RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

SCHEME & SYLLABUS

THIRD YEAR B.E. PROGRAMS

COMPUTER SCIENCE AND ENGINEERING

BACHELOR OF ENGINEERING (B.E.)

2021 SCHEME

ACADEMIC YEAR 2023-24

DEPARTMENT VISION

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

DEPARTMENT MISSION

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

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

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

ABBREVIATIONS

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

INDEX

V SEMESTER												
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**	**Max Marks CIE**		**SEE Duration (H)**	**Max Marks SEE**	
			L	**T**	**P**	**Total**			**Theory**	**Lab**		**Theory**	**Lab**
1	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	21CS54	Theory of Computation	3	1	0	4	CS	Theory	**100**	****	**3**	**100**	****
5	21CS55BX	Professional Core Elective-I (Group-B)	3	0	0	3	CS	Theory	**100**	****	**3**	**100**	****
6	21CS56CX	Professional Core Elective-II (Group C)	2	0	0	2	CS	**NPTEL**	**50**	****	**2**	**50**	****
7	21CSI57	Summer Internship- II	0	0	2	2	CS	Internship	****	**50**	**2**	****	**50**
						22							

Professional Core Elective-I (GROUP-B)		
Sl.No	**Course code**	**Course Title**
1	21CS55B1	Network Programming and Security
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**)

Professional Core Elective-I (GROUP-C)		
Sl.No	**Course code**	**Course Title**
1	21CS56C1	Information Security - 5 - Secure Systems Engineering
2	21CS56C2	AI: Constraint Satisfaction
3	21IS56C3	Foundation of Cloud IoT Edge ML
4	21AI56C4	Edge Computing
5	21IS56C5	Introduction To Soft Computing

Semester: V						
INTELLECTUAL PROPERTY RIGHTS AND ENTREPRENEURSHIP **Category: PROFESSIONAL CORE COURSE** (Common to all Programs) **(Theory)**						
Course Code	**:**	21HS51A		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3 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.	

Reference Books	
1.	Intellectual Property Rights: Unleashing Knowledge Economy, PrabuddhaGanguly, 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. **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)* (Small case lets and case example in one subdivision)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
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 +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

Laboratory Component

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

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

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

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

Semester: V						
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	**9 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	**9 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	**9 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	**8 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.	

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

Reference Books	
1	Elmasri and Navathe: Fundamentals of Database Systems, 6th 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.

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.

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**
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 PRATICE		**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**

Semester: V						
THEORY OF COMPUTATION **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	**21CS54**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L+30T**		**SEE Duration**	**:**	**3 Hours**

Course Learning Objectives: The students will be able to	
1.	Understand fundamental concepts of theory of computation and the use of mathematical thinking as it is applied to Computer Science.
2.	Compare finite automata; push down automata and Turing machines as Mathematical models of computation.
3.	Develop the concepts and skills necessary to be able to evaluate the computability and complexity of practical computational problems.
4.	Understand formal thought processes, computation, algorithms and their limits.
5.	Design a machine model to accept a specified language.

Unit-I	**9 Hrs**
Regular Languages and Regular Expressions, Memory Required to Recognize a Language, Deterministic Finite Automata (DFA), Non Deterministic Finite Automata (NFA), Non Deterministic Finite Automata with ϵ - transitions (NFA-ϵ), Equivalence, Regular Expressions and Finite Automata, Applications of Regular Expressions, Algebraic laws of Regular Expressions, Minimization of Finite Automata.	
Unit – II	**9 Hrs**
Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision properties of Regular languages, Context-free grammars (CFG), Parse trees, Applications, Ambiguity in grammars & languages, Simplification of CFG, Normal forms of CFGs. Regular Grammars, Equivalence of Regular Grammars and Finite Automata.	
Unit –III	**9 Hrs**
Push Down Automata (PDA): Definition, the languages of a PDA, Equivalence of PDA's & CFG's, Deterministic PDA. The Pumping Lemma for Context Free Languages (CFL), Closure properties of CFLs, Decision properties of CFLs	
Unit –IV	**9 Hrs**
Turing Machines (TM): Definitions and Examples, TM as a Language Accepter, Computing Partial Functions with Turing Machine, Variations of Turing Machines, Combining Turing Machines, Non Deterministic TM, Universal TM, Recursively Enumerable Languages (REL) and Recursive Languages. Properties of REL and Recursive Languages.	
Unit-V	**9 Hrs**
More General Grammars, Unrestricted Grammar, Context Sensitive Languages (CSL) and Linear Bounded Automata (LBA), Chomsky Hierarchy, Not all languages are Recursively Enumerable, Unsolvable Problem, Reducing One problem to another, The halting problem of TM, Post's Correspondence Problem (PCP), Time and Space Complexity of TM.	

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

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

EXPERIENTIAL LEARNING

Based on the concepts learnt in this course like Regular expressions, DFA , NFA, PDA, TM, CFG problems on syntax analysis, string matching, parsing and design of automata for complex problems can be given for Experiential learning.

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)	
CONTENTS	**MARKS**
PART A	
Objective type questions covering entire syllabus	20
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**

Semester: V						
NETWORK PROGRAMMING AND SECURITY **Category: PROFESSIONAL CORE ELECTIVE** **(Elective B)**						
Course Code	**:**	**21CS55B1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**9 Hrs**
The Transport Layer and introduction to sockets Introduction to TCP, UDP and SCTP, The big picture, Difference between UDP, TCP, SCTP, TCP connection establishment and termination, TIME_WAIT state, TCP port numbers and concurrent servers, Buffer sizes and limitation.Socket address structure, value result arguments, byte ordering functions, byte manipulation functions, inet_aton, inet_addr and inet_ntoa functions, inet_pton and inet_ntop functions.	
Unit – II	**8 Hrs**
TCP client/server Socket function, connect function, bind, listen, accept, fork, exec functions, concurrent servers, close function, getsockname and getpeername functions, TCP Echo server – main – str_echo ,TCP Echo client - main – str_echo, Normal startup, normal termination.	
Unit –III	**10 Hrs**
UDP client/server and Name server Socket options introduction, getsockopt and setsockopt functions. recvfrom and sendto functions, UDP Echo server & UDP Echo client, lost datagrams. DNS, Gethostbyname function, gethostbyaddr function, getservbyname and getservbyport functions, getaddrinfo function, gai_strerror function, freeaddrinfo function, getaddrinfo function: example, host_serv function.	
Unit –IV	**10 Hrs**
Traditional Block Cipher and Public Key Cryptosystem Stream Ciphers and Block Ciphers, Feistel Cipher Structure. The Data Encryption Standard- Encryption and Decryption. Principles of Public Cryptosystems- Public-Key Cryptosystems, Applications for Public-Key Cryptosystems Requirements for Public-Key Cryptosystems, Public-Key Cryptanalysis. The RSA algorithm-Description of the Algorithm, Computational Aspects. The security of RSA, Other Public key Cryptosystems: Diffie-Hellman Key Exchange: The Algorithm, Key Exchange Protocols, Man-in-the Middle Attack	
Unit –V	**8 Hrs**
Transport Layer Security and Wireless Network Security Web Security Considerations, Secure Socket Layer, Transport Layer security, HTTPS. Wireless NetworkSecurity: Wireless Security, Mobile Device Security, IEEE 802.11	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the variety of network programming concepts and protocols.
CO2:	Analyse the interoperability of networking protocols and its usage.
CO3:	Design the client/server communication on Unix platforms.
CO4:	Investigate & Design the cryptographic algorithms to ensure secure transfer of secret keys and encryption/decryption of messages.
CO5:	Demonstrate Network Programming and Cryptographic algorithms to solve real-world problems.

Reference Books	
1	UNIX Network Programming – The sockets networking API, W.Richard Stevens, Bill Fenner, Andrew M. Rudoff, Vol.I , 3rd edition, PHI. ISBN-13: 978-0131411555 ISBN-10: 9780131411555
2	Cryptography and Network Security Principles and Practice, William Stallings, 7th edition, 2017, Global edition, Pearson Education, ISBN: 978-0-13-444428-4.
3	Internetworking with TCP/IP, Douglas E. Comer, David L. Stevens, Vol. III, 6th Edition, 2015, Paperback, Publisher: Pearson India, ISBN-10: 9332549877, ISBN-13: 978-9332549876
4	Learning Network Programming with Java, Richard M Reese, First Published: December 2015, Packet Publishing Ltd., ISBN-13: 978-0123742551, ISBN-10: 0123742552

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

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

Semester: V						
INTERNET OF THINGS **Category: PROFESSIONAL CORE ELECTIVE** **(Common to CS & IS)** **(Elective B)**						
Course Code	**:**	**21CS55B2**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**9 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	**9 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	**9 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	**9 Hrs**
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	**9 Hrs**
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.	

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	
2.	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), 2011th, 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)		
#	**COMPONENT**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20)ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

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

Course Learning Objectives: The students will be able to

1.	Enhance their knowledge on asymptotic performance of various algorithms.
2.	Develop the skills to design and apply efficient algorithms tovarious real world problems.
3.	Ability to differentiate between various design paradigms and apply the same appropriately
4.	Appreciate the time and space complexity of various algorithms

Unit-I	**09Hrs**
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. **AmortizedAnalysis :**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	**09 Hrs**
Number Theoretic Algorithms: Elementary notions, GCD, Modular arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem.	
Unit –V	**09 Hrs**
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.

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	
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	PART B (Maximum of TWO Sub-divisions only)	
2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: V						
NATURAL LANGUAGE PROCESSING **Category: PROFESSIONAL CORE ELECTIVE** **(Common to CS & IS)** **(Elective B)**						
Course Code	**:**	**21IS55B4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hours**

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	**08Hrs**
NLP Applications (Continued) : Machine translation - Basic issues in MT. Statistical translation **formation Retrieval:** Vector space model, term weighting, homonymy, polysemy, synonymy, proving 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	TanveerSiddiqui,U.S.Tiwary,—NaturalLanguageProcessingandInformationRetrieval‖,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 andText Mining‖, , ISBN : 9781846281754
4	James Allen,—Natural Language Understanding‖, 2nd edition, Benjamin/Cummings publishing 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**

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 Week 8: 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

Semester: V						
AI: CONSTRAINT SATISFACTION **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**						
Course Code	**:**	**21CS56C2**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**2 Hours**
Unit-I						**10 Hrs**
Constraint satisfaction problems (CSP), examples. Constraint networks, equivalent and projection networks. Constraint propagation, arc consistency, path consistency, i-consistency.						
Unit – II						**10 Hrs**
Directional consistency and graph ordering, backtrack free search, adaptive consistency. Search methods for solving CSPs, lookahead methods, dynamic variable and value ordering.						
Unit –III						**10 Hrs**
Lookback methods, Gaschnig's backjumping, graph based backjumping, conflict directed back jumping. Combing lookahead with lookback, learning. Model based systems, model based diagnosis, truth maintenance systems, planning as CSP. Wrapping up.						

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand and explore problems w.r.t constraint satisfaction.
CO2:	Explore the aspects of propagation of constraint, consistency and implementation.
CO3:	Analyse model based systems and diagnosis.

Reference Books	
1	Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.
2	Rina Dechter, Constraint Processing, Morgan Kaufmann, 2003.

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

Semester: V						
EDGE COMPUTING **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**						
Course Code	**:**	**21AI56C4**		**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 and RTT. From Cloud to Edge computing: Waves of innovation, Introduction to Edge Computing Architectures, Edge Computing to support User Applications (5G-Slicing, self-driving cars and more)	
Unit – II	**10 Hrs**
Concepts of distributed systems in edge computing such as time ordering and clock synchronization, distributed snapshot, etc., Introduction to Edge Data Center, Lightweight Edge Clouds and its services provided by different service providers., Introduction to docker container and Kubernetes in edge computing. Design of edge storage systems like key-value stores	
Unit –III	**10 Hrs**
Introduction to MQTT and Kafka for end-to-end edge pipeline. Edge analytics topologies for M2M and WSN network (MQTT), Use cases of machine learning for edge sensor data in predictive maintenance, image classifier and self-driving cars. Deep Learning On-Device inference at the edge to support latency-based application.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand how cloud computing environments can be scaled to workloads.
CO2:	Develop mechanisms for distributing information and processing in an edge-cloud-environment
CO3:	Apply ML and DL frameworks suitable for edge computing.

Reference Books	
1	"Fog and Edge Computing: Principles and Paradigms", Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor), Wiley, 2019
2	Cloud Computing: Principles and Paradigms", Editors: Rajkumar Buyya, James Broberg,Andrzej M. Goscinski, Wiley, 2011
3	"Cloud and Distributed Computing: Algorithms and Systems", Rajiv Misra, Yashwant Patel, Wiley 2020.

Semester: V						
INTRODUCTION TO SOFT COMPUTING **Category: PROFESSIONAL CORE ELECTIVE** **(NPTEL Course)**						
Course Code	**:**	**21IS56C5**		**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 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:	Understand and explore fuzzy operations and fuzzy logic.
CO2:	Explore techniques of defuzzification.
CO3:	Understand and explore ANN and it s concepts.

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)

Semester: V						
SUMMER INTERNSHIP-II (Practical)						
Course Code	**:**	21CSI57		**CIE**	**:**	**50Marks**
Credits: L:T: P	**:**	0:0:2		**SEE**	**:**	**50Marks**
Total Hours	**:**	4Weeks		**SEE Duration**	**:**	**02Hrs**
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 THREEWEEKS.

B. At RVCE Center of Excellence/Competence

RVCE hosts around 16 CENTER OF EXCELLENCE in various domains and around 05CENTER OF 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

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

D. At Engineering Colleges nearby their home town

Students who are residing out of Bangalore, should take permission from the nearing Engineering College of their home town to do the internship. The near by 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 letterhead.

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 hardcopy/emailwithclearmentionofthetitleoftheworkassignedalongwiththedurationandthenameofthestudent.

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.

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		**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**

VI SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total			Theory	Lab		Theory	Lab
1	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	21CS64DX	Professional Core Elective-III (Group – D)	3	0	0	3	CS	Theory	100	****	3	100	****
5	21CS65EX	Professional Core Elective (Cluster Elective) (Group-E)	3	0	0	3	CS	Theory	100	****	3	100	****
6	21IE66FX	Institutional Electives – I (Group F)	3	0	0	3	Resp. BOS	Theory	100	****	3	100	****
						20							

Professional Core Elective - III(Group – D)		
Sl.no	**Course code**	**Course Title**
1	21CS64D1	Cryptography & Network Security
2	21IS64D2	Block Chain Technology (Common to CS &**IS**)
3	21CS64D3	Web Programming (Common to **CS** & IS)
4	21CS64D4	Techniques of Data Mining

Professional Core Elective – Cluster Elective (Group- E)		
Sl.no	**Course code**	**Course Title**
1	21AI65E1	Engineering Applications of Artificial Intelligence
2	21AI65E2	Quantum Computing
3	21CS65E1	Computer Vision
4	21CS65E2	Enterprise Architecture
5	21IS65E1	Human Computer Interaction
6	21IS65E2	Cloud Computing

Institutional Electives – I (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)

Semester: VI						
PRINCIPLES OF MANAGEMENT & ECONOMICS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	21HS61B		**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-ADmodel, 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.

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

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

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

Semester: VI						
SOFTWARE ENGINEERING **Category: PROFESSIONAL CORE COURSE** **(Common to CS & IS)** **(Theory and Lab)**						
Course Code	**:**	**21IS62**		**CIE**	**:**	**100+50Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50Marks**
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, Socio technical 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.	

CourseOutcomes:Aftercompletingthecourse,thestudentswillbeableto:-	
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.iitkgp.ac.in/se/ListofExperiments:

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

PART-B

Student will analyse, design, and implement an application using the appropriate Software engineering tools and practices. All topics learnt in virtual lab (SEphases) 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

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**
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**

Semester: VI						
COMPILER DESIGN **Category: PROFESSIONAL CORE COURSE** **(Common to CS & IS)** **(Theory and Lab)**						
Course Code	**:**	**21CS63**		**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**
Introduction to Compiling and Lexical Analysis Introduction, Language Processors, The structure of Compiler, Evolution of programming Languages. Lexical Analysis- The Role of Lexical Analyzer, Input Buffering, Specifications of Tokens, Recognition of Tokens.	
Unit – II	**9Hrs**
Syntax Analysis Introduction, Context-free Grammars, Writing a Grammar, Top-down Parsing, Bottom-up Parsing, Introduction to LR Parsing: Simple LR, Most powerful LR parsers (Excluding efficient construction and compaction of parsing tables), Using ambiguous grammars.	
Unit – III	**9 Hrs**
Lexical –Analyzer and Parser generators Lexical –Analyzer generator Lex, The parser generator YACC, Using YACC with ambiguous grammars, Creating YACC 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	**9Hrs**
Intermediate Code Generation Variants of Syntax trees, Three address code, Types and Declaration-Type Expressions, equivalence, Declaration, Control flow, Back patching.	
Unit – V	**9 Hrs**
Code Generation and optimization Issues in the design of Code Generator, The Target Language, Address in the target Code, Basic Blocks and Flow graphs, 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, techniques and 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)		
#	**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**

Semester: VI						
CRYPTOGRAPHY & NETWORK SECURITY **Category: PROFESSIONAL CORE ELECTIVE** **Elective D**						
Course Code	**:**	**21CS64D1**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hrs**

Unit -1	**9 Hrs**
Traditional Symmetric-Key Ciphers: Introduction, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers. Data Encryption Standard (DES): Introduction, DES Structure, DES Analysis, Security of DES. Advanced Encryption Standard: Introduction, Transformations, Key Expansion, The AES Ciphers, Examples, Analysis of AES.	
Unit – II	**10 Hrs**
Encipherment using Modern Symmetric-Key Ciphers: Use of Modern Block Ciphers, Use of Stream Ciphers. Asymmetric Key Cryptography: Introduction, RSA Cryptosystem, Elgamal Cryptosystem. **Other public key- cryptosystems**: Diffie-Hellman key exchange.	
Unit –III	**9 Hrs**
Cryptographic Hash functions: Applications of cryptographic hash functions, Two simple hash functions, Requirements and security, Hash functions based on cipher block chaining, SHA, SHA-3. **Message authentication**: Authentication Requirements, Authentication Functions, Message Authentication Codes, MACs based on hash functions: HMAC.	
Unit –IV	**9 Hrs**
Digital signatures: Digital Signatures, ElGamal digital signature scheme, Digital Signature standard. **Key management and distribution:** Distribution of public keys, X.509 certificates, Kerberos. **Transport level security:** Web Security considerations, Secure Sockets Layer and Transport layer security. **IP Security:** IP Security overview, IP Security policy, Encapsulating Security payload (ESP).	
Unit –V	**8 Hrs**
Wireless Network Security: IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP End-to-End Security.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply fundamentals of symmetric and Asymmetric key ciphers and encipherment modes for encryption/decryption.
CO2:	Identify wired/wireless network security policies and protocols to provide secure data transmission
CO3:	Analyse digital signature and key distribution mechanisms for secure key exchange for authentication.
CO4:	Demonstrate the use of hash functions and message authentication techniques for user authentication.

Reference Books	
1	Cryptography and network security, Behrouz A. Forouzan, DebdeepMukhopadhyay, McGraw Hill Education 2015, 3rd Edition, ISBN-13: 978-9339220945.
2	Cryptography and Network Security; William Stallings, 6th Edition, 2015, Pearson Education; ISBN 13: 9780273793359.
3	Cryptography Theory and Practice, Douglas Stinson, 4th Edition, 2019, Chapman & Hall, ISBN 9781138197015.
4	Computer Network Security, Joseph MiggaKizza, Springer International Edition, 2020, eISBN: 978-3-030-38141-7

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

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

Semester: VI						
BLOCK CHAIN TECHNOLOGY **Category: PROFESSIONAL CORE ELECTIVE** **(Common to CS & IS)** **Elective D**						
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 Block chain – 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 Block chain based crypto currency?	
Unit – II	**8 Hrs**
Technologies Borrowed in Block chain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc. Bitcoin block chain - 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, 3. (VOLII), pp 281-310 2015
4. Analysis of Blockchain protocol in Asynchronous networks, R.Pass et al, EUROCRYPT, 2017
5. Fruitchain, a fair blockchain, R.Pass et al, , PODC , 2017
6. 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**

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

Semester: VI						
WEB PROGRAMMING **Category: PROFESSIONAL CORE ELECTIVE** **(Common to CS & IS)** **Elective D**						
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.	

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 usingdifferent 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**

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

Semester: VI						
TECHNIQUES OF DATA MINING **Category: PROFESSIONAL CORE ELECTIVE** **Elective D**						
Course Code	**:**	**21CS64D4**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Introduction to Data Mining Introduction to Data Mining, Importance of Data mining, kinds of data and patterns to be mined, technologies used, Data Objects and Attribute Types, Data Preprocessing: Data cleaning, Data Integration, Data Reduction, Data Transformation and discretization. Parallel / Distributed Systems - Basic scenarios and Implications.	
Unit – II	**12 Hrs**
Distributed Architecture and Computing– Hadoop Hadoop Distributed File System (HDFS), Scheduling in Hadoop (using YARN). Example – Hadoop application.Map-reduce model: Examples (of map, reduce, map-reduce combinations, and Iterative map-reduce) **Hadoop Ecosystem:** Databases and Querying (HBASE, Pig, and Hive)	
Unit –III	**08 Hrs**
Distributed Architecture and Computing-HPCC Systems HPCC System functions, Data Lake Architecture, The HPCC Systems design, Thor Vs ROXIE, Hadoop V/s HPCC Systems, **ECL programming** An activity Declaration, A Record Declaration, Schema on Read (RECORD) explained, A Function Declaration, A MODULE, ECL File(s), Importing files, Spraying and Reading a file Data Shaping (Transforming) : Function, Module and Project, Iterate and Rollup ,Sort, Join and Dedup ,Normalize and Denormalize ,Distribute and Reading The Execution Graph, GROUP and functions (SUM, AVE, COUNT…), TABLE and AGGREGATE	
Unit –IV	**08 Hrs**
Association Analysis Basic Concepts, Apriori algorithm, Generating association rules from frequent itemsets, improving the efficiency of Apriori, Pattern growth approach for Mining frequent itemsets, Mining Frequent itemsets using vertical data format, Mining closed and max itemsets.	
Unit –V	**09 Hrs**
Data mining trends and research frontiers Mining sequential data, time series, Symbolic sequences, Biological sequences, mining graphs and networks, Data mining applications, Data mining and society	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Interpret/explore the importance of Data Mining techniques, Distributed Architectures and ECL programming in mining Massive Datasets.
CO2	Analyze and describe various data mining techniques such as Association, Clustering and Classification used for data mining
CO3	Apply Data Mining Techniques to the real world problems.
CO4	Design solutions for various interdisciplinary data mining problems using modern tools
CO5	Demonstrate the skills like investigation, effective communication, working in team/individual and following ethical practices by implementing Data Mining Models for various applications

Reference Books	
1.	Jiawei Han and Micheline Kamber, Jian Pei: Data Mining – Concepts and Techniques, 3rd Edition, Morgan Kaufmann, 2012, ISBN 978-0-12-381479-1.
2.	Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson Education, 2007, ISBN 978-81-317-1472-0.
3.	https://cdn.hpccsystems.com/releases/CE-Candidate-9.0.10/docs/EN_US/ECLLanguageReference_EN_US-9.0.10-1.pdf
4.	Seema Acharya and Subhashini Chellappan. *Big Data and Analytics*. Wiley India Pvt. Ltd. Second Edition. ISBN 812657951X, 978-8126579518

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

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

Semester: VI						
ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE **Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE** **Elective E**						
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	

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, VahapTecim and SezerBozkusKahyaoglu, CRC Press, 1st edition, 2023,ISBN: 978-1-032-13619-
2	Artificial Intelligence in Healthcare, Adam Bohr and KavehMemarzadeh, Elsevier Academic Press, 2020, ISBN: 978-0-12-818438-7
3	AI for Cars, JosepAulinas 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. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
QUANTUM COMPUTING **Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE** **Elective E**						
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.

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

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

Semester: VI						
COMPUTER VISION **Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE** **Elective E**						
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.	

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**

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

Semester: VI						
ENTERPRISE ARCHITECTURE **Category: PROFESSIONAL CORE ELECTIVE – CLUSTER ELECTIVE** **Elective E**						
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 and use 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.

Reference Books	
1	An Introduction to Holistic Enterprise Architecture, Scott A. Bernard, 4th Edition, 2020, Authorhouse, ISBN: 978-1728358055
2	Enterprise DevOps for Architects: Leverage AIOps and DevSecOps for secure digital transformation, JeroenMulde, 2021, Packt Publishing, ISBN:978-1801812153
3	Mastering ArchiMate Edition 3.1: A Serious Introduction to the ArchiMate® Enterprise Architecture Modeling Language, GerbenWierda, 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**

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**	**:**	**3Hours**
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, Shaping the 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.						

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 Ed,2007, ISBN: 978-0-471-27139-0.
3.	Human – Computer Interaction, Alan Dix, Janet Fincay, GreGoryd, 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 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, 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**

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	**:**	40L		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 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	**08 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	**08 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	**08 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	**08 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	

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.

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.

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, 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**

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.

Reference Books	
1.	Functional Safety in the Process Industry: A Handbook of practical Guidance in theapplication 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 andWilliam 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 albertapress,Canada, ISBN: 0888643942.
4.	ndustrial 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
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2	Unit 1 : (Compulsory)	16
3 & 4	Unit 2 : Question 3 or 4	16
5 & 6	Unit 3 : Question 5 or 6	16
7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: VI						
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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Understand the working principle and operation of various renewable energy sources and systems.
CO 2	Analyze the performance and characteristics of renewable energy sources and systems.
CO 3	Evaluate the parameters of wind and solar energy systems.
CO 4	Design and demonstrate the applications of renewable energy sources in a typical systems.

Reference Books	
1.	Non conventional energy sources, by G.DRai, Khanna publishes, 19th Edition, 2017, ISBN: 978-81-7409-073-8
2.	Solar photo voltaic Technology and systems, byChetan 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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
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:** Developingthe 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.	

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). THREE tests will be conducted. Each test will be evaluated for 50 Marks, adding upto 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: VI						
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.	
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, I 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**

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

Semester: VI						
MATHEMATICAL MODELLING **Category: INSTITUTIONAL 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.

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

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). 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 (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE THEORY	**100**

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

Semester: 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)	
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

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**

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	**:**	45Hrs		**SEE Duration**	**:**	**3Hours**

Unit-I	**08Hrs**
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	**08Hrs**
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	**10Hrs**
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	**10Hrs**
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	**09Hrs**
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.**PsychologicalCounseling** - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	

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

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

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

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

Semester: VI						
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)	

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**

Semester: VI						
UNIVERSAL HUMAN VALUES - II **Category: INSTITUTIONAL ELECTIVE** **(Elective F)**						
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.	

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

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

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

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

Semester: VI						
HUMAN MACHINE INTERFACE **Category: INSTITUTIONAL ELECTIVE** **(IndustryOfferedElective)** **(Elective F)**						
Course Code	**:**	21IE6F10		**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**
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, ECU swith in car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN,LIN,Most, FlexRay, Ethernet etc)	
Unit–II	**10 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-VehicleInformation Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touch screen 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	**08 Hrs**
UX and Guidelines: Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts, Graphic design tools- Adobe Photoshop, AdobeXD, Blender, GIMP, Asset Design-Overview, Guidelines and norms, 2D/3Drendering, OpenGL, OSG.	
Unit–IV	**08 Hrs**
HMI User Interface: User-centered HMI development process, Basics of Web-Server. Web-based HMI: Basics of Twin CAT and HTML, CSS, JavaScript. HMI on Mobile: Four Principles of MobileUI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites.	
Unit–V	**08 Hrs**
HMI Control Systems: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UIcontrols.**HapticsinAutomotiveHMI:**KinestheticFeedbackSystems,TactileFeedbackSystems,HapticsinMulti modalHMI,AutomotiveUse-Cases **HMI Testing:** Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - GraphicsTestSystems(GTS), UI analytics: Usage patterns,Debugging, Performance Profiling, Use Cases.	

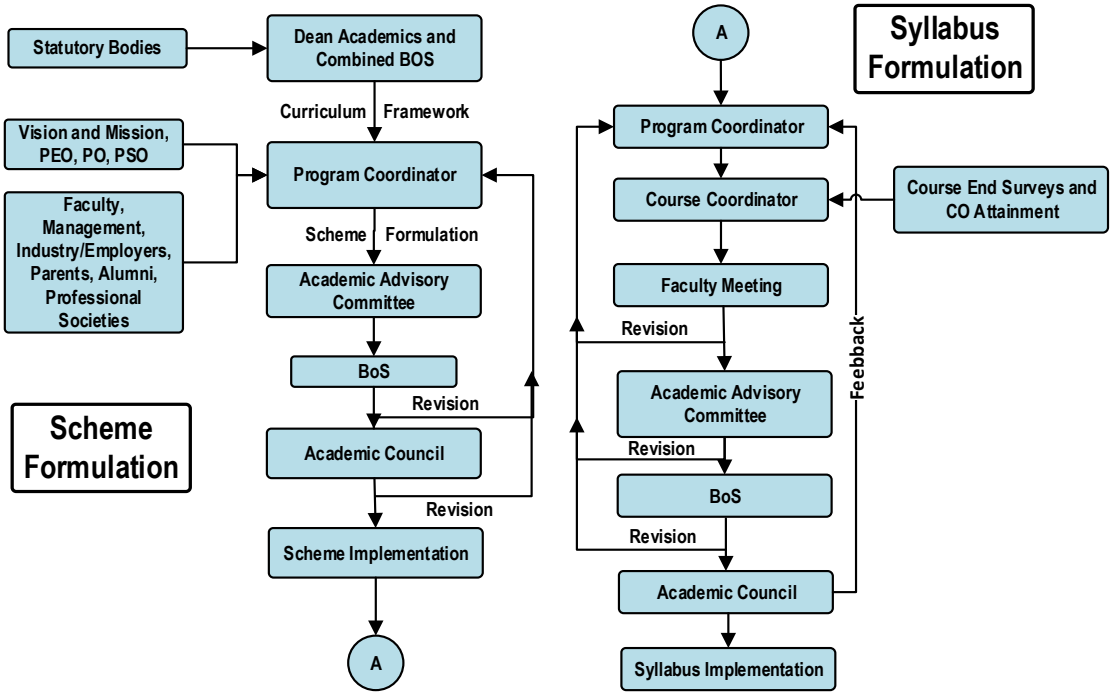
Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understanding the application of HMIs in various domain
CO2	Comparison of various communication protocols used in HMI development.
CO3	Apply and Analyse the car multimedia system free software and hardware evolution
CO4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

Reference Books	
1	Shuogao, Shuo Yan, Hang Zhao, Arokia Nathan"Touch based HMI; Principles and Applications" Springer NatureSwitzerlandAG,1st Edition
2	Robert Wells,"Unity2020 by Example: A Projectbasedguidetobuilding2D,3Daugumentedrealityand Virtual reality games from sratch" Packt Publishing ltd, edition 2020
3	Ryan Cohen,TaoWang,"GUI Design and Android Apps"Apress, Berkley,CA, 20l4

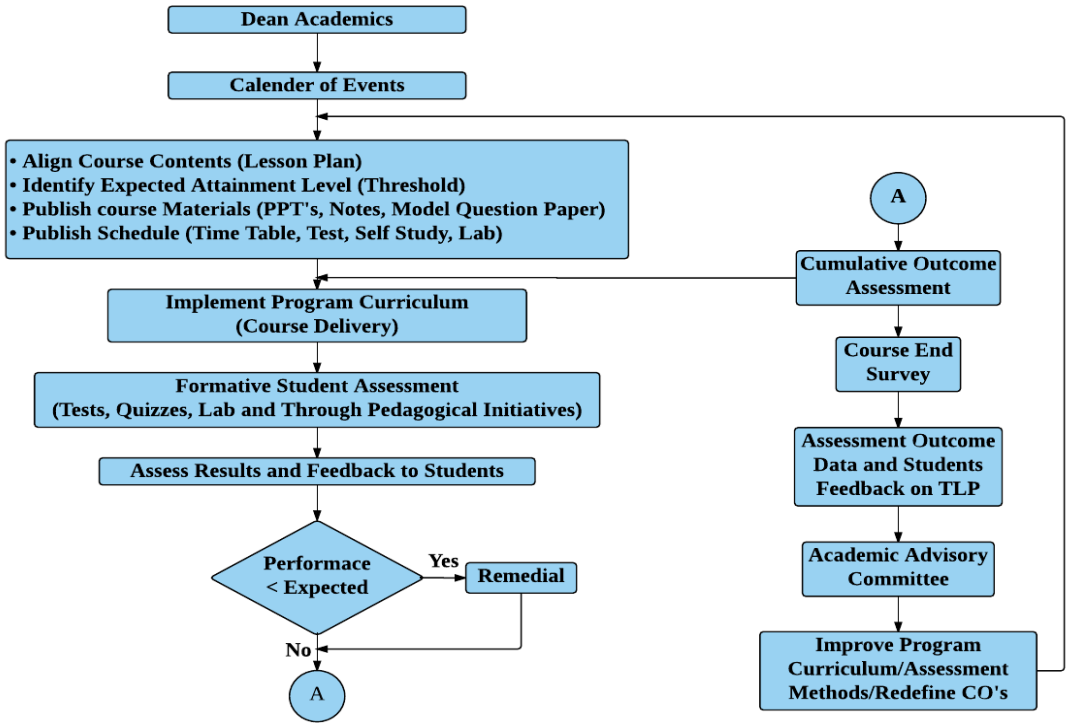
RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL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

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

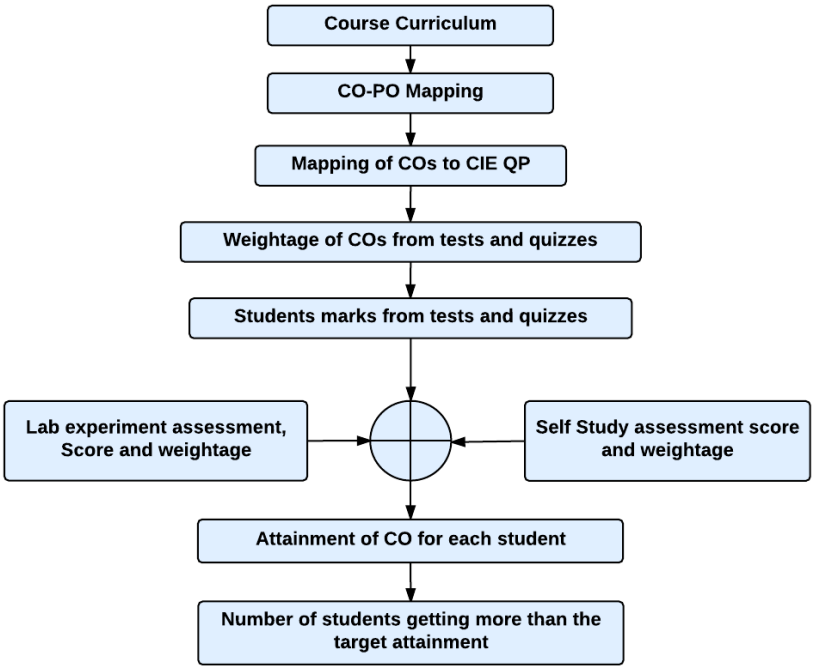
Curriculum Design Process



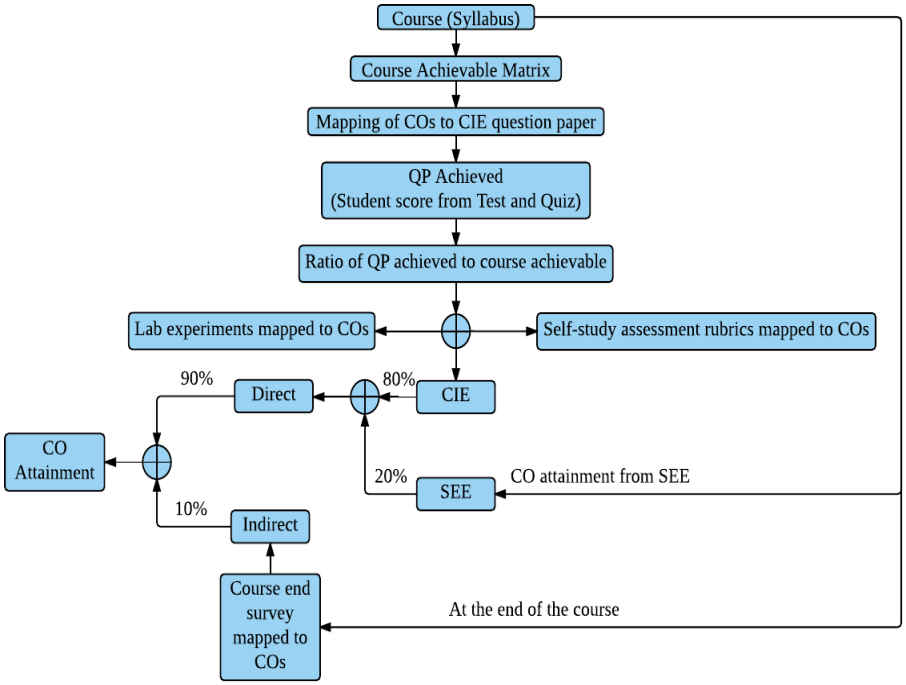
Academic Planning And Implementation



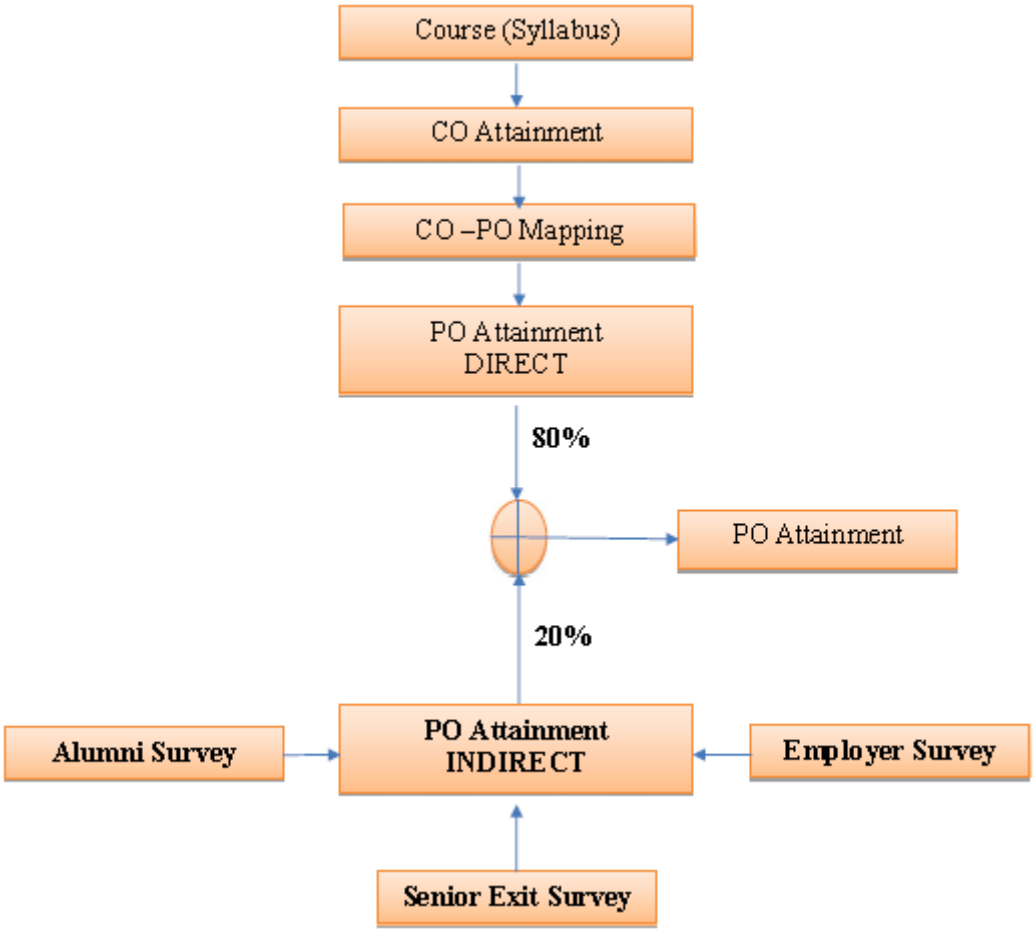
Process For Course Outcome Attainment



Final CO Attainment Process



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 specialisation for the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse 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:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

RV College of Engineering®

Autonomous Institution Affiliated toVisvesvaraya Technological University, Belagavi

Approved by AICTE, Accredated by NBA

Department of Computer Science and Engineering

Phone: 080-68188199, 8200 : e-mail: hod.cse@rvce.edu.in