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**BACHELOR OF ENGINEERING (B.E.)
2021 SCHEME**

**SCHEME & SYLLABUS
THIRD YEAR B.E. PROGRAMS**

**INFORMATION SCIENCE AND
ENGINEERING**

ACADEMIC YEAR 2023-24

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DEPARTMENT VISION

To be the hub for innovation in Information Science & Engineering through Teaching, Research, Development and Consultancy; thus make the department a well-known resource centre in advanced, sustainable and inclusive technology.

DEPARTMENT MISSION

ISE1: To enable students to become responsible professionals, strong in fundamentals of Information Science and engineering through experiential learning.

ISE2: To bring research and entrepreneurship into classrooms by continuous design of innovative solutions through research publications and dynamic development oriented curriculum.

ISE3: To facilitate continuous interaction with the outside world through student internship, faculty consultancy, workshops, faculty development programmes, industry collaboration and association with the professional societies.

ISE4: To create a new generation of entrepreneurial problem solvers for a sustainable future through green technology with an emphasis on ethical practices, inclusive societal concerns and environment.

ISE5: To promote teamwork through inter-disciplinary projects, co-curricular and social activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide adaptive and agile skills in Information Science and Engineering needed for professional excellence / higher studies /Employment, in rapidly changing scenarios.

PEO2: To provide students a strong foundation in basic sciences and its applications to technology.

PEO3: To train students in core areas of Information science and Engineering, enabling them to analyse, design and create products and solutions for the real-world problems, in the context of changing technical, financial, managerial and legal issues.

PEO4: To inculcate leadership, professional ethics, effective communication, team spirit, multi-disciplinary approach in students and an ability to relate Information Engineering issues to social and environmental context.

PEO5: To motivate students to develop passion for lifelong learning, innovation, career growth and professional achievement.

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PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Recognize and appreciate the principles of theoretical foundations, data organization, data communication, security and data analytical methods in the evolving technology
PSO2	Learn the applicability of various system software for the development of quality products in solving real-world problems with a focus on performance optimization
PSO3	Demonstrate the ability of teamwork, professional ethics, communication and documentation skills in designing and implementation of software products using the SDLC principles

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ABBREVIATIONS

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

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INFORMATION SCIENCE AND ENGINEERING
2021 Scheme

V SEMESTER

Sl. No.	CourseCode	Course Title	Credit Allocation				BoS	Category	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total			Theory	Lab		Theory	Lab
1	21HS51A	Intellectual Property Rights & Entrepreneurship	3	0	0	3	HSS	Theory	100	****	3	100	****
2	21AI52	Artificial Intelligence and Machine Learning **(Common to CS,IS & AI)**	3	0	1	4	AI	Theory + Lab	100	50	3	100	50
3	21CS53	Introduction To Database Systems **(Common to CS & IS)**	3	0	1	4	CS	Theory + Lab	100	50	3	100	50
4	21IS54	Cryptography and Network Security	3	1	0	4	IS	Theory	100	****	3	100	****
5	21IS55BX	Professional CoreElective-I **(Group-B)**	3	0	0	3	IS	Theory	100	****	3	100	****
6	21IS56CX	Professional CoreElective-II **(Group C)**	2	0	0	2	IS	NPTEL	50	****	2	50	****
7	21ISI57	Summer Internship- II	0	0	2	2	IS	Internship	****	50	2	****	50
						22							

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GROUP-B

Sl. No.	Course Code	Course Title
1	21IS55B1	Management Information Systems
2	21CS55B2	Internet of Things **(Common to CS & IS)**
3	21CS55B3	Advanced Algorithms **(Common to CS & IS)**
4	21IS55B4	Natural Language Processing **(Common to CS & IS)**

GROUP-C

Sl. No.	Course Code	Course Title
1	21CS56C1	Information Security - 5 - Secure Systems Engineering
2	21IS56C2	Data Mining
3	21IS56C3	Foundation of Cloud IoT Edge ML
4	21IS56C4	Introduction to Soft Computing
5	21IS56C5	Embedded System Design with ARM

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2021 Scheme

			VI SEMESTER									
Sl. No.	**CourseCode**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	21HS61B	Principles of Management& Economics	3	0	0	3	HSS	Theory	100	****	3	100	****
2	21IS62	Software Engineering **(Common to CS & IS)**	3	0	1	4	IS	Theory +Lab	100	50	3	100	50
3	21CS63	Compiler Design **(Common to CS & IS)**	3	0	1	4	CS	Theory +Lab	100	50	3	100	50
4	21IS64DX	Professional Core Elective-III **(Group – D)**	3	0	0	3	IS	Theory	100	****	3	100	****
5	21IS65EX	Professional Core Elective (Cluster Elective) **(Group-E)**	3	0	0	3	IS	Theory	100	****	3	100	****
6	21IE66FX	Institutional Electives – I **(Group F)**	3	0	0	3	Respective BoS	Theory	100	****	3	100	****
						20							

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Group-D		
Sl. No.	Course Code	Course Title
1	21IS64D1	Information Retrieval
2	21IS64D2	Block Chain Technology **(Common to CS & IS Board)**
3	21CS64D3	Web Programming **(Common to CS & IS Board)**
3	21IS64D4	Mobile Application Development

Group-E		
Sl. No.	Course Code	Course Title
1	21IS65E1	Human Computer Interaction
2	21IS65E2	Cloud Computing
3	21AI65E1	Engineering Applications Of Artificial Intelligence
4	21AI65E2	Quantum Computing
5	21CS65E1	Computer Vision
6	21CS65E2	Enterprise Architecture

Group-F			
Sl. No.	Course Code	BoS	Course Title
1	21IE6F1	CH	Industrial Safety and Risk Management
2	21IE6F2	EE	Renewable Energy Systems
3	21IE6F3	IM	Systems Engineering
4	21IE6F4	ME	Mechatronics
5	21IE6F5	MA	Mathematical Modelling
6	21IE6F6	ME	Industry 4.0 – Smart Manufacturing for The Future
7	21IE6F7	HSS	Industrial Psychology for Engineers
8	21IE6F8	IM	Elements of Financial Management
9	21IE6F9	HSS	Universal Human Values-II
10	21IE6F10	EC	Human Machine Interface (Industry Offered Elective)

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Semester: V / VI						
INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP (Common to all Programs) **(Theory)**						
Course Code	**:**	21HS51A/61A		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 L		**SEE Duration**	**:**	**3.00 Hours**
Unit-I						**09 Hrs**
Introduction: 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. Case examples.						
Unit – II						**08 Hrs**
Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India. **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. Case Examples.						
Unit –III						**08 Hrs**
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. **Introduction to Cyber law**: Information Technology Act, cybercrime and e-commerce, data security, confidentiality, privacy, international aspects of computer and online crime.						
Unit –IV						**09 Hrs**
Entrepreneurship: Introduction, Evolution of the Entrepreneurship, Importance of Entrepreneurship, Concept of Entrepreneurship, Characteristics of a successful Entrepreneur, Classification of Entrepreneur, Myths of Entrepreneurship, Entrepreneurial Development Models, Problems Faced by Entrepreneurs and Capacity Building for Entrepreneurship .Women Entrepreneurship in Asia, Women Entrepreneurship in India, Challenges Faced by Women Entrepreneurs. Case studies. **Entrepreneurship in the New Age**: Getting to know your Business, it's Eco-system and Environment, Passion and Values driving, building and growing Family businesses, Challenges and suggested management approaches.						
Unit –V						**11 Hrs**
Business Plans: Introduction ,Purpose of a Business Plan ,Contents of a Business Plan, Business Concept, Business Strategy, Marketing Plan, Operations Plan, Financial Plan, Presenting a Business Plan, Oral and Visual Presentation, Why Do Some Business Plans Fail? Procedure for Setting Up an Enterprise, Business Models and Business Model Innovation Creating a Business Plan. Case lets/Case studies. **Preparation of project**: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. Use of standard templates for preparation of project report.						

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Reference Books	
1	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.
2.	Intellectual Property and the Internet, Rodney Ryder, 2002, Lexis Nexis U.K., ISBN: 8180380025, 9788180380020.
3.	Poornima M. Charantimath "Entrepreneurship Development and Small Business Enterprise", Pearson Education, 2005, ISBN: 9788177582604
4.	Dynamics of Entrepreneurial Development & Management-Vasant Desai, Himalaya Publishing House, 6th Edition, 2018, ISBN - 978-93-5299-133-4
5	Entrepreneurial development, Khanka, Shobhan Singh, S. Chand Publishing, 2006, ISBN - 8121918014, 9788121918015

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Comprehend the applicable source, scope and limitations of Intellectual Property within the purview of engineering domain.
CO2	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives.
CO3	Enable the students to have a direct experience of venture creation through a facilitated learning environment.
CO4	It allows students to learn and apply the latest methodology, frameworks and tools that entrepreneurs use to succeed in real life.

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

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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**

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colspan="6"	**Semester: V**
colspan="6"	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** **Category: PROFESSIONAL CORE COURSE** **(Common to AI, CS & IS)** **(Theory and Practice)**
Course Code	:	21AI52	**CIE**	:	**100+50 Marks**
Credits: L: T: P	:	3:0:1	**SEE**	:	**100+50 Marks**
Total Hours	:	45L+30P	**SEE Duration**	:	**3.00 Hours**

Unit-I	**9Hrs.**

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	**9Hrs.**

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	**9Hrs.**

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	**9Hrs.**

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	**9Hrs**

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

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

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain and apply AI and ML algorithms to address various requirements of real-world problems.
CO2	Design and develop AI and ML solutions to benefit society, science, and industry.
CO3	Use modern tools to create AI and ML solutions.
CO4	Demonstrate effective communication through team presentations and reports to analyze the impact of AI and ML solutions on society and nature.
CO5	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

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

Q.NO.	RUBRIC FOR SEMESTER END EXAMINATION (THEORY)	
	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**

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

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Semester: V					
INTRODUCTION TO DATABASE SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Common to CS & IS)** **(Theory and Lab)**					
Course Code	:	21CS53	**CIE**	:	**100 + 50 Marks**
Credits: L:T:P	:	3:0:1	**SEE**	:	**100 + 50 Marks**
Total Hours	:	45L+30P	**SEE Duration**	:	**3Hrs + 3Hrs**

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	10 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	08 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, spark.	

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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.

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, 3th Edition, McGraw-Hill, 2003 ISBN : 978-0072465631.

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.

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RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO TESTS will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	**40**
3.	**EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS.**	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks**. THE FINAL MARKS WILL BE 50 MARKS**	**50**
MAXIMUM MARKS FOR THE CIE(THEORY AND PRACTICE)		**150**

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

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write up about the Project	**10**
2	Demo of the Project and Report	**30**
3	Viva	**10**
	TOTAL	**50**

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CRYPTOGRAPHY AND NETWORK SECURITY
Category: PROFESSIONAL CORE COURSE
(Theory)

Course Code	:	21IS54		CIE	:	100 Marks
Credits: L:T:P	:	3:1:0		SEE	:	100 Marks
Total Hours	:	45L+15T		SEE Duration	:	3Hours

Unit-I	9 Hrs

Classical Encryption Techniques : Symmetric Cipher Model: Cryptography, Cryptanalysis and Brute Force Attack, Substitution Techniques: Caeser cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One time pad., Transposition techniques, Rotor Machines, Steganography.

Unit – II	9 Hrs

Block Ciphers and the DES: Traditional Block Cipher Structure, Data Encryption Standard, A DES Example, Avalanche Effect, Strength of DES, Block Cipher Design principle. **Block Cipher Operation**: Multiple Encryption and Triple DES, Electronic Code Book, Cipher Block Chaining mode, Cipher Feedback mode, Output Feedback mode, Counter Mode, XTS- AES mode for block oriented storage device.

Unit –III	9 Hrs

Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA Algorithm, Diffie Hellman Key Exchange- Algorithm, Key exchange protocols, Man in the middle attack. **Cryptographic Hash functions**: Applications, Two Simple hash functions, Requirements and Security, Hash functions based on Cipher block chaining, SHA-512 Logic, Round function, Example.

Unit –IV	9 Hrs

Message Authentication Codes: Message Authentication requirements, Functions, Requirements for MAC, Security of MAC, MAC Based on Hash functions: HMAC, MAC's based on block ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM, Digital Signatures: Properties, Attacks and Forgeries, Requirements, Direct digital signature. **Key Management and Distribution:** Symmetric key distribution using symmetric encryption and asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key infrastructure.

Unit –V	9 Hrs

User Authentication: Remote User authentication principles and authentication using Symmetric encryption, Kerberos Version4, Version 5.**Transport Level Security:** Web Security, SSL, TLS **Electronic Mail Security**: PGP, **IP Security:** Encapsulating Security Payload, Format, Encryption and Authentication algorithms, padding, anti-replay service, transport and tunnel modes.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Identify and investigate for new solutions of network security threats, focusing on cryptography and network security concepts.
CO2	Apply security principles to design different computer applications.
CO3	Demonstrate experiments for new network security solutions using cryptographic algorithms, protocols to incorporate security in applications.
CO4	Create and design simple network applications using the knowledge acquired about the services of transport layer.

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	Reference Books
1.	William Stallings – Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson India Education, 2014, ISBN: 978-93-325-1877-3.
2.	Behrouz A Forouzan, Debdeep Mukhopadhyay – Cryptography and Network Security, 2nd Edition, Special Indian Edition, McGraw Hill Publication.
3.	Matt Bishop – Introduction to Computer Security, Pearson Publications.
4.	Menezes Bernard - Network Security and Cryptography, 1st Edition, Cengage Learning India, 2010, ISBN: 9788131513491
5	Douglas Stinson- Cryptography Theory and Practice, 2nd Edition, Chapman & Hall/CRC, ISBN: 978-1584885085.

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

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

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Semester V					
MANAGEMENT INFORMATION SYSTEMS **Category: PROFESSIONAL CORE ELECTIVE** **(Elective B)**					
Course Code	**:**	21IS55B1	**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0	**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L	**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Information systems in Global Business Today: The role of information systems in business today, Perspectives on information systems, Contemporary approaches to information systems, Hands-on MIS projects. Global E-Business and Collaboration: Business process and information systems, Types of business information systems, Systems for collaboration and team work, The information systems function in business. A Case study on E business.	
Unit – II	**09 Hrs**
Information Systems, Organizations and Strategy: Organizations and information systems, How information systems impact organization and business firms, Using information systems to gain competitive advantage, management issues, Ethical and Social issues in Information Systems: Understanding ethical and Social issues related to Information Systems, Ethics in an information society, The moral dimensions of information society. A Case study on business planning.	
Unit –III	**09 Hrs**
IT Infrastructure and Emerging Technologies: IT infrastructure, Infrastructure components, Contemporary hardware platform trends, Contemporary software platform trends, Management issues. Securing Information Systems: System vulnerability and abuse, Business value of security and control, Establishing framework for security and control, Technology and tools for protecting information resources. A case study on cybercrime.	
Unit –IV	**09Hrs**
Achieving Operational Excellence and Customer Intimacy: Enterprise systems, Supply chain management (SCM) systems, Customer relationship management (CRM) systems, Enterprise application. E-commerce: Digital Markets Digital Goods: E-commerce and the internet, E-commerce-business and technology, The mobile digital platform and mobile E-commerce, Building and E-commerce web site. A Case study on ERP.	
Unit –V	**09Hrs**
Managing Knowledge: The knowledge management landscape, Enterprise-wide knowledge management system, Knowledge work systems, Intelligent techniques. **Enhancing Decision Making**: Decision making and information systems, Business intelligence in the enterprise. Business intelligence constituencies. **Building Information Systems**: Systems as planned organizational change, Overview of systems development.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand and apply the fundamental concepts of information systems.
CO2	Develop the knowledge about management of information systems.
CO3	Interpret and recommend the use information technology to solve business problems.
CO4	Apply a framework and process for aligning organization's IT objectives with business strategy.

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Reference Books	
2	Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global Edition, 2016, ISBN:9781292094007.
2.	James A. O' Brien, George M. Marakas: Management Information Systems, Global McGraw Hill, 10th Edition, 2011, ISBN: 978-0072823110.
3.	Steven Alter: Information Systems The Foundation of E-Business, Pearson Education, 4th Edition, 2002, ISBN:978-0130617736.
4.	W.S. Jawadekar: Management Information Systems, Tata McGraw Hill, 2006, ISBN: 9780070616349.
5	Kenneth C. Laudon and Jane P. Laudon: Management Information System, Managing the Digital Firm, Pearson Education, 14th Global Edition, 2016, ISBN:9781292094007.

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

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

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Semester V					
INTERNET OF THINGS **Category: PROFESSIONAL CORE ELECTIVE** **(Elective B)** **(Common to CS & IS)**					
Course Code	:	**21CS55B2**	**CIE**	:	**100 Marks**
Credits: L:T:P	:	3:0:0	**SEE**	:	**100 Marks**
Total Hours	:	45L	**SEE Duration**	:	**3Hours**
Unit-I					**09 Hrs**
FUNDAMENTALS OF IoT: Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects.					
Unit – II					**09 Hrs**
IoT PROTOCOLS: IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT.					
Unit –III					**09 Hrs**
DESIGN AND DEVELOPMENT: Design Methodology – Embedded computing logic – Microcontroller, System on Chips – IoT system building blocks – Arduino – Board details, IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.					
Unit –IV					**09Hrs**
DATA ANALYTICS AND SUPPORTING SERVICES: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG.					
Unit –V					**09Hrs**
CASE STUDIES/INDUSTRIAL APPLICATIONS: Cisco IoT system – IBM Watson IoT platform – Manufacturing – Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model – Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.					

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand and Explore Internet of Things (IoT) with New Computing Paradigms and wireless communication advancements.
CO2	Analyze different components roles in making of Internet of Things (IoT)
CO3	Explore and apply different available options with the component available for designing the IOT applications with performance optimization as objective.
CO4	Design and Analyse the supportive systems that assist in drawing intelligent inference of the IOT systems.

Reference Books	
1	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, 1st Edition, Perason Education, 2017, ISBN: 9386873745, 978-9386873743.
3	Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, 1st Edition, 2014, Universities Press, ISBN:0996025510, 978-0996025515.
4	The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 2nd Edition, 2020, Wiley,ISBN:938899101X, 978-9388991018 (for Unit 2).
5	Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), 2011, Springer, ISBN:3642426980, 978-3642426988.
6	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2MCommunications, Daniel Minoli, 1st Edition, 2013, Willy Publications , ISBN: 978-1-118-47347-4.

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. 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**

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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**

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Semester V						
ADVANCED ALGORITHMS						
Category: PROFESSIONAL CORE ELECTIVE						
(Elective B)						
(Common to CS & IS)						
Course Code	**:**	**21CS55B3**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3Hours**
Unit-I						**09 Hrs**

Analysis techniques:
Growth of functions: Asymptotic notation, Standard notations and common functions, Substitution method for solving recurrences, Recursion tree method for solving recurrences, Master theorem.

Amortized Analysis : Aggregate analysis, The accounting method, The potential method.

Unit – II	**09 Hrs**

Sorting in Linear Time:
Lower bounds for sorting, Counting sort, Radix sort, Bucket sort.
Advanced Design and Analysis Technique: Matrix-chain multiplication, Longest common subsequence, Elements of the greedy strategy, An activity-selection problem

Unit –III	**09 Hrs**

Graph Algorithms
Bellman-Ford Algorithm, Shortest paths in a DAG, Johnson's Algorithm for sparse graphs.
https://www.ics.uci.edu/~eppstein/163/s12-hw3.html
Maximum Flow
Flow networks, Ford Fulkerson method and Maximum Bipartite Matching

Unit –IV	**09Hrs**

Number Theoretic Algorithms:
Elementary notions, GCD, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem.

Unit –V	**09Hrs**

Advanced Data structures:
Structure of Fibonacci heaps, Mergeable-heap operations, Decreasing a key and deleting a node, Binomial Queues, Splay Trees.
String Matching Algorithms: Naïve algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm

Course Outcomes: After completing the course, the students will be able to	
CO1:	Analyze various algorithms for their time and space complexity.
CO2:	Demonstrate a familiarity with major algorithms and data structures
CO3:	Apply appropriate design techniques for solving real world problems.
CO4:	Design and implement solutions using appropriate mathematical techniques.

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Reference Books	
1	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein; Introduction to Algorithms; Columbia University, 3rd Edition; 2009, ISBN-13: 978-0262033848.
2	Mark Allen Weiss; Data Structures and Algorithm Analysis in C++, Addison-Wesley; 4th Revised Edition; 2013, ISBN-13: 9780132847377.
3	Kozen DC, The design and analysis of algorithms , Springer Science & Business Media, 2012, ISBN: 978-0387976877
4	Kenneth A. Berman, Jerome L. Paul,Algorithms, Cengage Learning, 2002. ISBN: 978- 8131505212

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

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Semester V						
NATURAL LANGUAGE PROCESSING						
Category: PROFESSIONAL CORE ELECTIVE						
(Elective B)						
(Common to CS & IS)						
Course Code	**:**	**21IS55B4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3Hours**
Unit-I						**09 Hrs**

Overview and Language Modelling:
Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications -Information Retrieval.
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

Unit – II	**09 Hrs**

Categorizing and Tagging Words:
Using a Tagger, Tagged Corpora, Mapping Words to Properties Using Python Dictionaries Automatic Tagging, N-Gram Tagging, How to Determine the Category of a Word.
Introduction to Machine Learning: Supervised and Unsupervised algorithms.
Learning to Classify Text: Supervised Classification, Further Examples of Supervised Classification, Evaluation, Decision Trees, Naive Bayes Classifiers.

Unit –III	**08 Hrs**

Extracting Information from the text :
Information Extraction, Chunking, Developing, Named Entity Recognition, Term weighting, Inverse document frequency, Residual inverse document frequency.
Analyzing Sentence Structure: Some Grammatical Dilemmas, What's the Use of Syntax?, Context-Free Grammar, Parsing with Context-Free Grammar.

Unit –IV	**08 Hrs**

Analyzing the Meaning of words and Sentences :
The semantics of English sentences, Representing Meaning, Semantic Analysis, Lexical semantics, Word-sense disambiguation.
NLP Applications: Machine translation, Sentiment Analysis, Chat-Bot, Question Answering System, Text Classification, Spell Checking and Market Intelligence.

Unit –V	**08 Hrs**

NLP Applications (Continued) :
Machine translation - Basic issues in MT. Statistical translation
Information Retrieval: Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries.

Course Outcomes: After completing the course, the students will be able to	
CO1:	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.
CO2:	Understand the basic parsing technique for context-free grammars, the data structures and algorithms for parsing, and the approaches to ambiguity resolution.
CO3:	Apply the fundamental algorithms and techniques in the area of Natural Language Processing.
CO4:	Comprehend and compare different natural language models.

Reference Books	
1	Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval‖, OUP India, 2008, ISBN :9780195692327
2	Steven Bird, Ewan Klein, Edward Loper,―Natural Language Processing with Python, ‖Publisher: O'Reilly Media, June 2009, ISBN :9780596516499
3	Anne Kao and Stephen R. Poteet (Eds), ―Natural Language Processing and Text Mining‖, ISBN : 9781846281754
4	James Allen,―NaturalLanguageUnderstanding‖,2ndedition,Benjamin/Cummingspublishing company, 1995, ISBN : 9788131708958

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**

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	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						
INFORMATION SECURITY - 5 - SECURE SYSTEMS ENGINEERING **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**						
Course Code	:	21CS56C1		**CIE**	:	**50 Marks**
Credits: L:T:P	:	2:0:0		**SEE**	:	**50 Marks**
Total Hours	:	30L		**SEE Duration**	:	**2 Hours**
Unit-I						**10 Hrs**
Introduction/gdb/buffer overflow, Preventing buffer overflow based malware						
Unit – II						**10 Hrs**
Integer overflow and buffer overread and heap overflow. More on heap overflow; Access Control, Confinement						
Unit –III						**10 Hrs**
SGX, and Trustzone Micro-architectural Attacks, Hardware Security.						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the significance of security measures in preventing attacks.
CO2	Compare various security mechanisms in preventing attacks.
CO3	Identify the risks associated with software security
CO4	Analyze micro-architectural attacks and their impact on system security.

Reference Books	
1.	Chester Rebeiro, Information Security - 5 - Secure Systems Engineering, 106106199.pdf - Google Drive
2.	Rose J Anderson, Security Engineering: A Guide to Building Dependable Distributed Systems, 2nd Edition, April 14, 2008 by Wiley
3.	Mark Merkow, INFORMATION SECURITY : PRINCIPLES AND PRACTICES, 1st Edition, Pearson India

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
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 30 MARKS.**	**30**
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). **THE SUM OF ALL WILL BE THE FINAL MARKS OF 40 AND THEN REDUCE TO 10 MARKS**.	**10**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

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Q. NO.	CONTENTS	MARKS
\multicolumn{3}{c}{**RUBRIC FOR SEMESTER END EXAMINATION** **(THEORY)**}		
\multicolumn{3}{c}{**PART A**}		
1	Objective type questions covering entire syllabus	10
\multicolumn{3}{c}{**PART B** (Maximum of TWO Sub-divisions only)}		
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	13
5 & 6	Unit 3 : Question 5 or 6	13
	TOTAL	**50**

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Semester: IV						
Data Mining						
Category: PROFESSIONAL CORE ELECTIVE						
(NPTEL Course)						
Course Code	:	21IS56C2		CIE Marks	:	50 Marks
Credits: L:T:P	:	2:0:0		SEE Marks	:	50 Marks
Total Hours	:	30L		SEE Duration	:	2 Hours
Unit – I						**10 Hrs**
Introduction, Data Preprocessing, Association Rule Mining, Classification Basics, Decision Tree, Bayes Classifier, K nearest neighbor						
Unit – II						**10 Hrs**
Support Vector Machine, Kernel Machine , Clustering, Outlier detection , Sequence mining						
Unit – III						**10 Hrs**
Evaluation, Visualization, Case studies						

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand standard data mining methods and techniques such as association rules, data clustering and classification.
CO2:	Analyze data mining problems and reason about the most appropriate methods to apply to a given dataset and knowledge extraction need
CO3:	Implement basic pre-processing, association mining, classification and clustering algorithms.
CO4:	Apply the techniques on datasets of realistic sizes using modern data analysis frameworks.

Reference Books:	
1.	Introduction to Data Mining, Tan, Steinbach and Vipin Kumar, Pearson Education, 2016
2.	Data Mining: Concepts and Techniques, Pei, Han and Kamber, Elsevier, 2011

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	RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)	
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
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 30 MARKS.**	**30**
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)**. THE SUM OF ALL WILL BE THE FINAL MARKS OF 40 AND THEN REDUCE TO 10 MARKS**.	**10**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

	RUBRIC FOR SEMESTER END EXAMINATION (THEORY)	
Q. NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	10
	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	13
5 & 6	Unit 3 : Question 5 or 6	13
	TOTAL	**50**

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Semester: V					
Foundation of Cloud IoT Edge ML **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**					
Course Code	:	**21IS56C3**	**CIE**	:	**50 Marks**
Credits: L:T:P	:	**2:0:0**	**SEE**	:	**50 Marks**
Total Hours	:	**30L**	**SEE Duration**	:	**2 Hours**
Unit-I					**10 Hrs**
Introduction to Cloud and its limitations to support low latency use cases Edge Computing to support IoT applications such as self driving cars, etc Introduction to IoT Edge platforms such as Azure IoT hub, AWS IoT platform					
Unit – II					**10 Hrs**
Introduction to docker container and kubernetes in edge computing Concepts of distributed systems in IoT applications such as time ordering and clock synchronisation, distributed snapshot, etc					
Unit –III					**10 Hrs**
Edge Design of IoT storage system like key value store Introduction to MQTT and Kafka for end-to-end IoT pipeline Use Cases of Machine Learning for IOT in predictive maintenance, image classifier, and self-driving cars					

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and explore use cases of cloud and its implementation.
CO2:	Explore various technologies in edge computing.
CO3:	Explore various technologies in distributed and IoT systems.

Reference Books	
1	"Fog and Edge Computing: Principles and Paradigms", Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley, 2019
2	The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
3	Cloud Computing: Principles and Paradigms", Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011
4	Cloud and Distributed Computing: Algorithms and Systems", Rajiv Misra, Yashwant Patel, Wiley 2020

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RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will beconducted & Each Quiz will be evaluated for 10 Marks. **THE AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
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 30 MARKS.**	**30**
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)**. THE SUM OF ALL WILL BE THE FINAL MARKS OF 40 AND THEN REDUCE TO 10 MARKS**.	**10**
MAXIMUM MARKS FOR THE CIE THEORY		**50**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
PART A		
1	Objective type questions covering entire syllabus	10
PART B (Maximum of TWO Sub-divisions only)		
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	13
5 & 6	Unit 3 : Question 5 or 6	13
TOTAL		**50**

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Semester: V					
INTRODUCTION TO SOFT COMPUTING **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**					
Course Code	:	**21IS56C4**	**CIE**	:	**50 Marks**
Credits: L:T:P	:	**2:0:0**	**SEE**	:	**50 Marks**
Total Hours	:	**30L**	**SEE Duration**	:	**2Hours**

Unit-I	10 Hrs
Introduction to Soft Computing, Introduction to Fuzzy logic, Fuzzy membership functions, Operations on Fuzzy sets, Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences	
Unit – II	**10 Hrs**
Defuzzyfication Techniques-I, Defuzzyfication Techniques-II, Fuzzy logic controller-I, Fuzzy logic controller-II, Solving optimization problems, Concept of GA, GA Operators: Encoding, GA Operators: Selection-I GA Operators: Selection-II, GA Operators: Crossover-I, GA Operators: Crossover-II, GA Operators: Mutation	
Unit –III	**10 Hrs**
Introduction to EC-I, Introduction to EC-II, MOEA Approaches: Non-Pareto, MOEA Approaches: Pareto-I, MOEA Approaches: Pareto-II, Introduction to ANN, ANN Architecture, ANN Training-I, ANN Training-II, ANN Training-III, Applications of ANN	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Learn about soft computing techniques and their applications.
CO2	Understand perceptrons and counter propagation networks.
CO3	Analyze various neural network architectures
CO4	Define the fuzzy systems

Reference Books	
1.	An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2.	Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3.	Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4.	Neural Networks and Learning Machines Simon Haykin (PHI)

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 AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
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 30 MARKS.**	**30**
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)**. THE SUM OF ALL WILL BE THE FINAL MARKS OF 40 AND THEN REDUCE TO 10 MARKS**.	**10**
MAXIMUM MARKS FOR THE CIE THEORY		**50**

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RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
PART A		
1	Objective type questions covering entire syllabus	10
PART B (Maximum of TWO Sub-divisions only)		
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	13
5 & 6	Unit 3 : Question 5 or 6	13
	TOTAL	**50**

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Semester: V					
Embedded System Design With ARM **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**					
Course Code	**:**	21IS56C5		CIE Marks	:	50 Marks
Credits: L:T:P	:	2:0:0		SEE Marks	:	50 Marks
Total Hours	:	30L		SEE Duration	:	**2 Hours**

Unit – I	10 Hrs
Introduction to embedded systems and microcontrollers Instruction set architecture of ARM microcontroller, and assembly language programming D/A and A/D converter, sensors, actuators and their interfacing	

Unit – II	10Hrs
Microcontroller development boards and embedded programming platforms Hands-on and demonstration I: Temperature sensing unit, Light sensing unit, Sound sensing unit Hands-on and demonstration II: Feedback control system, relay control unit, driving electrical appliances like motors, bulb, pump, etc.	

Unit – III	10 Hrs
Hands-on and demonstration III: Object tracking using GPS and GSM Hands-on and demonstration IV: Introduction to Internet of Things, smart home concepts, motion sensing using accelerometer, control of appliances over SMS	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the main features of the ARM Cortex based Embedded System development environment
CO2:	Designing, developing, coding, testing and debugging system software.
CO3:	Analysing and enhancing efficiency, stability and scalability of system resources.
CO4:	Designing and implementing software of embedded devices and systems.

Reference Books:	
1.	F. Vahid and T. Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India Pvt. Ltd., 2002.
2.	A.N. Sloss, D. Symes and C. Wright, "ARM System Developer's Guide: Design and Optimizing System Software", Morgan Kaufman Publishers, 2004.
3.	W. Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.

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RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. **THE AVERAGE OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
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 30 MARKS.**	**30**
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)**. THE SUM OF ALL WILL BE THE FINAL MARKS OF 40 AND THEN REDUCE TO 10 MARKS**.	**10**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	CONTENTS	MARKS
PART A		
1	Objective type questions covering entire syllabus	10
PART B (Maximum of TWO Sub-divisions only)		
2	Unit 1 : (Compulsory)	14
3 & 4	Unit 2 : Question 3 or 4	13
5 & 6	Unit 3 : Question 5 or 6	13
	TOTAL	**50**

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Semester: V						
SUMMER INTERNSHIP – II **(Practical)**						
Course Code	**:**	21ISI57		**CIE**	**:**	50 Marks
Credits: L: T: P	**:**	0:0:2		**SEE**	**:**	50 Marks
Total Hours	**:**	4 Weeks		**SEE Duration**	**:**	02 Hrs
Students can opt the internship with the below options						4 Weeks

A. Within the respective department at RVCE (Inhouse) Departments may offer internship opportunities to the students through the available tools so that the students come out with the solutions to the relevant societal problems that could be completed within THREE WEEKS.

B. At RVCE Center of Excellence/Competence

RVCE hosts around 16 CENTER OP EXCELLENCE in various domains and around 05 CENTER OP COMPETENCE. The details of these could be obtained by visiting the website https:/ /rvce.edu.in / rvce-center-excellence. Each centre would be providing the students relevant training/internship that could be completed in three weeks.

C. At InternShala

Intern Shala is India's no.1 internship and training platform with 40000+ paid internships in Engineering. Students can opt any internship for the duration of three weeks by enrolling on to the platform through https: / /internshala.com

D. At Engineering Colleges nearby their hometown

Students who are residing out of Bangalore, should take permission from the nearing Engineering College of their hometown to do the internship. The nearby college should agree to give the certificate and the letter/email stating the name of the student along with the title of the internship held with the duration of the internship in their official letter head.

E. At Industry or Research Organizations

Students can opt for interning at the industry or research organizations like BEL, DRDO, ISRO, BHEL, etc.. through personal contacts. However, the institute/industry should provide the letter of acceptance through hard copy/email with clear mention of the title of the work assigned along with the duration and the name of the student.

Procedures for the Internship:

1. Request letter/Email from the office of respective departments should go to Places where internships are intended to be carried out with a clear mention of the duration of Three Weeks. Colleges/Industry/ CoEs/CoCs will confirm the training slots and the number of seats allotted for the internship via confirmation letter/ Email.
2. Students should submit a synopsis of the proposed work to be done during internship program. Internship synopsis should be assessed or evaluated by the concerned Colleges/Industry/CoEs/CoC. Students on joining internship at the concerned Colleges/Industry/ CoEs/CoCs submit the Daily log of student's dairy from the joining date.
3. Students will submit the digital poster of the training module/project after completion of internship.
4. Training certificate to be obtained from industry.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Develop interpersonal, critical skills, work habits and attitudes necessary for employment.
CO2	Assess interests, abilities in their field of study, integrate theory and practice and explore career opportunities prior to graduation.
CO3	Explore and use state of art modern engineering tools to solve the societal problems with affinity towards environment and involve in ethical professional practice.
CO4	Compile, document and communicate effectively on the internship activities with the engineering community.

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RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION		
#	COMPONENTS	MARKS
1.	**REVIEW I:** Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments, exhibiting professional and ethical practice, communication skills (oral and body language).	**20**
2.	**REVIEW II**: Presentation in the form digital poster, report writing, exhibiting ethics in report writing, oral presentation.	**30**
MAXIMUM MARKS FOR THE CIE THEORY		**50**

RUBRICS FOR SEMESTER END EXAMINATION		
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner.		
Q.NO.	CONTENTS	MARKS
1	Write Up	**10**
2	Conduction of the Experiments	**20**
3	Viva	**20**
	TOTAL	**50**

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Semester: V/VI					
PRINCIPLES OF MANAGEMENT & ECONOMICS					
Category: PROFESSIONAL CORE COURSE					
(Theory)					
Course Code	:	21HS51B / 61B	**CIE**	:	100 Marks
Credits: L:T:P	:	3:0:0	**SEE**	:	100 Marks
Total Hours	:	45 Hrs	**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 Equity theory, 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.					
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. **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.					
Unit –V					**09 Hrs**
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.					

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.

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	CONTENTS	MARKS
PART A		
1	Objective type questions covering entire syllabus	20
PART B		
(Maximum of TWO Sub-divisions only; 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**

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Semester: VI					
SOFTWARE ENGINEERING Category: PROFESSIONAL CORE COURSE (Common to CS & IS) (Theory and Lab)					
Course Code	:	21IS62	CIE	:	100 + 50 Marks
Credits: L:T:P	:	3:0:1	SEE	:	100 + 50 Marks
Total Hours	:	45L+30P	SEE Duration	:	3Hrs + 3 Hrs
Unit-I					09 Hrs

Overview: Introduction: Professional Software Development, Software Engineering Ethics.

Software Processes: Models, Process activities, Coping with Change, Process improvement. The Rational Unified Process. Computer Aided Software Engineering. Agile Software Development: Introduction to agile methods, Agile development techniques, Agile project management and scaling agile methods

Unit – II	09 Hrs

Requirements Engineering and System Modeling:

Software Requirements: Functional and Non-functional requirements. Requirements Elicitation, Specification, Validation and Change.

Advanced Software Engineering: Dependable systems: Dependability properties, Sociotechnical systems, dependable processes, formal methods and dependability, Reliability engineering: Availability and reliability, reliability requirements,Reliability measurements,

Unit –III	09 Hrs

System Modeling: Context models, Interaction models, Structural models, Behavioural models, Model driven architecture. Architectural Design: Design decisions, Architectural views, Architectural patterns and architectures.

Development and Testing: Design and implementation: Object oriented design using UML, Design patterns, Implementation issues, Open-source development. Software Testing: Development testing, Test-driven development, Release testing, User testing.

Unit –IV	09 Hrs

Software Evolution: Evolution processes. Legacy system evolution, Software maintenance

Project Planning: Software Pricing, Plan driven development, Project Scheduling, Agile planning, Estimation Techniques, COCOMO cost modeling.

Unit –V	09 Hrs

Software Management: Project Management: Risk Management, Managing People, Teamwork, , Case studies

Emerging trends in SE: Technology Evolution, Observing Software Engineering Trends, Identifying "Soft-Trends", Tools related trends.

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Comprehend various software life cycle models and steps of software development process
CO2	Apply concepts of Software Project Planning and software Design techniques
CO3	Analyze capabilities of various tools to assist in the software development activities
CO4	Develop robust software design and software project plan from requirement gathering to implementation
CO5	Exhibit effective communication, SDL and engage in continuing professional development through experiential learning

Reference Books	
1.	Ian Sommerville,“ Software Engineering”, 9th Edition, Pearson Education, 2013, ISBN: 9788131762165
2.	Roger.S.Pressman,“ Software Engineering-A Practitioners Approach”, 7th Edition, Tata McGraw Hill, 2007, ISBN:9780071267823
3.	Pankaj Jalote,“ An Integrated Approach to Software Engineering”, 3rd Edition, Narosa Publishing House, 2013, ISBN: 9788173197024
4.	Smart Cities, Germaine Halegoua, The MIT Press, 1st Edition, 2020, ISBN-13 : 978-0262538053.
5.	Rajib Mall, Fundamentals of Software Engineering, 3rd Edition, Prentice-hall Of India Pvt Ltd., 2012, ISBN:9788120348981

Lab Component
PART-A

Software Engineering Virtual Labs will be used to carry out activities weekly in the
laboratory. The Virtual Lab is aMHRD, Govt. of India initiative.
http://vlabs.iitkgpac.in/se/
List of Experiments:
1) Identifying the Requirements from Problem Statements
2) Estimation of Project Metrics
3) Modeling UML Use Case Diagrams and Capturing Use Case Scenarios
4) Identifying Domain Classes from the Problem Statements
5) State chart and Activity Modeling
6) Modeling UML Class Diagrams and Sequence diagrams
7) Modeling Data Flow Diagrams
8) Estimation of Test Coverage Metrics and Structural Complexity
9) Designing Test Suites

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PART-B

Student will analyse, design, and implement an application using the appropriate Software engineering tools and practices.All topics learnt in virtual lab (SE phases) need to be covered. A report of the same is expected to be submitted.

Some example applications are listed below(not limited to):

- Automated banking application
- Online shopping portal
- CIE seating arrangement
- SEE Exam invigilation duty allotment
- UG Project Evaluation system
- Employee Payroll system

List of Submissions:

- Requirements Analysis document
- Design document
- Implementation details
- Testing document with appropriate test cases
- Constraints and Dependencies

#	COMPONENTS	MARKS
\multicolumn	**RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)**	
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. **THE FINAL MARKS WILL BE 50 MARKS**	**50**
	MAXIMUM MARKS FOR THE CIE(THEORY AND PRACTICE)	**150**

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Q. NO.	CONTENTS	MARKS
\multicolumn{3}{c}{**RUBRIC FOR SEMESTER END EXAMINATION (THEORY)**}		
\multicolumn{3}{c}{**PART A**}		
1	Objective type questions covering entire syllabus	20
\multicolumn{3}{c}{**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**

Q.NO.	CONTENTS	MARKS
\multicolumn{3}{c}{**RUBRIC FOR SEMESTER END EXAMINATION (LAB)**}		
1	Write up about the Project	**10**
2	Demo of the Project and Report	**30**
3	Viva	**10**
	TOTAL	**50**

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Semester: VI					
COMPILER DESIGN Category: PROFESSIONAL CORE COURSE (Common to CS & IS) (Theory and Lab)					
Course Code	:	21CS63		CIE	:	150 Marks
Credits: L:T:P	:	3:0:1		SEE	:	150 Marks
Total Hours	:	42L+30P		SEE Duration	:	3Hours

Unit-I	09 Hrs

Introduction to Compiling and Lexical Analysis

Introduction, Language Processors, The structure of Compiler, Evolution of programming Languages. LexicalAnalysis- The Role of Lexical Analyzer, Input Buffering, Specifications of Tokens, Recognition of Tokens.

Unit – II	09 Hrs

Syntax Analysis

Introduction, Context-free Grammars, Writing a Grammar, Top-down Parsing, Bottom-up Parsing, Introduction toLR Parsing: Simple LR, Most powerful LR parsers (Excluding efficient construction and compaction of parsing tables), Using ambiguous grammars.

Unit –III	09 Hrs

Lexical –Analyzer and Parser generators

Lexical –Analyzer generator Lex, The parser generator YACC, Using YACC with ambiguous grammars, CreatingYACC lexical Analyzer with LEX, Error recovery in YACC

Syntax-Directed Translation

Syntax-Directed Definitions, Evaluation orders for SDD, Application of Syntax Directed Translation.

Unit –IV	09 Hrs

Intermediate Code Generation

Variants of Syntax trees, Three address code, Types and Declaration-Type Expressions, equivalence, Declaration, Control flow, Back patching.

Unit –V	09 Hrs

Code Generation and optimization

Issues in the design of Code Generator, The Target Language, Address in the target Code, Basic Blocks and Flowgraphs, Optimization of Basic blocks, A Simple Code Generator, Peephole Optimization. Introduction to LLVM compiler and Clang.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand and explore the fundamental concepts of compiler design and its implementation.
CO2	Identify and apply rules for designing various phases of compiler
CO3	Analyse the practices adopted in constructing an efficient compiler.
CO4	Implement and demonstrate in-depth knowledge of various technologies related to principles, techniquesand tools for designing compiler.

	Reference Books
1.	Compilers- Principles, Techniques and Tools, Alfred V Aho, Monica S.Lam, Ravi Sethi, Jeffrey D Ullman; 2nd Edition, 2013, Pearson Education, ISBN – 10-1-292-02434-8, ISBN –13- 978-1-292-02434-9.
2.	Compiler Design, Santanu Chattopadhyay, 1st Edition, 2011, PHI Learning, ISBN-978-81-203-2725-2.
3.	Compiler Construction Principles & Practice, Kenneth C Louden; Cengage Learning, 1st Edition, 2009. ISBN – 0534939724.
4.	Crafting a Compiler with C, Charles N. Fischer, Richard J. leBlanc, Jr., 1st Edition, 2009, Pearson Education, ISBN-13:978-0136067054, ISBN-10: 0136067050.

Laboratory Component

Student should be able to design phases of compiler by incorporating following features:
    1. Writing a scanner, writing predictive parser for a language constructs.
    2. Experiment with scanner (lex/flex) and parser (yacc/byson) generators
    3. Writing scanner-parse specification for a simple language constructs.
    4. Translation of the language constructs to an intermediate form (e.g. three-address code),
    5. Generation of target code (in assembly language) using compiler construction tools.
    6. Code improvement and optimization using LLVM compiler.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	20
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	40
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	40
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks**. THE FINAL MARKS WILL BE 50 MARKS**	50
MAXIMUM MARKS FOR THE CIE(THEORY AND PRACTICE)		**150**

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

RUBRIC FOR SEMESTER END EXAMINATION (LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write up about the Project	**10**
2	Demo of the Project and Report	**30**
3	Viva	**10**
	TOTAL	**50**

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Semester: VI						
INFORMATION RETRIEVAL **Category: PROFESSIONAL CORE ELECTIVE** **Elective D**						
Course Code	:	21IS64D1		**CIE**	:	**100 Marks**
Credits: L:T:P	:	3:0:0		**SEE**	:	**100 Marks**
Total Hours	:	45L		**SEE Duration**	:	**03 Hours**

Unit-I	**09 Hrs**
Introduction: Motivation, Basic concepts, Past, present, and future, The retrieval process. **Modeling:** Introduction, A taxonomy of information retrieval models, Retrieval: Adhoc and filtering, A formal characterization of IR models, Classic information retrieval, Alternative set theoretic models, Alternative algebraic models,	
Unit – II	**09Hrs**
Modeling: Alternative probabilistic models, Structured text retrieval models, Models for browsing. **Retrieval Evaluation:** Introduction, Retrieval performance evaluation, Reference collections. **Query Languages:** Introduction, keyword-based querying, Pattern matching, Structural queries, Query protocols. **Query Operations:** Introduction, User relevance feedback, Automatic local analysis, Automatic global analysis.	
Unit –III	**09Hrs**
Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup languages, Multimedia. **Text Operations:** Introduction, Document preprocessing, Document clustering, Text compression, Comparing text compression techniques. **Indexing and Searching:** Introduction; Inverted Files; Other indices for text; Boolean queries; Sequential searching; Pattern matching; Structural queries; Compression.	
Unit –IV	**09 Hrs**
Parallel and Distributed IR: Introduction, Parallel IR, Distributed IR. **Searching the Web:** Introduction, Challenges, Characterizing the web, Search engines, Browsing, Metasearchers, Finding the needle in the haystack, Searching using hyperlinks.	
Unit –V	**09Hrs**
User Interfaces and Visualization: Introduction, Human-Computer interaction, The information access process, Starting points, Query specification, Context, Using relevance judgments, Interface support for the search process	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Identify and design the various components of an Information Retrieval system.
CO2:	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO3:	Analyze the Web content structure.
CO4:	Evaluate the performance of search engines.

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Reference Books	
1	Ricardo Baeza – Yates, Berthier Ribeiro – Neto; Modern Information Retrieval; 1st Edition; Pearson Education Limited; 2013; ISBN-9788131709771.
2	David A. Grossman, Ophir Frieder; Information Retrieval Algorithms and Heuristics; 2nd Edition; Springer Verlag; 2012; ISBN-9788181289179.
3	William B. Frakes, Ricardo Baeza-Yates; Information Retrieval Data Structures and Algorithms; 1st Edition; Pearson Education Limited; 2012; ISBN-9788131716922.
4	Hinrich Schutze, Prabhakar Raghavan, Christopher D Manning; Introduction To Information Retrieval; 1st Edition; Cambridge University Press India Pl; 2014; ISBN-9781107666399.

#	COMPONENTS	MARKS
\multicolumn{3}{c}{**RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)**}		
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
\multicolumn{2}{r}{**MAXIMUM MARKS FOR THE CIE THEORY**}		100

CONTENTS	MARKS
\multicolumn{2}{c}{**RUBRIC FOR SEMESTER END EXAMINATION (THEORY)**}	
\multicolumn{2}{c}{**PART A**}	
Objective type questions covering entire syllabus	20
\multicolumn{2}{c}{**PART B** (Maximum of FOUR Sub-divisions only)}	
Unit 1 : (Compulsory)	16
Unit 2 : Question 3 or 4	16
Unit 3 : Question 5 or 6	16
Unit 4 : Question 7 or 8	16
Unit 5: Question 9 or 10	16
TOTAL	**100**

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		Semester: VI			
		BLOCK CHAIN TECHNOLOGY **Category: PROFESSIONAL CORE ELECTIVE** **Elective D** **(Common to CS & IS)**			
Course Code	:	21IS64D2	**CIE**	:	**100 Marks**
Credits: L:T:P	:	3:0:0	**SEE**	:	**100 Marks**
Total Hours	:	42L	**SEE Duration**	:	**3.00 Hours**

Unit-I	**8 Hrs**
Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency?	
Unit – II	**8 Hrs**
Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc. Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions	
Unit –III	**8 Hrs**
Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).Bitcoin scripting language and their use	
Unit –IV	**9Hrs**
Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Some attacks on smart contracts	
Unit –V	**9Hrs**
Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain. Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms. Limitations of blockchain as a technology, and myths vs. reality of blockchain technology	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define and explain the fundamentals of Blockchain
CO2:	Illustrate the technologies of blockchain
CO3:	Describe the models of blockchain
CO4:	Analyze and demonstrate the Ethereum
CO5:	Analyze and demonstrate Hyperledger fabric

Textbook/ Textbooks

•	Blockchain Technology: Cryptocurrency and Applications S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan Oxford University Press 2019
•	Bitcoin and cryptocurrency technologies: a comprehensive introduction Arvind Narayanan et. Al. Princeton University Press 2016

Reference Books

1	Research perspectives and challenges for Bitcoin and cryptocurrency Joseph Bonneau et al, SoK IEEE Symposium on security and Privacy 2015
2	The bitcoin backbone protocol - analysis and applications J.A.Garay et al, EUROCRYPT LNCS VOl 9057, (VOL II), pp 281-310 2015
3	Analysis of Blockchain protocol in Asynchronous networks, R.Pass et al, EUROCRYPT, 2017
4	Fruitchain, a fair blockchain, R.Pass et al, , PODC , 2017
5	Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming' Josh Thompson Create Space Independent Publishing Platform 2017

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**

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Q.NO.	CONTENTS	MARKS
RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
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**

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Semester: VI					
WEB PROGRAMMING Category: PROFESSIONAL CORE ELECTIVE Elective D (Common to CS & IS)					
Course Code	:	21CS64D3	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	45L	SEE Duration	:	3Hours

Unit-I	7 Hrs
Introduction to Web, HTML and XHTML: Fundamentals of Web, XHTML: Basic syntax, Standard structure, Basic text markup, Images, Hypertext Links, Lists, Tables, Forms, Frames. HTML 5: The audio Element; The video Element; Organization Elements; The time Element, Syntactic Differences between HTML and XHTML. **CSS (Cascading Style Sheet):**Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The box model, Background images, The and tags, Conflict resolution.	

Unit – II	9 Hrs
The Basics of JavaScript: Overview of JavaScript; Object orientation and JavaScript; General syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements. **JavaScript (continued):**Object creation and modification; Arrays; Functions; Constructor; Pattern matching using regular expressions; Errors in scripts	

Unit –III	10 Hrs
JavaScript and HTML Documents: The JavaScript execution environment; The Document Object Model; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The DOM 2 event model; The navigator object. **Dynamic Documents with JavaScript:** Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements.	

Unit –IV	9 Hrs
Introduction to PHP: Origins and uses of PHP; overview of PHP; General syntactic characteristics; Primitives, Operations and Expressions; Output; Control statements; Arrays; Functions; Pattern Matching; Form Handling; Cookies; Session Tracking. **XML**: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets.	

Unit –V	10 Hrs
Ajax: Overview of Ajax; History of Ajax; Ajax Technology; Implementing Ajax, Basics of Ajax: The Application; The Form Document; The Request Phase; The Response Document; The Receiver Phase; Cross-Browser Support. **AngularJS and Node JS** Introducing AngularJS and Node JS:MVC Architecture and Benefits, Philosophy and Simple applications.	

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Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic syntax and semantics of web technology tools such as HTML/XHTML, JavaScript, PHP and XML.
CO2:	Appy web technology tools for designing static and dynamic web pages.
CO3:	Investigate & web based design solution to a given problem using different modern web tools and appropriate techniques.
CO4:	Implement Client and Server side web based real-time applications using JavaScript, PHP, AJAX, Angular JS and Node JS.
CO5:	Demonstrate good coding practices for web applications engaging in lifelong learning and team work.

Reference Books	
1	Programming the World Wide Web – Robert W. Sebesta, 8th Edition, Pearson Education, 2021, ISBN-13:978-1-0133775983
2	Web Programming Building Internet Applications – Chris Bates, 3rd Edition, Wiley India, 2006, ISBN: 978-81-265-1290-4.
3	Internet & World Wide Web How to H program – M. Deitel, P.J. Deitel, A. B. Goldberg, 3rd Edition, Pearson Education / PHI, 2004, ISBN-10: 0-130-89550-4
4	The Complete Reference to HTML and XHTML- Thomas A Powell, 4th Edition, Tata McGraw Hill, 2003, ISBN: 978-0-07-222942-4.

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**

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Q. NO.	CONTENTS	MARKS
	RUBRIC FOR SEMESTER END EXAMINATION (THEORY)	
	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**

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Semester: VI					
MOBILE APPLICATION DEVELOPMENT Category: PROFESSIONAL CORE ELECTIVE Elective D					
Course Code	:	21IS64D4	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
TotalHours	:	45L	SEE Duration	:	03 Hours

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, Testing, debugging, and using support libraries, The Android Studio Debugger, Testing and 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, App Settings. Storing data using SQLite, SQLite Database. Sharing data with content providers. Loading data using loaders. Displaying and Fetching Information, Using Dialogs and Fragments, Advanced Android Programming: Internet, Entertainment, and Services. Displaying web pages and maps, communicating with SMS and emails. Creating and consuming services- Location based services, Sensors.	

Unit–V	09 Hrs
Hardware Support & devices: Permissions and Libraries, Performance and Security. Fire base and Ad Mob, Publish and Polish, Multiple Form Factors, Using Google Services.	

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

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	Android Studio Development Essentials-Android6, Neil Smyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4	Professional Android2Application Development, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898
5	Beginning Android3, Mark Murphy, A press Springer India Pvt Ltd, 1st Edition,2011, ISBN-13:978-1-4302-3297-1
6	Android Developer Training-https://developers.google.com/training/android/ Android Testing Support Library-https://google.github.io/android-testing-support-library/

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

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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

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Semester: VI					
HUMAN COMPUTER INTERACTION					
Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE					
Elective E					
Course Code	**:**	21IS65E1		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3 Hours**

Unit-I	08 Hrs
Usability of Interactive Systems: Introduction, Usability goals and Measures, Usability Motivations, Universal Usability, Goals for Our Profession; **Guidelines, Principles, and Theories**: Introduction, Guidelines, Principles, and Theories.	

Unit – II	08 Hrs
Managing Design Process es: Introduction, Organizational Design to Support Usability, The Four Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact Statement for Early Design Review, Legal Issues. **Evaluating Interface Designs**: Introduction, Expert Reviews, and Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation During Active Use Controlled Psychologically Oriented Experiments.	

Unit –III	09 Hrs
Direct Manipulation and Virtual Environment: Introduction Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces Teleoperation, Virtual and Augmented Reality. **Menu Selection, Form Fill-in, and Dialog Boxes:** Introduction, Task-Related Menu Organization, Single Menus, Combinations of Multiple Menus, Content Organization Fast Movement through Menus, Data Entry with Menus: Form Fill-in, Dialog Boxes and Alternatives, Audio Menus and Menus for Small Displays.	

Unit –IV	08 Hrs
Collaboration and Social Media Participation: Introduction, Goals of Collaboration and Participation, Asynchronous Distributed Interfaces: Different Place, Different Time Synchronous Distributed Interfaces: Different Place, Same Time, Face-to-Face Interfaces: Same Place, Same Time. **Quality of Service:** Introduction, Models of Response Time Impacts Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences.	

Unit –V	09 Hrs
Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Web Page Design, Window Design, Color. **User Documentation and Online Help:** Introduction, Online versus Paper, Documentation, Reading from Paper versus from Displays, Shapingthe Content of the Documentation, Accessing the Documentation, Online Tutorials and Animated Demonstrations, Online Communities for User Assistance, The Development Process. **Information Search:** Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interface.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Demonstrate Understanding of Interaction between the human and computer components.
CO2	Apply and analyse HCI design principles and guidelines in the software process.
CO3	Compare and Implement Interaction design rules.
CO4	Design prototypes, methods and criteria for evaluation of the design.

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Reference Books	
1.	Designing the User Interface: Techniques for Effective Human-Computer Interaction, Ben Shneiderman and Catherine Plaisant, Pearson Publications, 6th Edition, 2016, ISBN: 9780123822291.
2.	The essential guide to user interface, Wilbert O Galitz, Wiley, 3rd Edition,2007, ISBN: 978-0-471-27139-0.
3.	Human – Computer Interaction, Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson 3rd Edition,2004, ISBN 0-13-046109-1.
4.	Interaction Design, Prece, Rogers, Sharps, Wiley, 3rd Edition,2011, ISBN: 978-1-119-02075-2.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZESwill 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, 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. 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**

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Semester: VI					
CLOUD COMPUTING Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE Elective E					
Course Code	:	**21IS65E2**	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 Cloud Computing: Defining cloud computing, types of cloud, Characteristics of cloud computing, benefits of cloud computing, Disadvantages of cloud computing.
Services & Applications:
Defining infrastructure as a service (Iaas); Defining Software as a service (SaaS); Defining Platform as aservice (PaaS); Defining identity management as a service (IDaaS); Defining Communications as a Service(CaaS).

Unit – II	09 Hrs

Using Google Web Services: Exploring Google Applications, Surveying the Google Application Portfolio, Exploring the Google Toolkit, Working with the Google App Engine
Using Amazon Web Services: Understanding Amazon Web Services, Amazon Web Services Components and Servies, Working with EC2, Working with Amazon Storage Systems, Understanding Amazon Database Services
Using Microsoft Cloud Services: Exploring Microsoft Cloud Services, Defining the Windows Azure Platform, Using Windows Live

Unit –III	09 Hrs

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

SaaS: Overview, Driving Forces, Company Offerings, Industries
Software plus Services: Overview, Mobile Device Integration, Providers, Microsoft Online
Developing Applications: Google, Microsoft, Intuit QuickBase, Cast Iron Cloud, Bungee Connect, Development, Application Management

Unit –V	09 Hrs

Local Clouds and Thin Clients: Virtualization in Organization, Server Solutions, Thin Clients
Migrating to the Cloud: Cloud Services for Individuals, Cloud Services Aimed at the Mid-market, Enterprise Class Cloud Offerings, Migration

Reference Books	
1.	Cloud computing bible, Barrie Sosinsky, CRC Press, 2010, ISBN: 978-0-470-90356-8.
2.	Cloud Computing, A practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, 2011, Wiley India, ISBN: 0071626948
3.	Cloud Application Architectures, George Reese, Wiley India 2011, ISBN: 978-0596156367.
4.	Cloud Computing-Web Based applications that change the way you work and collaborate online, Michael Miller, Pearson Education, 2009, ISBN: 9780789738035.

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the basics of cloud computing models and virtualization.
CO2	Evaluate the issues related to the development of cloud applications.
CO3	Apply the concepts to design cloud based simple applications.
CO4	Analyse real world case studies of existing cloud based software solutions.

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

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

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Semester: VI						
ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE						
Category: Professional Core Elective						
Cluster Elective						
(Theory)						
Course Code	:	21AI65E1		CIE	:	100 Marks
Credits: L: T: P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3 Hours

Unit-I	09 Hrs
Conceptual Design: Introduction, Components of smart cities, Basic requirements of sustainable smart cities: Reliability of IT, Technology lifecycle, Compatibility with existing platform, Security, Smart city design alternatives **From digital to sustainable urban systems:** Introduction, Utilization of smart city(SC) in the architecture of artificially intelligent cities: The use of AI and information computer technology for sustainable development: strengths and opportunities, Implementation of Big data in smart city practice: examples of artificially intelligent cities, From digital to sustainable: smart city(SC) strategy for urban planning: The motivation for sustainable SC strategy in the digital are, SC objectives for sustainable urban systems, The use of SC in urban planning process: pros and cons	

Unit – II	09 Hrs
Industry 4.0 for smart cities: Introduction, Industry 4.0, Smart City, Dimensions of smart city, Enabling technologies: cloud/edge computing, AI, IoT, Industry 4.0 and smart cities, applications of AI and industry 4.0 in smart cities, Discussion: Transportation, Healthcare, Smart Home, Agriculture, Electric supply, Waste management **Waste Management for smart cities:** Current state of WM, Waste categorization and WM problems, WM solutions for smart cities, AI solutions, smart WM information systems for SC, intelligent technology-based solutions: Block chain, Cloud and fog, Drone technology, IoT based including GPS	

Unit –III	09 Hrs
Sustainable financing of smart cities: Introduction, distinctive features of smart city finance, financial sustainability of smart cities, financing methods for smart cities: traditional methods, innovative financing methods, application of AI tools in financing smart cities: AI inspire-investment decision-making process, managing regulations, financial benefits of using acquired data: data monetizing, utilizing data to determine financial and non-financial returns, impact of AI on crowdfunding, merging block chain, AI and IoT	

Unit –IV	09 Hrs
Current healthcare, big data and machine learning: Current healthcare practice, value-based treatment and healthcare services, increasing data volumes in healthcare, analytics of healthcare data **The rise of AI in healthcare applications:** The new age of healthcare, precision medicine, AI and medical visualization, intelligent personal health records, robotics and AI-powered devices, ambient assisted living **Cancer diagnostics and treatment decisions using AI:** AI, ML and DL in cancer, AI to determine cancer susceptibility, AI for enhanced cancer diagnosis and staging, AI to predict cancer treatment response, AI to predict cancer recurrence and survival, AI for personalized cancer pharmacotherapy	

Unit –V	09 Hrs
AI for advanced driver assistance systems: Automatic Parking, Traffic Sign Recognition, Driver Monitoring System **AI for autonomous driving**: Perception, Planning, Motion Control **AI for in-vehicle infotainment systems:** Gesture Control, Voice Assistant, User Action Prediction **AI for research & development:** Automated Rules Generation, Virtual Testing Platform, Synthetic Scenario Generation **AI for services:** Predictive Diagnostics, Predictive Maintenance, Driver Behavior Analysis	

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the need for Artificial Intelligence in some of the engineering domains.
CO2	Identify and analyze some AI use cases in engineering domains like smart cities, healthcare, automobiles, etc.
CO3	Apply AI and develop or propose solutions for some engineering applications using AI tools.
CO4	Investigate some novel applications of AI in engineering domains applicable to industry and society.
CO5	Appraise the knowledge and potential of AI, work in teams, and communicate their ideas effectively.

Text Book/Reference Books	
1	Artificial Intelligence perspective for Smart Cities, Vahap Tecim and Sezer Bozkus Kahyaoglu, CRC Press, 1st Edition, 2023, ISBN: 978-1-032-13619-
2	Artificial Intelligence in Healthcare, Adam Bohr and Kaveh Memarzadeh, Elsevier Academic Press, 2020, ISBN: 978-0-12-818438-7
3	AI for Cars, Josep Aulinas and Hanky Sjafrie, Chapman and Hall/CRC, 1st Edition, 2021

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

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Semester: VI						
QUANTUM COMPUTING						
Category: Professional Core Elective						
Cluster Elective						
(Theory)						
Course Code	:	21AI65E2		CIE	:	100 Marks
Credits: L: T: P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3 Hours

Unit-I	09 Hrs.
Quantum Building Blocks: Quantum mechanics of Photon Polarization, Single Quantum bits, Single Qubit Measurement, A Quantum key Distribution Protocol, State Space of a Single-Qubit System, Direct Sums and Tensor Products of Vector Spaces, State Space of an n-Qubit System, Entangled States, Multi-Qubit Measurement, QKD using Entangled states	
Unit – II	09 Hrs.
Multiple-Qubit States Measurements: Dirac Bra/Ket Notation for Linear Transformation, Projection Operators for Measurement, Hermitian Operator Formalism for Measurement, EPR Paradox and Bell's Theorem.	
Unit –III	09 Hrs.
Quantum State Transformations: Unitary transformations, No-Cloning Principle, Some Simple Quantum Gates, Pauli transformations, Hadamard Transformations, Multiple-Qubit Transformations, Controlled-NOT and other singly controlled gates, Applications of Simple Gates, Dense coding, Quantum teleportation	
Unit –IV	09 Hrs.
Introduction To Quantum Algorithms: Computing with Superpositions, Walsh-Hadamard transformation, Quantum Parallelism, Notions of Complexity, Query Complexity, Communication Complexity, Simple Quantum Algorithm- Deutsch's Problem	
Unit –V	09 Hrs.
Simple Quantum Algorithms: Deutsch-Jozsa Problem, Bernstein-Vazirani Problem, Simon's Problem, Machine Models and Complexity Classes, Shor's factoring Algorithm, Example illustrating Shor's Algorithm	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the various essentials of quantum computation, Qubits, and Quantum operators.
CO2	Analyze the working of quantum transformations and quantum gates.
CO3	Describe the principle of working of some of the quantum algorithms and conduct simulations using open-source quantum simulators.
CO4	Investigate the applications of quantum computing algorithms and quantum cryptography in real-world applications.
CO5	Appraise the knowledge and potential in quantum computing to build a successful career, work in teams, and communicate their ideas effectively.

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Reference Books	
1	Quantum Computing: A Gentle Introduction, Eleanor Rieffel and Wolfgang Polak, 2011, The MIT Press, ISBN 9780262015066.
2	An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, Muchele Mosca, Oxford University Press, 2007, ISBN-13: 978-0198570493, ISBN-10: 019857049X
3	Quantum Computing for Computer Scientists, 1st Edition, Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, 2008, ISBN 978-0-521-879965.

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

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

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Semester: VI					
COMPUTER VISION					
Category: Professional Core Elective					
Cluster Elective					
(Theory)					
Course Code	:	21CS65E1		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3Hours

Unit-I	09 Hrs
Geometric Camera Models: **Image Formation:** Pinhole Perspective, Weak perspective, Cameras with lenses; **Geometric Camera Calibration:** Linear approach to camera calibration, Non- Linear approach to camera calibration; **Light and Shading:Modeling Pixel brightness:** Reflection at surfaces, Sources and their effects, Lambertineaand Spectacular model, Area sources; **Inferences from shading***:* Radiometric calibration and high dynamic range images, The Shape of Specularities , Inferring Lightness and Illumination, Photometric Stereo: Shape from Multiple Shaded Images.	

Unit – II	09 Hrs
Early vision: **Linear Filters:**Linear Filters and Convolution; Shift Invariant Linear Systems: Discrete Convolution, Continuous Convolution, Edge Effects in Discrete Convolution; Spatial Frequency and Fourier Transforms: Fourier Transforms; Sampling and Aliasing, Filters as Templates; **Stereopsis:** Binocular Camera Geometry and the Epipolar constraint- Epipolar geometry, The essential matrix , The fundamental matrix ; Binocular reconstruction : Image rectification.	

Unit –III	09 Hrs
Mid level Vision: Segmentation by clustering, Human Vision: Grouping and Gestalt; Important applications; Image Segmentations by Clustering pixels; Segmentation, Clustering, and Graphs. **Grouping and Model Fitting:** The Hough transform, Fitting lines and planes; Fitting Curved Structure; Robustness; Fitting using Probabilistic models; Motion Segmentation by Parameter estimation. **Tracking:** Simple Tracking strategies; Tracking using Matching; Tracking Linear dynamics models with Kalman filters.	

Unit –IV	09 Hrs
High level Vision: Registration; Model based Vision: Registering Rigid Objects; Registering deformable objects. **Classifying images:** Building good Image features; Classifying Images of Single Objects; Image Classification in practice.	

Unit –V	09 Hrs
Detecting Objects in Images: Sliding Window method; Detecting Deformable Objects; The State of the Art of Detection **Object recognition:** Basics of Object Recognition: Object Recognition System, Current Strategies, Categorization, Selection; Feature questions; Geometrical questions; Semantic questions.	

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Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore and acquire knowledge on fundamentals of Computer Vision concepts.
CO2:	Analyze and interpret the inherent difficulties encountered in Computer Vision.
CO3:	Apply Computer Vision techniques to solve problems in the visible world around us.
CO4:	Investigate and draw inferences by processing Image in real time applications.

Reference Books	
1	Computer Vision: A Modern Approach, David Forsyth and Jean Ponce, 2nd Edition, 2015, Pearson Education India, ISBN-10: 9332550115, ISBN-13 : 978-9332550117
2	Computer Vision: Algorithms and Applications, Richard Szeliski, Springer Verlag, 2013 Edition, ISBN-13: 978-1848829343, ebook :http://szeliski.org/Book/
3	Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 4th Edition; 2018, Pearson Education, ISBN-10: 9353062985, ISBN-13: 978-9353062989
4	Introductory Computer Vision, Imaging Techniques and Solutions, Adrian Low , 2nd Edition, 2010, BS Publications, ISBN-13 9788178001977

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

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Q. NO.	RUBRIC FOR SEMESTER END EXAMINATION (THEORY)	MARKS
	CONTENTS	
	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**

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Semester: VI					
ENTERPRISE ARCHITECTURE **Category: PROFESSIONAL CORE ELECTIVE** **Cluster Elective** **(Theory)**					
Course Code	:	21CS65E2		**CIE**	:	100 Marks
Credits: L:T:P	:	3:0:0		**SEE**	:	100 Marks
Total Hours	:	45L		**SEE Duration**	:	3Hours

Unit-I	10 Hrs
Introduction to Enterprise Architecture: Evolution of Enterprise Architecture, Popular Enterprise Architecture Frameworks, Primary Domains of Enterprise Architecture, Value Benefits of Enterprise Architecture, Emerging Trends in Enterprise Architecture, Roles in Enterprise Architecture. **TOGAF Standard:** Development of EA with TOGAF Standard, Taxonomy and Core Concepts, Enterprise Architecture Development Method, Architecture Content, Enterprise Architecture Capability and Governance.	

Unit – II	8 Hrs
EA Modelling: Language and Tools, Importance of Modelling in Enterprise Architecture, Enterprise Architecture Modelling Language – ArchiMate, Enterprise Architecture Tools	

Unit –III	8 Hrs
Reference Architectures: Overview of Reference Architectures, Leading Reference Architectures (RA), Re-Architecting the IT Functions for Managing Digital Lifecycle, Introduction to Digital Product, Key Taxonomies.	

Unit –IV	10 Hrs
IT Value Streams in Managing Digital, IT4IT Level 1 Reference Architecture, Brief on Digital Product Backbone Object, Service Offer Backbone Data Objects. **Leveraging Enterprise Architecture for Strategic Initiatives**: Supply Chain Transformation, Merger, Acquisition & Divestiture Transition, Government to Citizen Service Transformation, IT Portfolio Rationalization, Architecture for Digital Technologies	

Unit –V	9 Hrs
Realizing Values through Enterprise Architecture: Key Performance Indicators, Metrices to Measure Enterprise Architecture Values **Managing Enterprise Architecture Operations:** Setting up Enterprise Architecture Office, Sustaining Enterprise Architecture Office, Enterprise Architecture Program Management, Common EA Pitfalls to Avoid	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Acquire basic knowledge and skills to elaborate EA models, apply EA approach & methods anduse EA in management decision and communication situations.
CO2:	Leverage Enterprise Architecture for various strategic initiatives like supply chain transformation, IT portfolio rationalization, and divestiture transitions
CO3:	Apply metrics, indicators, risk evaluations related to EA model building blocks and objects.
CO4:	Understand and clearly allocate responsibilities within an organization using EA models.
CO5:	Express and supplement their own analysis and conclusions using EA terminology, business &IT architecture models as a platform of common understanding.

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Reference Books		
1	An Introduction to Holistic Enterprise Architecture, Scott A. Bernard, 4th Edition, 2020, Author house, ISBN: 978-1728358055
2	Enterprise DevOps for Architects: Leverage AIOps and DevSecOps for secure digital transformation, Jeroen Mulde, 2021, Packt Publishing, ISBN:978-1801812153
3	Mastering ArchiMate Edition 3.1: A Serious Introduction to the ArchiMate® Enterprise Architecture Modeling Language, Gerben Wierda, 2021, R&A, ISBN: 978-9083143415
4	TOGAF standards and White Papers published by The Open Group.

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**

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Semester: VI					
INDUSTRIAL SAFETY AND RISK MANAGEMENT **Category: Institutional elective** **Stream: Chemical Engineering** **(Theory)**					
Course Code	:	**21IE6F1**	**CIE**	:	**100 Marks**
Credits: L:T:P	:	**3:0:0**	**SEE**	:	**100 Marks**
Total Hours	:	**40L**	**SEE Duration**	:	**3Hours**
Unit-I					**08 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, Hazard recognition.					
Unit – II					**08 Hrs**
Risk assessment and control: Individual and societal risks, Risk assessment, Risk perception, Acceptable risk, ALARP, Prevention through design. **Hazard Identification Methods:** Preliminary Hazard List (PHL): Overview, methodology, worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analyses.					
Unit –III					**08 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Definition, Process parameters, Guide words, HAZOP matrix, Procedure, Example. Failure Modes and Effects Analysis (FMEA): Introduction, system breakdown concept, methodology, example.					
Unit –IV					**08 Hrs**
Application of Hazard Identification Techniques: Case of pressure tank, heat exchanger, system breakdown structure, Accident paths, HAZOP application, risk adjusted discounted rate method, probability distribution, Hiller's model					
Unit –V					**08 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	Recall 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.

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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). 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**

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Semester: VI					
RENEWABLE ENERGY SYSTEMS					
Category: Institutional Elective					
(Theory)					
Course Code	:	21IE6F2		**CIE**	:	100Marks
Credits: L:T:P	:	3:0:0		**SEE**	:	100 Marks
Total Hours	:	40L		**SEE Duration**	:	3 Hours

Unit-I	**08 Hrs**
Introduction: Energy systems model causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India. **Basics of Solar Energy:** Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Application. Block diagram of solar energy conversion.	

Unit – II	**08 Hrs**
Solar PV Systems: Basic Principle of SPV conversion – Types of PV Systems(Standalone, Grid connected, Hybrid system)- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Array design (different methodologies),peak-power operation, system components.Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications..	

Unit –III	**08 Hrs**
Wind Power Systems: **Wind speed and energy:** Introduction, history of wind energy, scenario- world and India. Basic principle of Wind energy conversion system (WECS), Classifications of WECS, part of a WECS. Derivation of power in the wind, electrical power output and capacity of WECS, wind site selection consideration, advantages and disadvantages of WECS. Maximum energy capture, maximum power operation, , environmental aspects.	

Unit –IV	**08 Hrs**
Geothermal and ocean energy systems: Geothermal well drilling, advantages and disadvantages, Comparison of flashed steam and total flow concept (T-S diagram). Associated Problems, environmental Effects. **Energy from ocean:** OTEC power generation, OPEN and CLOSED cycle OTEC. Estimate of Energy and power in simple single basin tidal and double basin tidal system. Issues Faced in Exploiting Tidal Energy	

Unit –V	**08 Hrs**
Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production through block diagram, Use of Hydrogen Energy, Merits and Demerits, Problems Associated with Hydrogen Energy. **Biomass Energy:** Introduction-Biomass resources –Energy from Biomass: conversion processes-Biomass Cogeneration-Environmental Benefits. Biomass products – ethanol, biodiesel, biogas Electricity and heat production by biomass.	

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the working principle and operation of various renewable energy sources and systems.
CO2	Analyze the performance and characteristics of renewable energy sources and systems.
CO3	Evaluate the parameters of wind and solar energy systems.
CO4	Design and demonstrate the applications of renewable energy sources in a typical systems.

Reference Books	
1.	Non conventional energy sources, by G.D Rai, Khanna publishes, 19th Edition, 2017, ISBN: 978-81-7409-073-8
2.	Solar photo voltaic Technology and systems, by Chetan Singh Solanki, 3rd Edition, PHI, Learning private limited New Delhi, 2013, ISBN: 978-81-203-4711-3.
3.	Wind and solar power system design, Analysis and operation, Mukund R. Patel, 2nd Edition. CRC Group, Taylor and Francis group, New Delhi, ISBN 978-0-8493-1570-1.
4.	Renewable energy: Technology, Economics and Environment, Martin Kaltschmitt, Wolfgang Streicher Andreas Wiese, Springer Publication, 2007, ISBN 978-3-540-70947- 3

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

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Semester: VI					
SYSTEMS ENGINEERING Category: INSTITUTIONAL ELECTIVE (Theory)					
Course Code	:	21IE6F3		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45 Hrs		SEE Duration	:	3.00 Hours

Unit-I	06 Hrs

System Engineering and the World of Modem System: What is System Engineering?, Origins of System Engineering, Examples of Systems Requiring Systems Engineering, System Engineering viewpoint, Systems Engineering as a Profession, The power of Systems Engineering, problems.
Structure of Complex Systems: System building blocks and interfaces, Hierarchy of Complex systems, System building blocks, The system environment, Interfaces and Interactions.
The System Development Process: Systems Engineering through the system Life Cycle, Evolutionary Characteristics of the development process, The system engineering method, Testing throughout system development, problems.

Unit – II	10 Hrs

Systems Engineering Management: Managing systems development and risks, Work breakdown structure (WBS), System Engineering Management Plan (SEMP), Risk Management, Organization of Systems Engineering, Systems Engineering Capability Maturity Assessment, Systems Engineering standards, Problem. **Needs Analysis:** Originating a new system, Operations analysis, Functional analysis, Feasibility analysis, Feasibility definition, Needs validation, System operational requirements, problems. **Concept Exploration:** Developing the system requirements, Operational requirements analysis, Performance requirements formulation, Implementation concept exploration, Performance requirements validation, problems.

Unit –III	10 Hrs

Concept Definition: Selecting the system concept, Performance requirements analysis, Functional analysis and formulation, Concept selection, Concept validation, System Development planning, System Functional Specifications, problems
Advanced Development: Reducing program risks, Requirements analysis, Functional Analysis and Design, Prototype development, Development testing, Risk reduction, problems.

Unit –IV	10 Hrs

Engineering Design: Implementing the System Building blocks, requirements analysis, Functional analysis and design, Component design, Design validation, Configuration Management, problems.
Integration and Evaluation: Integrating, Testing and evaluating the total system, Test planning and preparation, System integration, Developmental system testing, Operational test and evaluation, problems.

Unit –V	09 Hrs

Production: Systems Engineering in the factory, Engineering for production, Transition from development to production, Production operations, Acquiring a production knowledge base, problems.
Operations and support: Installing, maintenance and upgrading the system, Installation and test, In-service support, Major system upgrades: Modernization, Operational factors in system development, problems.

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the Life Cycle of Systems.
CO2	Explain the role of Stake holders and their needs in organizational systems.
CO3	Develop and Document the knowledge base for effective systems engineering processes.
CO4	Apply available tools, methods and technologies to support complex high technology systems.

Reference Books:	
1	Alexander Kossoaikoff, William N Sweet, "Systems Engineering – Principles and Practice" John Wiley & Sons, Inc, Edition: 2012, ISBN: 978-81-265-2453-2
2.	Andrew P. Sage, William B. Rouse, "Handbook of Systems Engineering And Management" John Wiley & Sons, Inc., Edition:1999, ISBN 0-471-15405-9
3.	Ludwig von Bertalanffy, "General System Theory: Foundation, Development, Applications", Penguin University Books, 1973, Revised, ISBN: 0140600043, 9780140600049.
4.	Blanchard, B., and Fabrycky, W. Systems Engineering and Analysis, Saddle River, NJ, USA: Prentice Hall, 5th Edition, 2010.

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**

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Semester: VI					
MECHATRONICS					
Category: Institutional Elective					
(Theory)					
Course Code	**:**	21IE6F4		**CIE**	**:** 100 Marks
Credits: L:T:P	**:**	3:0:0		**SEE**	**:** 100 Marks
Total Hours	**:**	45 Hrs		**SEE Duration**	**:** 3 Hours

Unit-I	**09 Hrs**

Overview of Mechatronic Systems

Traditional and mechatronic design, automatic washing machine, automatic door, dishwasher, compact disc drive copy machine, camera and temperature control. Principle and working of hall sensor, displacement sensor, absolute and incremental encoders, photoelectric sensors, inductive and capacitive proximity sensors, Relays and solenoids, Brushless DC, AC and servo motors, pulse width modulation by basic transistor circuit, H bridge circuit, Stepper motor: variable reluctance and permanent magnet, stepper motor control circuits, selection of motors.

Unit – II	**10 Hrs**

Signal Conditioning

Operational Amplifiers - circuit diagrams and derivation - Numerical, filtering, multiplexers, 4:1 MUX, time division multiplexing -seven segment display, data acquisition, Analog and digital signals, analog to digital converters. Introduction to Digital signal processing – difference equation (Numericals).

Programmable logic controllers

Components, principle of operation, modifying the operation, basic PLC instructions, and concepts of ladder diagram, latching, timer instructions, counter instructions.

Unit –III	**10 Hrs**

Ladder Diagram for PLCs

Examples with ladder logic programs, simple programs using Boolean logic, word level logic instructions. Relay to ladder conversion examples.,

Industrial applications of PLCs

Central heating system, valve sequencing, traffic light control in one direction, water level control, overhead garage door, sequential process, continuous filling operation, Fluid pumping with timers, parking garage counter, can counting in assembly line.

Unit –IV	**08 Hrs**

Microcontrollers

Components of a full featured microcontroller, Memory, I/O Ports, Bus, Read & Write Cycle, Architecture of Intel 8051 microcontroller, Pin diagram, simple instructions for a microcontroller. – Data transfer, arithmetic functions, logical operations, Jump and branching operation.

Digital circuits

Digital representations, Combinational logic - Case studies: BCD to 7 segment decoder, calendar subsystem in a smartwatch., timing diagrams, Karnough maps – 3 variable and 4 variable, design of logic networks, flip-flops, Counters.

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Unit –V	08 Hrs
Dynamic Responses of Systems Closed loop system, Terminology, transfer functions, step response of first order and second order systems, performance measures for first and second order systems, - Numerical **Mechanical Actuation Systems** Four bar chain, slider crank mechanism, Cams and followers, gear trains - Numerical	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Select appropriate sensors and transducers and devise an instrumentation system for collecting information about processes
CO2	Apply the electrical and logic concepts and inspect the functioning of mechatronic systems.
CO3	Evaluate a control system for effective functioning of Mechatronics systems using digital electronics, microprocessors, microcontrollers and programmable logic controllers
CO4	Develop conceptual design for Mechatronics products based on potential customer requirements

Reference Books	
1.	Nitaigour Premchand, 'Mechatronics-Principles, Concepts & Applications', TMH 1st Edition, 2009, ISBN: 9780070483743
2.	Bolton W., 'Mechatronics-Electronic Control System in Mechanical and Electrical Engineering', Pearson Education, 4th Edition, 2012; ISBN:9788131732533
3.	Tilak Thakur 'Mechatronics', Oxford University Press, 1st Edition, 2016, ISBN: 9780199459329
4.	Petruzella, Frank D, Programmable logic controllers, McGraw-Hill, 4th Edition, 2013, ISBN-13: 978-0-07-351088-0

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

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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**

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Semester: VI					
MATHEMATICAL MODELLING					
Category: INSTITUTIONAL ELECTIVE					
(Theory)					
Course Code	**:**	21IE6F5		**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
Continuous Models Using Ordinary Differential Equations: Basic concepts, real world problems (Science and Engineering), approximation of the problem, steps involved in modelling, formation of various continuous models.	
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 chain, applications of Markov modelling.	
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 and 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 of engineering.
CO2:	Apply the knowledge and skills of discrete and continuous models.
CO3:	Analyze the appropriate mathematical model to solve the real-world problem and optimize the solution
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

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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**
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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)		
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5 & 6	Unit 3: Question 5 or 6	16
7 & 8	Unit 4: Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

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Semester: VI						
INDUSTRY 4.0 - SMART MANUFACTURING FOR THE FUTURE **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	21IE6F6		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**07 Hrs**
Introduction: The Various Industrial Revolutions, Need – Reason for Adopting Industry 4.0, Definition, Goals and Design Principles – Interoperability, Virtualization, Decentralization, Real-time Capability, Service Orientation, Modularity. Individualization, Volatility, Energy and resource efficiency. Road to Industry 4.0 - Internet of Things (IoT), Architecture of IoT, Technologies for IoT & Industrial Internet of Things (IIoT), Internet of Services, Standardization, Cyber-Physical Systems, Smart Manufacturing, Network via Ethernet/ Wi-Fi for high-speed data transmission, Mobile technologies	
Unit – II	**10 Hrs**
Opportunities and Challenges Lack of resources, Availability of skilled workers, Broadband infrastructure, Policies, Future of Works and Skills in the Industry 4.0 Era, Disruption as manufacturing's greatest modern challenge **Robotics in Industry 4.0** Robotic Automation and Collaborative Robots, Human-Machine Interaction **Big Data** Evolution**,** Essential of Big Data in Industry 4.0, Big Data Merits, Data transparency, Business Intelligence, Production planning, Quality, Acquisition of Automation Data, Digital Traceability, Radio-Frequency Identification (RFID), GPS, Data transformation, Big Data Characteristics, Data as a new resource for organizations, Data driven applications, Harnessing and sharing knowledge in organizations, Data analytics - Descriptive Analytics, Diagnostic analytics, Predictive Analytics, Prescriptive analytics	
Unit –III	**10 Hrs**
Cloud Computing Fundamentals, Cloud/Edge Computing and Industry 4.0, The IT/OT convergence, Cyber Security **Horizontal and Vertical integration** End-to-end engineering of the overall value chain, Digital integration platforms, Role of machine sensors, Sensing classification according to measuring variables, Machine-to-Machine communication **Artificial Intelligence/Machine Learning in Industry 4.0** Fundamentals, Case Studies, Technology paradigms in production logistics - Intelligent conveyor system, Intelligent commissioning system, Intelligent production machine, Intelligent load carrier, Application-specific demand on Intelligent Objects (user-oriented functions), Technological realization of Intelligent Objects (product-oriented functions)	

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Unit –IV	08 Hrs
Augmented Worker Augmented and Virtual Reality, softwares, Industrial Applications – Maintenance, Assembly, Collaborative operations, Training **Digital-to-Physical** Additive Manufacturing technologies, Advantages, impact on environment, Applications – Automotive, Aerospace, Electronics and Medical	
Unit –V	**07 Hrs**
Digital twin, Virtual factory, Total Productive Maintenance, Industry 4.0 case studies, Understanding I 4.0 in MSMEs, What's Next: Industry 5.0/Society 5.0	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Identify the basic components of Industry 4.0
CO2	Analyse the role of Big data for modern manufacturing
CO3	Create AR/VR models for industrial scenario
CO4	Create simple Additive manufactured parts

Reference Books	
1.	Industry 4.0: Managing the Digital Transformation, Alp Ustundag, Emre Cevikcan, 2017, Springer, ISBN: 978-3-319-57869-9, ISBN: 978-3-319-57870-5
2.	The Concept Industry 4.0 - An Empirical Analysis of Technologies and Applications in Production Logistics, Christoph Jan Bartodziej, 2017, Springer Gabler, ISBN 978-3-658-16501-7 ISBN 978-3-658-16502-4
3.	Industry 4.0 - The Industrial Internet of Things, Alasdair Gilchrist, 2016, APRESS, ISBN-13 978-1-4842-2046-7 ISBN-13: 978-1-4842-2047-4
4.	Digitizing the Industry – Internet of Things connecting the Physical, Digital and Virtual Worlds, Ovidiu Vermesan, 2016, River Publishers, ISBN 978-87-93379-81-7 ISBN 978-87-93379-82-4

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

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Semester: VI						
Industrial Psychology for Engineers							
Category: Institutional Elective							
(Theory)							
Course Code	:	21IE6F7		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.

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Reference Books	
1.	Understanding Psychology Feldman R. S, 4th Edition, (1996) McGraw Hill India
2.	Psychology Robert A. Baron, 3rd 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, 4th 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). 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

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Semester: VI					
ELEMENTS OF FINANCIAL MANAGEMENT Category: INSTITUTIONAL ELECTIVE					
(Theory)					
Course Code	:	21IE6F8	CIE	:	100 Marks
Credits: L:T:P	:	3:0:0	SEE	:	100 Marks
Total Hours	:	45 Hrs	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.
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)

Unit – II	10 Hrs

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.
Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications
(Conceptual and Numerical treatment)

Unit –III	10 Hrs

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.
Cost of Capital: Preliminaries Cost of debt and preference, cost of retained earnings, cost of external equity, determining the proportions, weighted average cost of capital, weighted marginal cost of capitalschedule.
Capital structure and cost of capital: Assumptions and concepts, net income approach, net operating income approach, traditional position, Modigliani and Miller Position, Taxation and Capital structure, Otherimperfections and Capitalstructure
(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.
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)

Unit –V	09 Hrs

Contemporary topics in Finance: Reasons and Mechanics of a merger, Takeovers,Divestures, Demergers, World monetary system, Foreign exchange markets, raising foreign currency finance, International capital budgeting, Options market, Futures market, Warrants, Venture capital financing framework, Indian venture capital scenario. (Conceptual treatment only)

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Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the features of financial system and basic principles of financial management.
CO2	Describe the processes and techniques of capital budgeting and theories of capital structure.
CO3	Demonstrate an understanding of various sources of long term and working capital financing by organizations.
CO4	Analyze the trends in global financial scenarios.

Reference Books:	
1.	Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill
2.	Education(India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5
3.	Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018,
4.	McGraw Hill Education(India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184

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**

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Semester: VI						
Universal Human Values - II						
Category: INSTITUTIONAL ELECTIVE						
(Theory)						
Course Code	:	21IE6F9		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.	

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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). 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**

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		Semester: VI				
		Human Machine Interface (HMI) Category: INSTITUTIONAL ELECTIVE (Industry Offered Elective) (Theory)				
Course Code	:	21IE6F10		CIE	:	100 Marks
Credits: L:T:P	:	3:0:0		SEE	:	100 Marks
Total Hours	:	45L		SEE Duration	:	3Hours

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.

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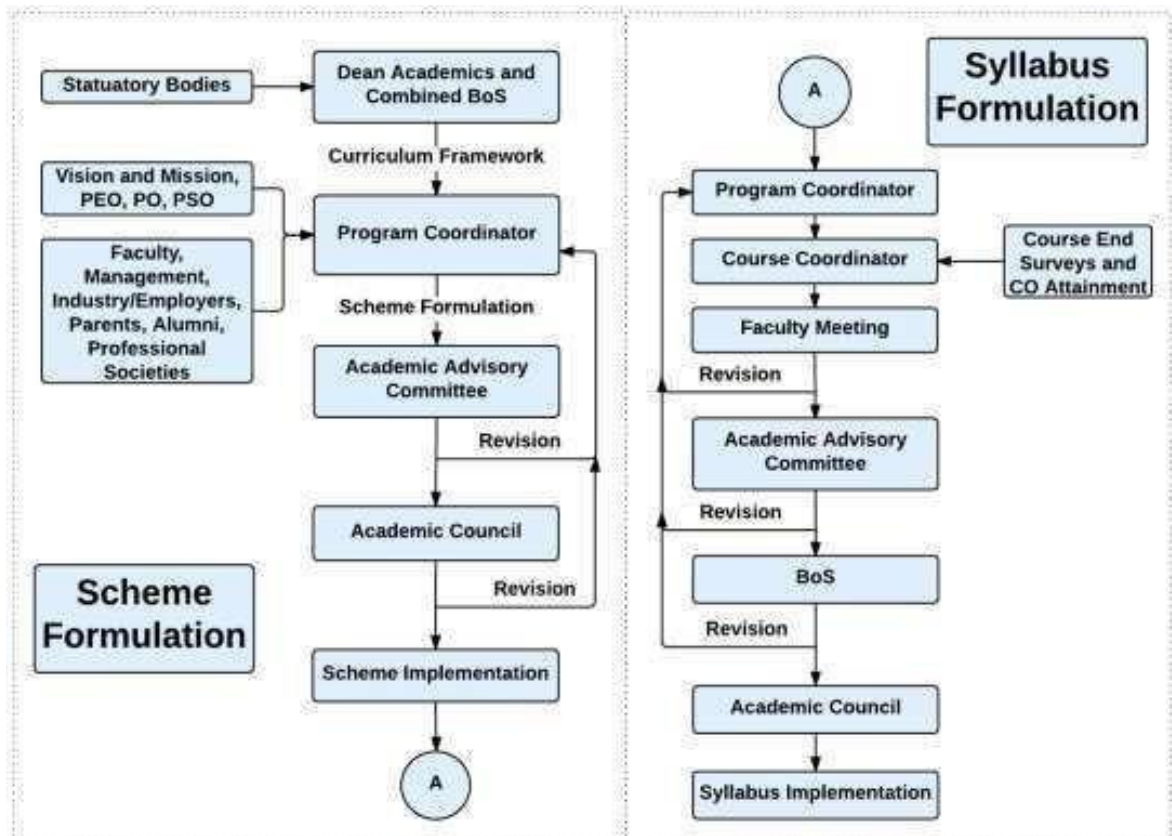| Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understanding the application of HMIs in various domain
CO2	Comparison of various communication protocols used in HMI development.
CO3	Apply and Analyse the car multimedia system free software and hardware evolution
CO4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

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

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Curriculum Design Process

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Academic Planning and Implementation

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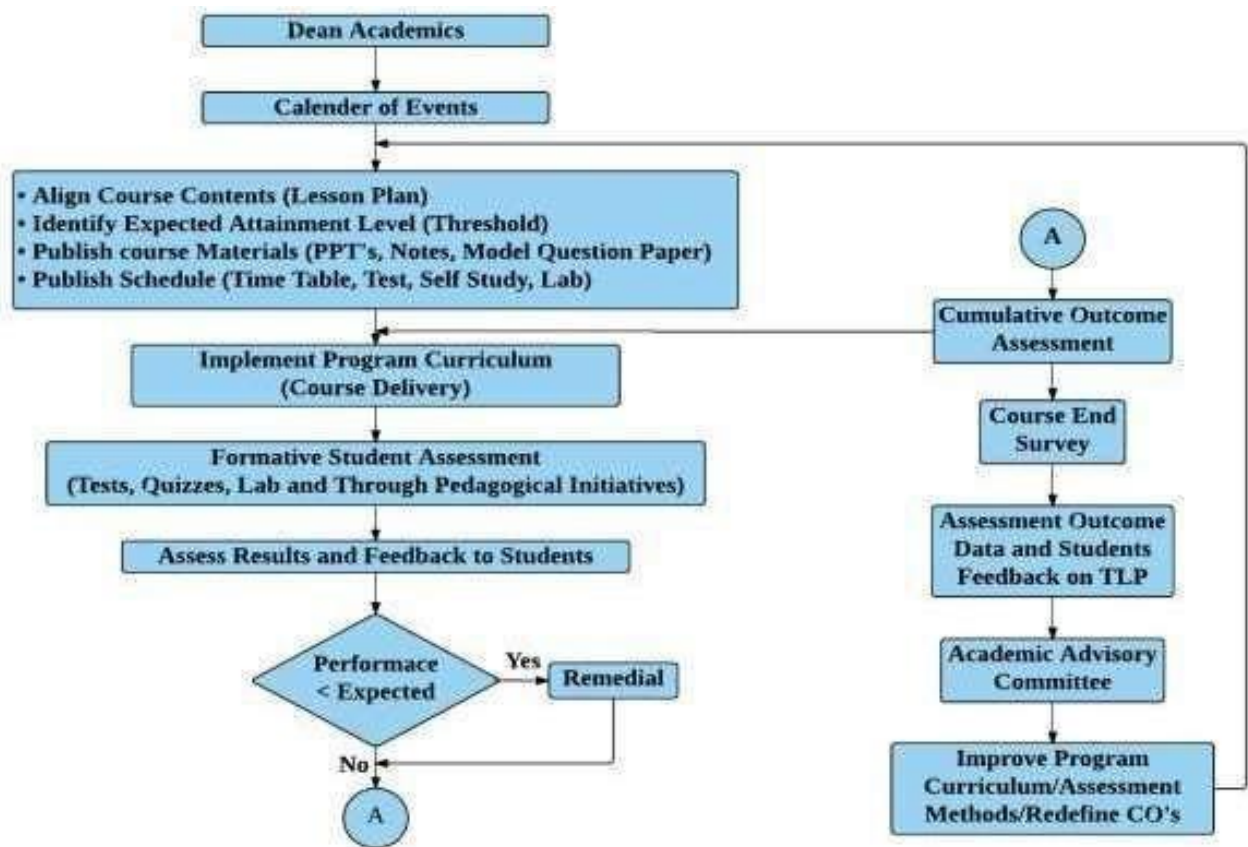
Process for Course Outcome Attainment

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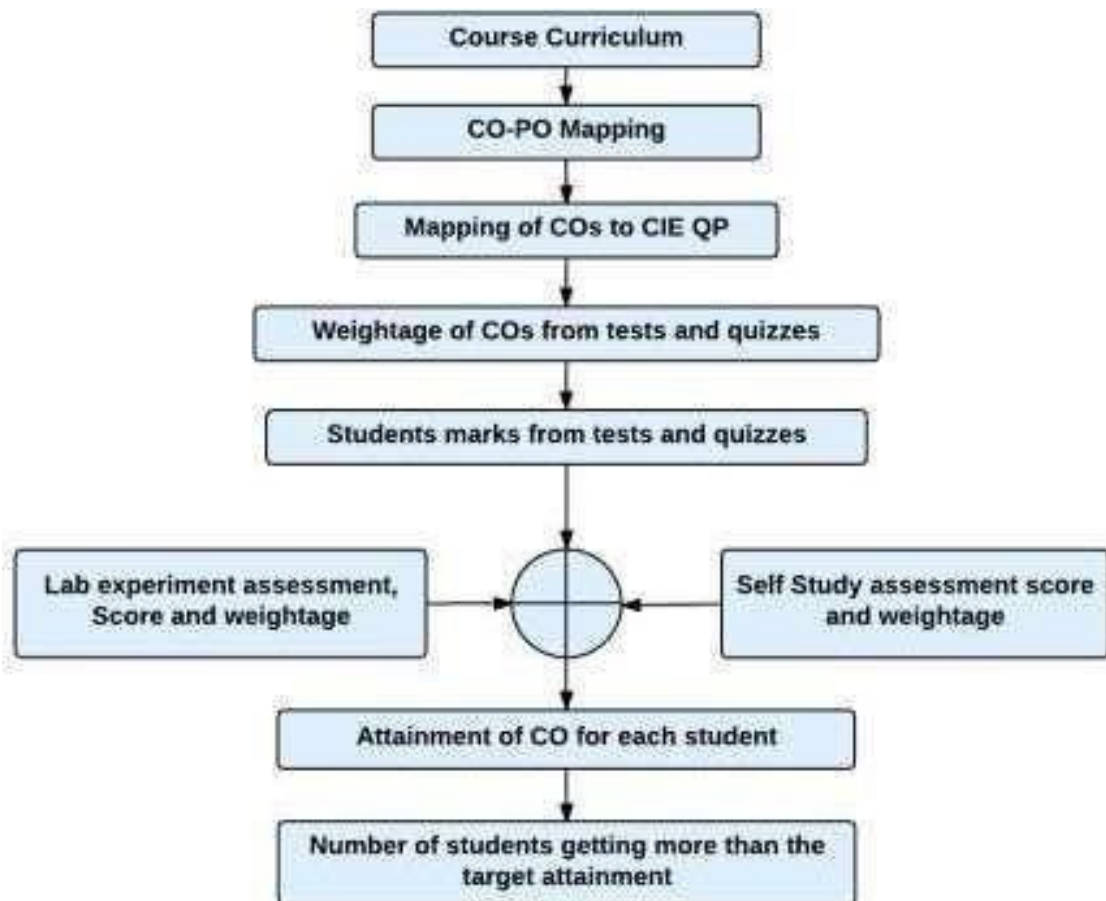
Final CO Attainment Process

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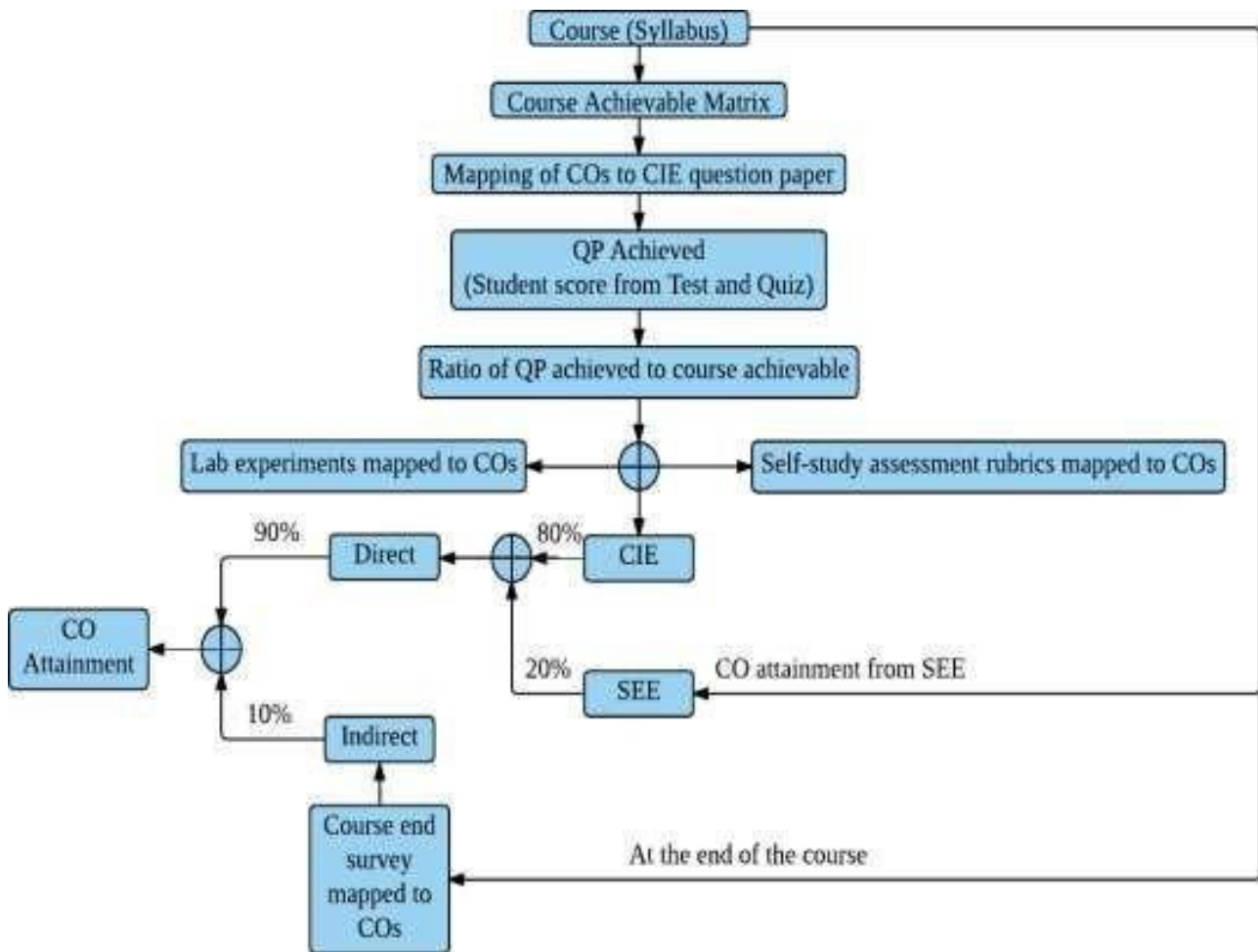
Program Outcome Attainment Process

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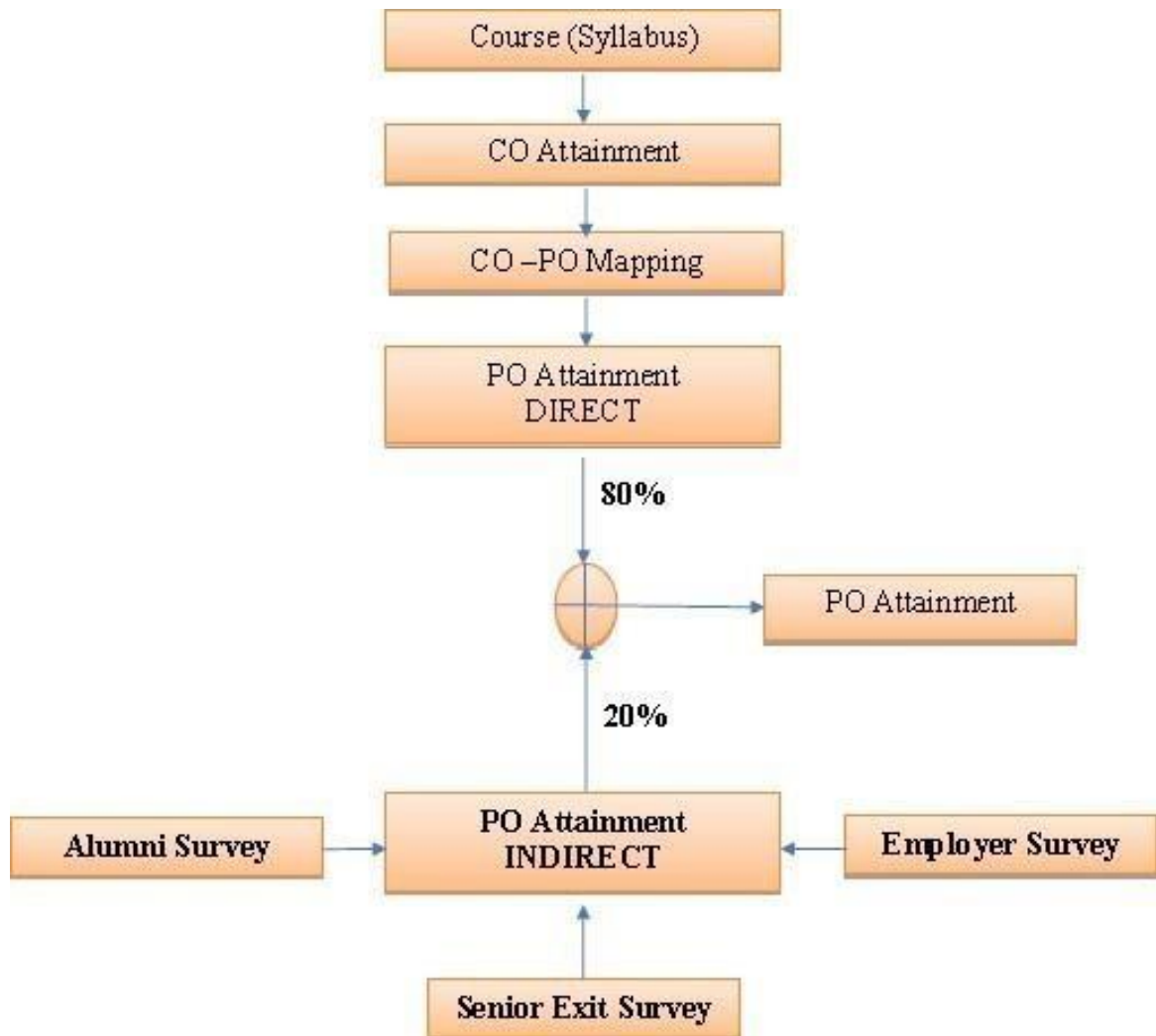
PROGRAM OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change.

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