Compare the performance features of 2G and 3G Cellular Technologies.
CO4	Analyze and Compare the architectures of various Wireless technologies and standards.

Reference Books	
1.	Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1
2.	Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar SManvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3.	Wireless Communication, Upena Dalal, 1st Edition, 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
4	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**)** **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**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: VI						
MOBILE APPLICATION DEVELOPMENT **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**IS266TEO**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
TotalHours	**:**	**45L**		**SEE Duration**	**:**	**03 Hours**

Prerequisite: - Programming in Java.

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

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

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

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

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

Semester: VI						
ELEMENTS OF FINANCIAL MANAGEMENT **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**IM266TEQ**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Financial Management-An overview: Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework. **The financial System:** Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system.	
Unit – II	**10 Hrs**
Financial statements, Taxes and cash flow: Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes. **(Conceptual treatment only)** **Time Value of Money:** Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity. **Valuation of securities:** Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches.	
Unit –III	**10 Hrs**
Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications. **Techniques of Capital Budgeting:** Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Payback period, Accounting rate of return. **(Conceptual and Numerical treatment)**	
Unit –IV	**10 Hrs**
Long term finance: Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking **Securities Market:** Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market.	
Unit –V	**09 Hrs**
Working Capital – Policy and Financing: Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper, Factoring **(Conceptual treatment only)**	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the features and elements of a financial system.
CO2	Recognize the relevance basic principles of financial management in decision making.
CO3	Describe the processes and techniques of capital budgeting and working capital financing by organizations.
CO4	Demonstrate an understanding of various sources of finance.

Reference Books:	
1.	Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5
2.	Financial Management ,I M Pandey, 12th edn, 2021, Pearson, ISBN-939057725X, 978-9390577255
3.	Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184
4.	Fundamentals of Financial Management, Eugene F Brigham, Joel F Houston, 8th Edition, 2014, Cengage Learning, ISBN : 9781285065137, 1285065131.

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

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

Semester: VI						
OPTIMIZATION TECHNIQUES **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**IM266TER**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**03 Hours**

UNIT – I	**08 Hrs**
Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel. **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables.	
UNIT – II	**09 Hrs**
Simplex Algorithm: How to Convert an LP to Standard Form, Preview of the Simplex Algorithm, Direction of Unboundedness, Why Does an LP Have an Optimal basic feasible solution, The Simplex Algorithm, Using the Simplex Algorithm to Solve Minimization Problems, Alternative Optimal Solutions, Degeneracy and the Convergence of the Simplex Algorithm, The Big M Method, The Two-Phase Simplex Method.	
UNIT – III	**09 Hrs**
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	
UNIT – IV	**09 Hrs**
Project Management Using Network Analysis: Network construction, CPM & PERT, Determination of critical path and duration, floats. Crashing of Network. Usage of software tools to demonstrate N/W flow problems	
UNIT – V	**09 Hrs**
Game Theory: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance	

Course Outcomes: After going through this course the student will be able to	
CO1	Understand the characteristics of different types of decision – making environments and the appropriate decision making approaches and tools to be used in each type.
CO2	Build and solve Transportation Models and Assignment Models.
CO3	Design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.
CO4	Implement practical cases, by using TORA, WinQSB, Excel, GAMS.

Reference Books:	
1.	Operation Research An Introduction, Taha H A, 10th Global Edition, 2017, Pearson Education Limited, ISBN 13: 978-1-292-16554-7
2.	Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg, 2nd Edition, 2007, John Wiley & Sons (Asia) Pvt Ltd, ISBN 13: 978-8126512560
3.	Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 10th Edition, 2017, McGraw Hill Education, ISBN 13: 978-9339221850
4.	Operations Research Theory and Application, J K Sharma, 6th Edition, 2009, Trinity Press, ISBN : 978-93-85935-14-5

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

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

Semester: VI						
AUTOMOTIVE MECHATRONICS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**ME266TES**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	**03 Hours**

Unit-I	**09 Hrs**
Automobile Engines Classifications of Internal Combustion Engines**.** Engine nomenclature and mechanics. Mixture formation – External, internal, quality and quantity control – homogeneous and stratified injection. Thermodynamic principles of Otto and Diesel cycle. Characteristics – pressure curve and energy yield, engine speed, torque, and power	
Unit-II	**10 Hrs**
Engine Auxiliary Systems: Turbocharger, Intercooler, Exhaust manifold, 3-way catalytic convertor, Exhaust Gas Recirculation system. **Common Rail Fuel Injection system**- Low pressure and high pressure fuel systems, Return line, Quantity control valve and Injectors.	
Unit-III	**10 Hrs**
Vehicular Auxiliary Systems: Vehicle frame and body classification- Hatchback, Sedan, SUV, Coupe, Roadster. Adaptive Brakes - Disc and drum brakes, Antilock Braking Systems, ESP, TCS. Wheels and Tyres- Toe-In, Toe-Out, Caster and Camber angle. Classification of tyres, Radial, Tubeless. **Supplemental Restraint System**: Active and passive safety, Vehicle structure, Gas generator and air bags, Belt Tensioner, Acceleration sensor, Rollover sensor, Seat occupancy recognition.	
Unit-IV	**09 Hrs**
EV Technology: Types of EV's, ICE vs EV torque output, Architecture and Working of EV's. Battery Thermal Management System, Regenerative braking, Safety system and Impacts of EV on the environment.	
Unit-V	**07 Hrs**
Telematics in vehicles – Radio Transmission, Exchange of information, signal path & properties, Concept of radio waves. **Sensors:** Oxygen sensors, Crankshaft/Cam shaft Sensor, Boost Pressure Sensor, Coolant Temperature Sensor, Hot Film Air Mass flow Sensor, Throttle Position Sensor, Rain/Light sensor	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Describe the functions of Mechatronic systems in a modern automobile
CO2:	Evaluate the performance of an engine by its parameters
CO3:	Analyse the automotive exhaust pollutants as per emission norms
CO4:	Demonstrate communication of control modules using a On-Board Diagnostic kit

Reference Books	
1.	Automotive Technology – A systems approach, Jack Erjavec, 5th Edition, Delamr Cengage Learning, ISBN-13: 978-1428311497
2.	Automotive Engineering Fundamentals, Richard Stone and Jeffrey K. Ball, 2004, SAE International, ISBN: 0768009871
3.	Bosch Automotive Handbook, Robert Bosch, 9th Edition, 2004, ISBN: 9780768081527
4.	Understanding Automotive Electronics, William B Ribbens, 5th Edition, Butterworth–Heinemann, ISBN 0-7506-7008-8

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding 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: VI						
MATHEMATICAL MODELLING **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**MA266TEU**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to	
1	Understand the basic procedure of mathematical modeling.
2	Use the concepts of continuous and discrete process models to the problems arising in various fields.
3	Apply the concepts of Markov modelling to stochastic problems.
4	Demonstrate demonstrate the practical importance of graph theoretic models, variational problem and dynamic programming.

Unit-I	**09 Hrs**
Introduction to Mathematical Modelling: Basic concepts, steps involved in modelling, classification of models, assorted simple mathematical models from diverse fields.	
Unit – II	**09 Hrs**
Mathematically Modelling Discrete Processes: Difference equations - first and second order, Introduction to Difference equations, Introduction to discrete models-simple examples, Mathematical modelling through difference equations in economics, finance, population dynamics, genetics and other real world problems.	
Unit –III	**09 Hrs**
Markov modelling: Mathematical foundations of Markov chains, application of Markov Modelling to problems.	
Unit –IV	**09 Hrs**
Modelling through graphs: Graph theory concepts, Modelling situations through different types of graphs.	
Unit –V	**09 Hrs**
Variational Problem and Dynamic Programming: Optimization principles and techniques, Mathematical models of variational problem and dynamic programming, Problems with applications.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamental concepts of mathematical models arising in various fields engineering.
CO2:	Apply the knowledge and skills of discrete and continuous models to understand various types of analysis.
CO3:	Analyze the appropriate mathematical model to solve the real world problem and to optimize the solution.
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	Mathematical Modeling, J. N. Kapur, 1st Edition, 1998, New Age International, New Delhi, ISBN: 81-224-0006-X.
2	Mathematical Modeling: Models, Analysis and Applications, Sandip Banerjee, 2014, Chapman and Hall/CRC Textbook, ISBN 9781439854518.
3	Case studies in mathematical modeling, D. J. G. James and J. J. Mcdonald, 1981, Stanly Thames, Cheltonham, ISBN: 0470271779, 9780470271773.
4	Modeling with difference equations, D. N. Burghes, M. S. Borrie, Ellis Harwood, 1981, ISBN 13: 9780853122869.

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

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

Semester: VI						
MATHEMATICS FOR QUANTUM COMPUTING **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**MA266TEV**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the basic principles of Quantum Computing.
2	Use the concepts of Quantum gates to build quantum algorithms
3	Apply the Quantum algorithms to solve the problems arising in various fields.
4	Demonstrate the practical importance of Quantum computing.

Unit-I	**09 Hrs**
Introduction to Quantum Computing: Quantum superposition, Qubits, Linear algebra for quantum computing, Inner products and Tensor products of vector spaces, Quantum states in Hilbert space, The Bloch sphere, Generalized measurements, No-cloning theorem.	
Unit – II	**09 Hrs**
Quantum Gates: Universal set of gates, quantum circuits, Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits.	
Unit –III	**09 Hrs**
Quantum Algorithm - I: Deutsch Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazarani Algorithm, Simon periodicity algorithm, Phase estimation algorithm, Quantum Fourier transform.	
Unit –IV	**09 Hrs**
Quantum Algorithm - II: Grover search algorithm, Shor quantum factoring algorithm, Harrow-Hassidim-Lloyd (HHL) algorithm for solving linear system problems.	
Unit –V	**09 Hrs**
Applications of Quantum Computing: Application to: order-finding, discrete logarithm, quantum counting, Boolean satisfiability problems(SAT), graph theory problems.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamental concepts of quantum computing.
CO2:	Apply the knowledge and skills of quantum computing to understand various types of problems arising in various fields engineering
CO3:	Analyze the appropriate quantum algorithm to solve the real-world problem and to optimize the solution.
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, 2007, Oxford University press.
2	Quantum Computing for Everyone, Chris Bernhardt, 2020, The MIT Press, Cambridge.
3	Quantum Computation and Quantum Information, M. A. Nielsen & I. Chuang, 2013, Cambridge University Press.
4	Quantum Computing for the quantum curious, Cirian Hughes et. al., 2021, Springer, ISBN 978-3-030-61600-7.
5	Concise guide to quantum computing, Sergei Kurgalin, Sergei Borzunov, 2021, Springer, ISBN 978-3-030-65051-3, ISBN 978-3-030-65052-0 (eBook).

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

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

Semester: VI						
APPLIED PSYCHOLOGY FOR ENGINEERS **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**HSS266TEW**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**08 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit –III	**10 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio-Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment.	
Unit –IV	**10 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	
Unit –V	**09 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. **Psychological Stress**: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress.Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control. Type A and Type B.**Psychological Counseling** - Need for Counseling, Types – Directed, Non-Directed, Participative Counseling.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Describe the basic theories, principles, and concepts of applied psychology as they relate to behaviors and mental processes.
CO2	Define learning and compare and contrast the factors that cognitive, behavioral, and Humanistic theorists believe influence the learning process.
CO3	Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.
CO5	Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.

Reference Books	
2.	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India
2.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3.	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4.	Organisational Behaviour : Human Behaviour at Work ,John W. Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5
5	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

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

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

Semester: VI						
Universal Human Values - II **Category: INSTITUTIONAL ELECTIVES-I** **(Group-E)** **(Theory)**						
Course Code	**:**	**HS266TEY**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution. The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	
Unit – II	**10 Hrs**
Right Understanding (Knowing)- Knower, Known & the Process. The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	
Unit –III	**08 Hrs**
Understanding Existence (including Nature). A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
Unit –IV	**08 Hrs**
Understanding Human Being. Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body, the activities and potentialities of the self, Reasons for harmony/contradiction in the self.	
Unit –V	**08 Hrs**
Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living. Understanding Human Conduct, Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	

Course Outcomes: After completion of the course the students will be able to	
CO1	Understand the basic human aspiration with program of its fulfilment and meaning of resolution in the complete expanse of human living.
CO2	Understand human being in depth and see how self is central to human being
CO3	Understand existence in depth and see how coexistence is central to existence
CO4	Understand human conduct and the holistic way of living leading to human tradition

Reference Books	
1	A foundation course in human values and professional ethics, R. R. Gaur, R Asthana, G P Bagaria, 2nd revised Edition, excel books, New Delhi – 2019, ISN 978-93-87034-47-1
2	Avartansheel Arthshastra, A Nagraj, Divya Path Sansthan, Amarkantak, India, ISBN 978-8-174-46781-2
3	Economy of Performance- a quest for social order based on non – violence, J C Kumarappa, 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India
4	Energy and Equity, Ivan Illich, 1974, The Trinity Press, Worcester & Harper Collins, USA, ISBN, 0060803274, 9780060803278

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

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

Semester VI						
INTERDISCIPLINARY PROJECT						
Course Code	**:**	**CS367P**		**CIE**	**:**	**50Marks**
Credits: L:T:P	**:**	**0:0:3**		**SEE**	**:**	**50Marks**
Total Hours	**:**	**15 P**		**SEE Duration**	**:**	**2Hours**

Major Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to the irrespective internal guide(s) before the beginning of the VI semester.
2. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of VI semester.

Batch Formation:

- Students are free to choose their project partners from any other program.
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house only.
- ***The project work is to be carried out by a team of two to four students.***

Project Topic Selection:

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

Project Evaluation:

Continuous monitoring of project work will be carried out and cumulative evaluation will be done.

- The students are required to meet their guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Guide regularly.
- For CIE assessment the project groups must give a final presentation with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.

Course Outcomes:	
1	Identifying critical thinking and problem-solving abilities by analyzing and addressing interdisciplinary challenges, utilizing creative approaches and innovative solutions.
2	Exhibit proficiency in conducting comprehensive research, including literature review, data collection, modelling, simulation, and analysis, to address significant technical challenges and propose innovative solutions.
3	Demonstrate the ability to do effective teamwork, leadership, project management, and communication skills, while adhering to ethical standards and professional responsibility in delivering the project outcomes within time and budget constraints.
4	Utilize appropriate engineering tools, technologies, and software to design, test, and implement project solutions, ensuring adherence to technical specifications, safety standards, and industry best practices.

CIE Assessment:

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

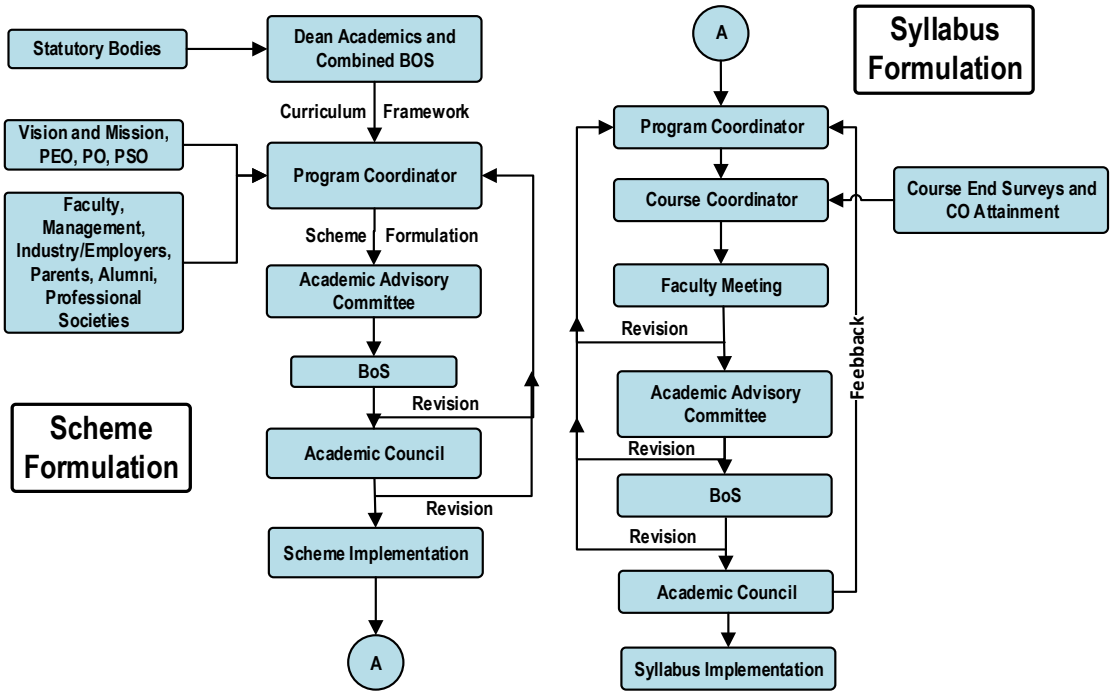
1.	Selection of the topic and formulation of objectives	10%
2.	Design and Development of Project methodology	25%
3.	Execution of Project	25%
4.	Presentation, Demonstration and Results Discussion	30%
5.	Report Writing & Publication	10%

SEE Assessment:

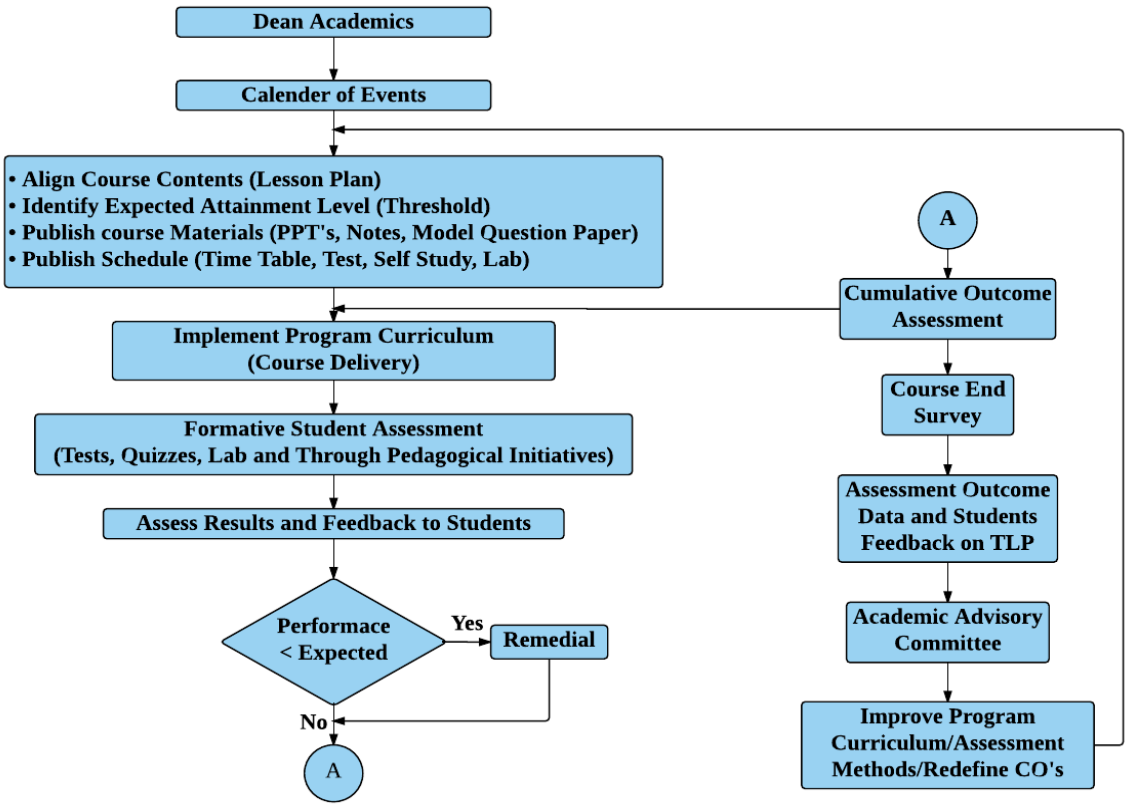
The following are the weightages given during Viva Examination.

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

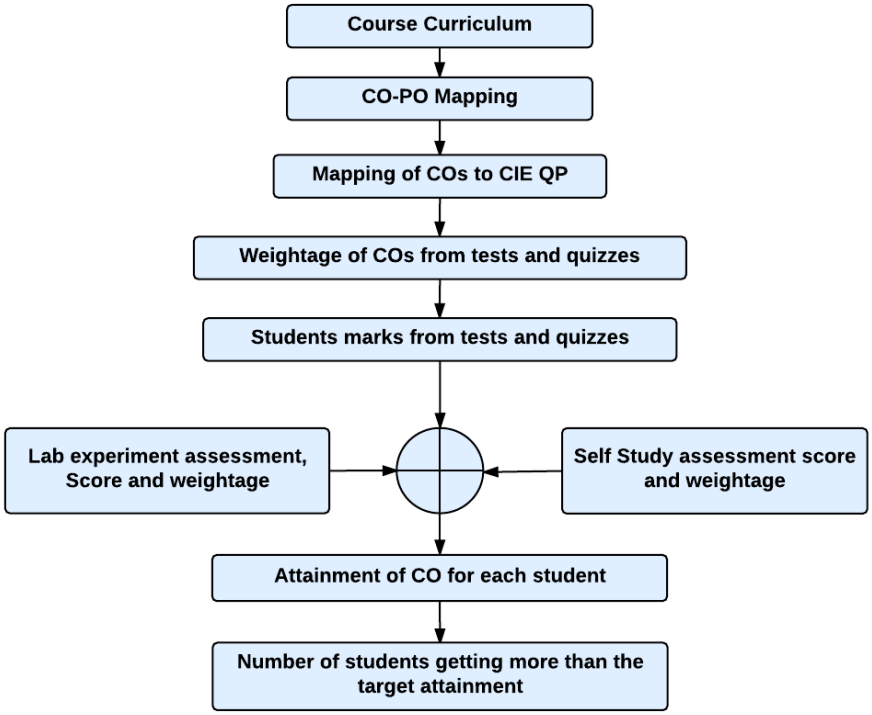
Curriculum Design Process



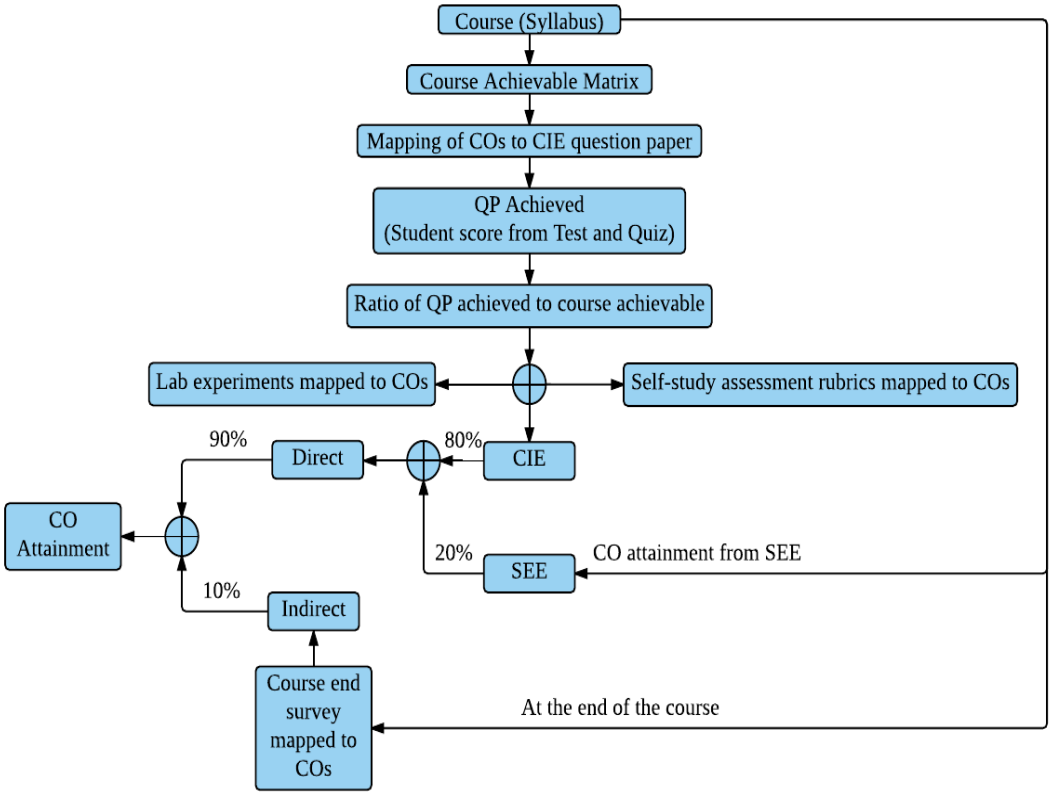
Academic Planning And Implementation



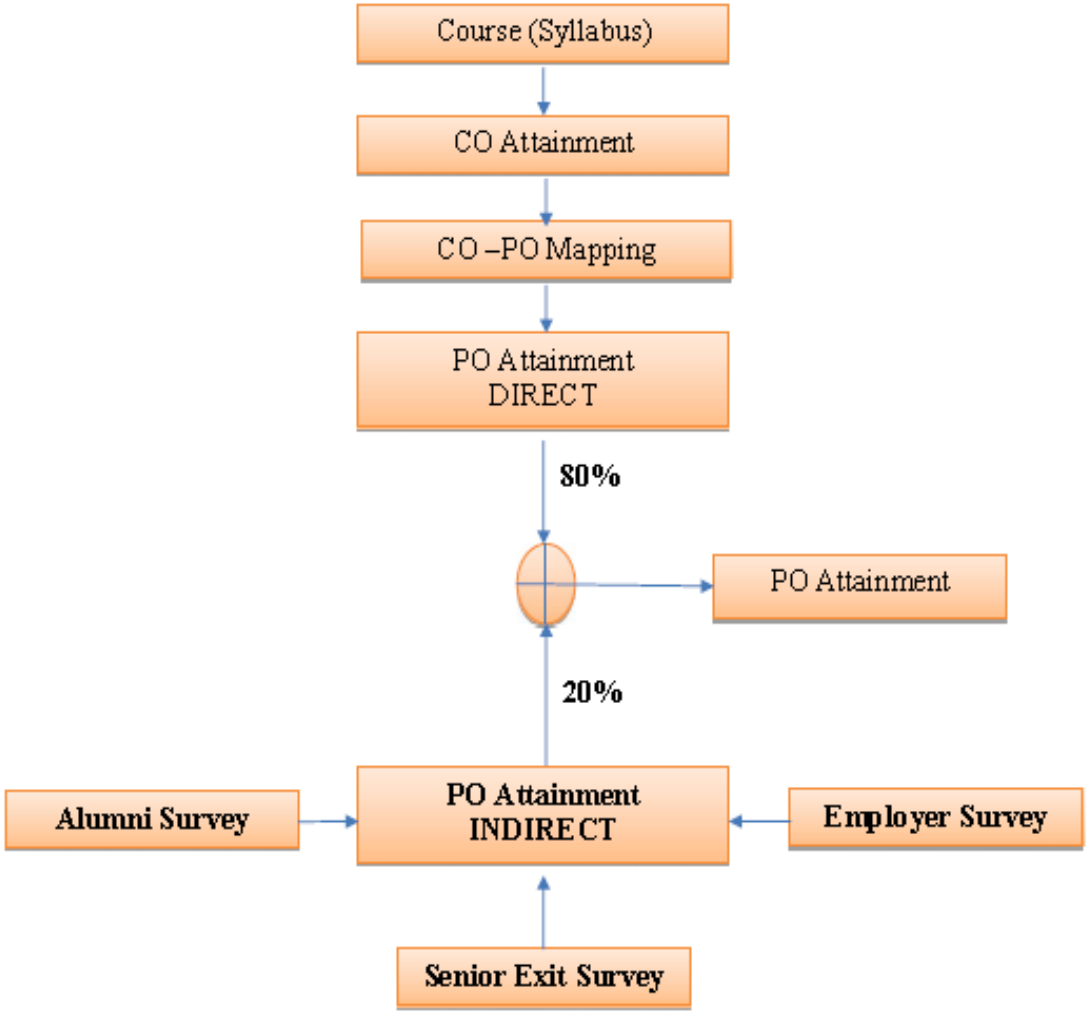
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Knowledge and Attitude Profile (WK)

- **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.

New Program Outcomes (PO)

- **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. QUIZOOSP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/5.3 (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