RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

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Scheme & Syllabus of

III & IV Semesters (2021 Scheme)

(AS PER NEP-2020 GUIDELINES)

BACHELOR OF ENGINEERING (B.E)

IN

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(ACADEMIC YEAR 2022-2023)

ABBREVIATIONS

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

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SECOND YEAR COURSES			
Sl. No.	Course Code	Name of the Course	Page No.
1.	21MA31D	Mathematics for AI and ML	
2.	21BT32A	Environmental Technology	
3.	21AI33	Data Structures and Data Analysis	
4.	21AI34	Foundations of Cyber Physical Systems	
5.	21CS35	Operating Systems	
6.	21CS36	Discrete Mathematical Structures	
7.	21DCS37*	Bridge Course: C Programming	
8.	21AI39	Design Thinking Lab	
9.	21AII310	Internship Evaluation	
10.	21AI41	Statistics for Data Science	
11.	21BT42	Bio-Inspired Engineering	
12.	21CS43	Design And Analysis of Algorithms	
13.	21AI44	Database Management Systems	
14.	21CS45	Computer Networks	
15.	21AI4AX	Professional Elective - Group A	
16.	21HS46A/21HS46V	Kannada Course: AADALITHA KANNADA / VYAVAHARIKA KANNADA	
17.	21HSAE46A/B/C/D/E	Ability Enhancement course	
18.	21DMA47	Bridge Course: Mathematics	
19.	21HSU48	Universal Human Values and Professional Ethics	
20.	21CS49	Object Oriented Programming Using Java	

Bachelor of Engineering in

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

III SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21MA31D	Mathematics for AI and ML	3	1	0	**4**	MA	Theory	1.5	**100**	****	**3**	**100**	****
2	21BT32A	Environmental Technology	2	0	0	**2**	BT	Theory	1	**50**	****	**2**	**50**	****
3	21AI33	Data Structures and Data Analysis	3	0	1	**4**	AI	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	21AI34	Foundations of Cyber Physical Systems	3	0	1	**4**	AI	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
5	21CS35	Operating Systems (Common to CS, IS, AI)	2	0	1	**3**	CS	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
6	21CS36	Discrete Mathematical Structures (Common to CS, IS, AI)	3	0	0	**3**	CS	Theory	1.5	**100**	****	**3**	**100**	****
7	21DCS37*	Bridge Course: C Programming	2(A)	0	0	**AUDIT**	CS	Theory	1.5	**50**	****	****	****	****
8	21AI39	Design Thinking Lab	0	0	2	2	AI	Lab	1	****	50	2	****	50
9	21AII310	Summer Internship- I	0	0	1	**1**	AI	Internship	1	****	**50**	**2**	****	**50**
						23								

* Summer Internship-1 will be done after the II sem for 03 Weeks

ENGINEERING MATHEMATICS - III		
COURSE TITLE	**COURSE CODE**	**BRANCHES**
Linear algebra, Integral transforms and Number theory for CS & IS	21MA31A	CS and IS
Linear algebra, Integral transforms and Fourier series for AS, EC, EE, EI & ET	21MA31B	AS, EC, EE, EI, ET
Integral transforms, Optimization and Numerical Techniques for BT, CH, CV, IM & ME	21MA31C	BT, CH, CV, IM, ME
Mathematics for AI & ML	21MA31D	AI and ML
MANDATORY COURSES		
Environmental Technology	21BT32A	All circuit Branches
Biology for Engineers	21BT32B	BT & AS
Engineering Materials	21ME32	ME, CH & AS
***Bridge Course: Audit course for lateral entry diploma students (Only CIE and NO SEE)**		
COURSE TITLE	**COURSE CODE**	**BRANCHES**
Bridge Course Mathematics	21DMA37	AS, BT, CH, CV, EC, EE, EI, IM, ME & TE
Bridge Course C Programming	21DCS37	CS, IS & AI

Bachelor of Engineering in

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

IV SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	21AI41	Statistics for Data Science	2	1	0	**3**	AI	Theory	1.5	**100**	****	**3**	**100**	****
2	21BT42	Bio-Inspired Engineering	2	0	0	**2**	BT	Theory	1	**50**	****	**2**	**50**	****
3	21CS43	Design And Analysis of Algorithms (Common to CS, IS, AI)	3	0	1	**4**	CS	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	21AI44	Data Base Management Systems	3	0	1	**4**	AI	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
5	21CS45	Computer Networks (Common to CS, IS, AI)	3	0	0	**3**	CS	Theory	1.5	**100**	****	**3**	**100**	****
6	21AI4AX	Professional Elective – Group A	2	0	0	**2**	AI	MOOC	1	**50**	****	**2**	**50**	****
	21HS46A/ 21HS46V	Kannada Course: AADALITHA KANNADA / VYAVAHARIKA KANNADA)	1	0	0	**1**	HSS	Theory	1	**50**	****	**2**	**50**	****
7	21HSAE46 A/B/C/D/E**	Ability Enhancement course	0	0	1	**1**	HSS	Lab	1	****	**50**	**2**	****	**50**
8	21DMA47	Bridge Course: Mathematics	2 (A)	1	0	**AUDIT**	MA	Theory	1.5	**50**	****	****	****	****
9	21HSU48	Universal Human Values and Professional Ethics	2	0	0	**2**	HSS	Theory	1	**50**	****	**2**	**50**	****
10	21CS49	Object Oriented Programming Using Java (Common to CS& AI)	0	0	1	**1**	CS	Lab	2	****	**50**	**2**	****	**50**
						23								

* Summer Internship-II will be done after the IV sem for 04 Weeks

ENGINEERING MATHEMATICS - III		
COURSE TITLE	**COURSE CODE**	**BRANCHES**
Materials for Electronics Engineering (Common with EC/EE/ EI/ET).	21EC42	EC,EE,EI,TE
Environmental technology for AS, CH, IM & ME Programs	21ME42	AS,BT,CH,IM &ME
Bio inspired Engineering	21BT42	AI,CS & IS
Civil Engineering Materials for CV Program	21CV42	CV
Bridge Course: Audit course for lateral entry diploma students		
Bridge Course Mathematics	21DMA47	CS,IS & AI
Ability enhancement courses **		
National Service Scheme (NSS)	21HSAE39A	
National Cadet Corps (NCC)	21HSAE39B	
Physical Education	21HSAE39C	
Music/Dance/Theatre	21HSAE39D1/2/3	
Art work/ Photography & Film making	21HSAE39E1/2	

Sl. No.	Course Code	Course Title
1.	21AI4A1	Object Oriented Analysis and Design
2.	21AI5A2	Theory of Computation
3.	21AI5A3	Embedded System Design With ARM
4.	21AI5A4	Modern Algebra
5.	21AI5A5	Computer Graphics

Course Code	**:**	**21MA31D**	**MATHEMATICS FOR AI and ML**	**CIE Marks**	**:**	**100**
Credits L-T-P	**:**	**3:01:00**	***(Theory)***	**SEE Marks**	**:**	**100**
Hours	**:**	**45L+15T**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**09 Hrs**

Linear Algebra – I:
Vector spaces, subspaces, linear dependence and independence, basis and dimension, four fundamental subspaces. Rank and nullity theorem (without proof). Linear transformations - matrix representation, kernel and image of a linear transformation, dilation, reflection, projection and rotation matrices.

UNIT - II	**09 Hrs**

Linear Algebra - II:
Inner Products, orthogonal matrices, orthogonal and orthonormal bases, Gram-Schmidt process, QR-factorization. Eigen values and Eigen vectors, diagonalization of a matrix (symmetric matrices) and singular value decomposition.

UNIT - III	**09 Hrs**

Laplace and Inverse Laplace Transform:
Existence and uniqueness of Laplace transform (LT), transform of elementary functions. Properties - linearity, scaling and s – domain shift, differentiation in the s – domain, division by t, differentiation and integration in the time domain. Inverse Laplace transforms - properties, evaluation using different methods, convolution theorem (without proof) and problems.

UNIT - IV	**09Hrs**

Convex Optimization I:
Introduction to optimization-local and global optima, convex sets, convex functions, separating hyperplane, gradient vector, Hessian matrix, optimization using Hessian matrix method, Sequential search methods for 1D problems – three-point interval search, Fibonacci search**.**

UNIT - V	**09 Hrs**

Convex Optimization II:
Unconstrained optimization – The method of steepest ascent, The Newton – Raphson method. Constrained optimization – Lagrange multipliers, duality, Lagrange dual problem, Karush-Kuhn-Tucker (KKT) optimality conditions.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Illustrate the fundamental concepts of linear algebra, Laplace and inverse Laplace transforms and convex optimization.
CO2	:	Apply the acquired knowledge of linear algebra, Laplace and inverse Laplace transforms, number theory and convex optimization to solve the problems of engineering applications.
CO3	:	Analyze the solution of the problems using appropriate techniques of linear algebra, integral transforms and convex optimization to the real world problems arising in many practical situations.
CO4	:	Interpret the overall knowledge of linear algebra, Laplace and inverse Laplace transforms and convex optimization gained to engage in life-long learning.

Reference Books:

1. Linear Algebra and its Applications, Gilbert Strang, 4th Edition, 2014, Cengage Learning India Edition, ISBN: 9788131501726, 8131501728.

2.Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 9788193328491.

3. Theory and Problems of Operations Research, Schaum's Outline series, 2nd Edition, 1983, McGraw – Hill, ISBN-10: 0070990751. ISBN-13: 9780070584006.

4.Linear Algebra and its Applications, David C Lay, 4th Edition, 2012, Pearson Education India, ISBN-13: 970321385178, ISBN-10: 0321385171.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analysing, Evaluating, and Creating)		
Test – 1	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
MATLAB	**20**	
Model presentation/ case study/ video preparation	**20**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**

Course Code	**:**	**21BT32A**	**ENVIRONMENTAL TECHNOLOGY**	**CIE Marks**	**:**	**50**
Credits L-T-P	**:**	**2:00:00**	***(Theory)*** ***(Common to AI, BT, CS & IS)***	**SEE Marks**	**:**	**50**
Hours	**:**	**26L**		**SEE Durations**	**:**	**2 Hours**

UNIT - I	**08 Hrs**

Introduction: Climate action – Paris convention, Sustainable Developmental Goals in relation to environment, Components of environment, Ecosystem. Environmental education, Environmental acts & regulations, role of non-governmental organizations (NGOs), EMS: ISO 14000, Environmental Impact Assessment. Environmental auditing.

UNIT - II	**09 Hrs**

Pollution and its remedies: Air pollution – point and non-point sources of air pollution and their controlling measures (particulate and gaseous contaminants). Noise pollution, Land pollution (sources, impacts and remedial measures),
Water management: Advanced water treatment techniques, water conservation methods.
Waste management: Solid waste, e-waste & biomedical waste – sources, characteristics & disposal methods. Concepts of Reduce, Reuse and Recycling of the wastes.
Waste to Energy: Different types of Energy, Conventional sources & Non-conventional sources of energy: Solar, Hydro Electric, Wind, Nuclear, Biomass & Biogas Fossil Fuels and Hydrogen.

UNIT - III	**09 Hrs**

Environmental design: Green buildings, green materials, Leadership in Energy and Environmental Design (LEED), Hydroponics, Organic Farming, Biofuels, IC engine to E mobility transition and its impacts, Carbon Credits, Carbon Foot Prints, Opportunities for Green Technology Markets, Carbon Sequestration.
Resource recovery system: Processing techniques, Materials recovery systems, Biological conversion (composting and anaerobic digestion). Thermal conversion products (Combustion, Incineration, Gasification, Pyrolysis, use of Refuse Derived Fuels). Case studies.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Identify the components of environment and exemplify the detrimental impact of anthropogenic activities on the environment.
CO2	:	Differentiate the various types of wastes and suggest appropriate safe technological methods to manage the waste.
CO3	:	Apply different renewable energy resources and can analyse the nature of waste and propose methods to extract clean energy.
CO4	:	Adopt the appropriate recovering methods to recover the essential resources from the wastes for reuse or recycling.

Reference Books:

1.Shashi Chawla, A Textbook of Environmental Studies, McGraw Hill Education, 2017, ISBN: 1259006387

2. Richard A Schneider and Jerry A Nathanson, Basic Environmental Technology, Pearson, 6th Edition, 2022. ISBN: 9789332575134

3.G. Tyler Miller (Author), Scott Spoolman (Author), (2020) Environmental Science – 15th edition, Publisher: Brooks Cole, ISBN-13: 978-1305090446 ISBN-10: 130509044.

4.Howard S. Peavy, Donald R. Rowe and George Tchobanoglous. 2000. Environmental Engineering, McGraw Hill Education, First edition (1 July 2017). ISBN-10: 9351340260, ISBN-13: 978-9351340263

Experiential learning topics	
Assessment of the environment of certain big campuses/areas/industries etc, a case study	
1	Development of data sheet
2	Survey and its record
3	Identifying the problems associated
4	Provide a solution for the identified problem

Experiments to be performed	
1	Data development
2	Working model (in silico or demo model)
3	Preparing a report
4	Brainstorming of the work carried out.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 5 marks adding up to **10 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to 20 **MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**20**	
Case Study-based Teaching-Learning	**10**	
Experiments performed	**10**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**50**	**100**

Experiential learning evaluation will be evaluated based on the experiments and the preparation, presentation of the topics, equal weightage is given for experiments and theory.

Course Code	:	**21AI33**	**Data Structures and Data Analysis**	**CIE Marks**	:	**150**
Credits L-T-P	:	**3:00:01**	***(Theory and Practice)***	**SEE Marks**	:	**150**
Hours	:	**45L+30P**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**09 Hrs**

Importance of Data Structures and Data Analysis in AIML engineering with real-world examples.
Introduction: Introduction to Data structures, Types of Data Structures, linear & non-linear Data Structures, dynamic memory allocation concepts, and syntax in C.
Linked Lists: Linked list data structure concept, Chains, Merging of two sorted lists, Circular lists, Doubly linked Circular lists
Stacks and Queues: Stack and Queues data structure concepts, Stack implementation, Queue implementation, Queue implementation using Circular array. Application of stacks in recursion.

UNIT - II	**09 Hrs**

Trees: Tree data structure concepts, Tree representation, Binary trees and Properties, BT Representation and Traversals
Threaded Binary Trees: Threads, In-order traversal of TBTs, Binary Search Tree: Definitions, Search, Insert, Delete
Heaps: Priority Queues, Max Heap, Insertion, Deletion

UNIT - III	**09 Hrs**

Graphs: Introduction, Representations, Adjacency Lists, Adjacency Matrix, Weighted Graph Representation, Spanning Trees, Searching in a graph: DFS, BFS
Hash Tables: Introduction, Hash Tables for Integer Keys, Hashing by Division, Hashing by multiplication, Universal Hashing, Random Probing (Chaining, Linear Probing, Quadratic Probing, Double Hashing) .

UNIT - IV	**09Hrs**

Introduction to Data Analysis: Data and knowledge, intelligent data analysis, data analysis process, methods, tasks, tools, practical data analysis, data understanding and pattern finding, explanation finding, predicting the future. Project understanding, determine the project objective, assess the situation, and determine analysis goals.

UNIT - V	**09 Hrs**

Data Understanding: Attribute understanding, data quality, data visualization, methods for one and two attributes, methods for higher dimensional data, correlation analysis, missing values, data understanding in R

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the knowledge of data structures in providing solutions to some software development requirements.
CO2	:	Perform data analysis of some real-world scientific/business use cases and present the analysis results.
CO3	:	Investigate appropriate data structures and understand requirements in solving some problems of industry and society.
CO4	:	Use data analysis tools to illustrate the principles of data interpretation, statistical analysis, and graphical visualizations of the datasets.
CO5		Appraise data structures and analysis knowledge to build a successful career as an AIML engineer, work in teams, and communicate their ideas effectively.

Reference Books:

1. Handbook of Data Structures and Applications, Edited by Dinesh P Mehta, and Sartaj Sahni, Chapman & Hall/CRC, 2005

2.Guide to intelligent data analysis, Michael R. Berthold, Christian Borgelt, Fran Hoppner and Frank Klawonn, Texts in Computer Science, Springer, 2010.

3. The R Book, Michael J. Crawley, Second Edition, John Wiley Publications, 2013

4.Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahni, Illustrated Edition, Computer Science Press.

5.R for Beginners, Emmanuel Paradis, 2005

List of Laboratory Experiments			
Expt.No		**Data Structure Name**	**Application to be coded using C**
PART A			
1		Stack	•Arithmetic Expression Evaluation o Evaluating the prefix expression by considering the priority of the operators. o Identify the invalid Expression o Identify the invalid values for the operands
2		Queue	• Simulating a shared resource management o Create a simulated version of a shared resource like CPU, Disk, Printer, etc. o Generate the series of random requests o Use queues to manage the resource
3		Singly Linked List	• Polynomial Arithmetic o Adding two polynomials o Multiplying two polynomials
4		Doubly Linked List	• Simple Text Editor o Browsing through the text, line by line in both directions o Insert New lines anywhere in the text o Delete line/s from the text
5		Binary Trees	• Arithmetic Expression Conversion o Building an expression tree o Infix to Prefix conversion o Infix to Postfix conversion
6		Binary Search Tree	• Creating a dictionary of words o Insert a new word into a dictionary o Delete a word from a dictionary o Print Dictionary
7		Graphs	• Implementing Dijkstra's algorithm and finding the shortest route between nodes
8		Hash Table	• Implementing the Rabin-Karp algorithm for pattern matching using Hashing
9		Heaps	• Implement a Max-heap data structure from a binary tree
PART B			
A batch of two students develops a prototype using the C/C++ language. The prototype demonstrates the use of data structure in real-time applications. E.g., using trees to index search results, using graphs to navigate places, using graphs for recommendations and match-making, using queues for message passing, developing spell and grammar checkers, using matrices to generate the survey insights, etc. (Ref: https://www.geeksforgeeks.org/real-time-application-of-data-structures/). The innovative applications of data structures attract high marks.			

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**.	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
Presenting an industrial case-study on data analysis	**10**	
Student has to perform an detail statistical interpretation, calculation and graphical visualization using the data analysis tools like R, on the dataset selected from the sources such as: • www.data.gov.in • https://datasetsearch.research.google.com/ • www.kaggle.com • https://webscope.sandbox.yahoo.com/ • https://www.analyticsvidhya.com/blog/tag/datasets/	**20**	
Video based seminar (4-5 minutes per student)	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**150 MARKS**	**150 MARKS**

Course Code	:	**21AI34**	**Foundations of Cyber Physical Systems**	**CIE Marks**	:	**150**
Credits L-T-P	:	**3:00:01**	***(Theory and Practice)***	**SEE Marks**	:	**150**
Hours	:	**45L+30P**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**08 Hrs**

Cyber-Physical Systems-Basics and Fundamentals
Introduction, CPS concept and requirements, CPS Architecture, CPS Applications: CPS for Vehicular Environments, CPS for Agriculture, CPS for Health and Medical Sciences, CPS for the Smart Grids, Future aspects of CPS, Challenges and Opportunities.

UNIT - II	**10 Hrs**

Basics of Computer and Embedded Architecture
Computer Architecture-Processors, Basic System Architecture, Interrupts, CISC and RISC, Digital Signal Processors, Memory-RAM and ROM, Input/ Output: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA)-Standard block transfer, Demand-mode transfers, Fly-by transfer, Data-chaining transfers. Parallel and Distributed Computers-Introduction to parallel architectures, SIMD computers, MIMD computers, Embedded Computer Architecture.

UNIT - III	**09 Hrs**

Embedded System Components
Introduction, Hardware Components- Sensors, Actuators, IO Interfaces, Processor Complex or System on Chip (SoC), Processor and IO Interconnection, Bus Interconnection, High-Speed Serial Interconnection, Low-Speed Serial Interconnection, Firmware Components - Boot Code, Device Drivers, Operating System Services.

UNIT - IV	**09Hrs**

Sensors:Sensor Definition, Use of Sensors, Sensor Network Definition and the Use of Sensor Networks, Traditional Sensor Networks vs. WSNs, Types of Sensors, Sensor Performance, Smart Sensors, Sensor Networks and Associated Technologies: Wireless Sensor Networks as Sensor Networks and Smart Sensor Networks.

UNIT - V	**09 Hrs**

Actuators : Electro Magnetic Actuators, Electrostatic Actuators, Electro-optic devices, Piezoelectric actuators.
Robotic Application
Introduction, Robotic Arm, Sensing, Actuation, Automation and Autonomy.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand and apply the knowledge of engineering specialization to address the complex engineering problems
CO2	:	Analyze the various Cyber-Physical components used in solving the real-world problem
CO3	:	Design solution for complex engineering problem using Cyber Physical Systems
CO4	:	Communicate effectively and collaborate in group to carryout Cyber Physical System activities
CO5		Demonstrate design skills to solve inter-disciplinary problems using modern tools effectively by exhibiting team work through oral presentation and written reports.

Reference Books:

1. Cyber-Physical System Design with Sensor networking Technologies, Control, Robotics and Sensor Series, Edited by Sherali Zeadally and Nafaa Jabeur ISBN 978-1-84919-825-7

2.Designing Embedded Hardware, John Catsoulis, 2nd Edition, O'Reilly Media, 2005, ISBN: 0-596-00755-8.

3. Real-Time Embedded Components and Systems with LINUX and RTOS, S. Siewert and J. Pratt, 2016, ISBN: 978-1-942270-04-1.

4.Sensors and Transducers: Characteristics, Applications, Instrumentation, Interfacing, M.J Usher, D.A Keating, Second Edition, MACMILLAN PRESS LTD, ISBN-978-1-349-13345-1.

List of Laboratory Experiments

Expt.No		**Experiments**
		PART A
1		Write a program with ESP8266 to calculate the distance of an obstacle. If the distance calculated is less than a certain value turns
2		Write a program with ESP8266 to indicate the level of temperature using the LEDs indicating the low, medium and high values of temperature (Red, Blue and Green)
3		Write a program to collect data using Temperature sensors on RaspberryPi3 and apply visualization techniques to display the processed data.
4		Write a program to collect data using RaspberryPi3 from the environment, and upload data to the any of the Cloud Platform.

5		Write an interactive python script on RaspberryPi3 to control servo motor						
6		Write a program to capture the live image using the USB Camera on RaspberryPi3 and send a it as notification.						
7		Write a program to capture the live image using the USB Camera on RaspberryPi3 development kit and mark the region of interest and display using OpenCV.						
8		Write a program to show the communication between client and server using RaspberryPi3.						

PART B

A batch of two students should develop a prototype for any one of the Sustainable Development Goals. The prototype should demonstrate the use of various sensors & actuators, and embedded modules in real-time applications.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	SEE
WEIGHTAGE	50%	50%
QUIZZESS		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**	
Quiz-II		
(Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		

EXPERIENTIAL LEARNING (40 Marks)		
Presenting a case-study on embedded systems application	**10**	
Student has to develop an embedded system application. Also, students should provide the Graphical User Interface (GUI) to control the various sensors and actuators used.	**20**	
Video-based seminar (4-5 minutes per student) – Topic allotted by the faculty	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**150 MARKS**	**150 MARKS**

Course Code	**:**	**21CS35**	**Operating Systems (Theory and Practice)**	**CIE Marks**	**:**	**150**
Credits L-T-P	**:**	**2:00:01**	***(Common to AI, CS & IS)***	**SEE Marks**	**:**	**150**
Hours	**:**	**30L+30P**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**06 Hrs**
Introduction- Perspectives **Business domain: Virtualisation and Cloud Computing Application: Traditional computing, Mobile computing, Distributed systems** **Introduction :What Operating System do, Operating System structure, Operating system Operations.** **System Structures:Operating system services, System Calls, Types of System calls Process Management:Process concept, Process scheduling, Operations on processes**	
UNIT - II	**06 Hrs**
Multithreaded programming:Overview, Multicore programming, Multithreading models, Thread libraries - pthreads **CPU scheduling and Process Synchronization:Basic concepts, scheduling criteria, scheduling algorithms-FCFS, SJF, RR, priority, Real-time CPU scheduling**	
UNIT - III	**06 Hrs**
Process Synchronization:Background, The Critical section problem, Peterson's Solution **Process Synchronization:Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization**	
UNIT - IV	**06Hrs**
Main Memory Management :Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table. **Virtual memory :Background, Demand Paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing**	
UNIT - V	**06 Hrs**
File Systems :File Naming, File Structure, File Types, File Access, File Attributes, File Operations, An example program using File-System calls, File-System Layout, Implementing Files	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the operating systems concepts to solve problems in computing domain.
CO2	:	Analyse data structures and algorithms used to implement OS concepts.
CO3	:	Design solutions using modern tools to solve applicable problems in operating systems domain
CO4	:	Implement process, memory, scheduling, synchronization and other operating system techniques.
CO5		Demonstrate skills like investigation, effective communication, working in team/Individual and following ethical practices by implementing operating system concepts and applications..

Reference Books:

1. Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin , Greg Gagne, 9th Edition, Incorporated, 2018, John Wiley & Sons, ISBN 978-1-265-5427-0

2. Modern operating systems, Tanenbaum, Andrew, 4th Edition, Pearson Education, Inc 2009. ISBN 013359162X, 978-0133591620

3. UNIX System Programming Using C++, Terrence Chan, 2011, Prentice Hall India, ISBN: 9788120314689 978-8120314689.

4.Operating systems - A concept based Approach, D.M Dhamdhere, 3rd Edition, 2017, Tata McGraw-Hill, ISBN: 1259005585, 978-1259005589

5."xv6: a simple, Unix-like teaching operating system", https://pdos.csail.mit.edu/6.828/2014/xv6/book-rev8.pdf

EXPERIENTIAL LEARNING

1. Students need to implement Operating system with kernel concepts with the help of references like:
   - Weenix- project for people interested in writing parts of a Unix kernel.
   - GitHub - cfenollosa/os-tutorial: How to create an OS from scratch
2. Open Ended Problems are given to students to solve using various latest OS technology.

List of Laboratory Experiments		
Expt.No		**Experiments**
		PART A
1		Implementation of basic UNIX commands using file APIs- Write a program to implement commands ls(-l option), cp, rm and mv using UNIX file APIs.
2		Apply the concepts of Process control system calls to build applications to demonstrate use of fork, execve, wait, getpid, exitsystem calls
3		Apply the pthread library to build Applications to demonstrate use of pthread library functions to create and manage threads
4		Apply the concepts of Process/Thread synchronization to build Applications to demonstrate process/thread synchronization using semaphores and mutex. Implement Dining philosophers problem, reader-writer and producer-consumer
5		Apply the concepts of Process/Thread synchronization for file access to build applications to demonstrate process/thread synchronization using file locks.
6		Apply Memory management concepts to write a program to simulate Buddy memory allocation algorithm.
7		Apply the concepts of Static and Shared libraries to write a program to create and use static and shared libraries. Demonstrate the advantage of shared libraries over static libraries in terms of memory usage.
		PART B

The students are expected to implement a mini project using operating system concepts and APIs/system calls learned in the theory. The primary emphasis of the experiment is to understand and gain knowledge of operating system concepts so as to apply these concepts in implementing solutions to real world problems. Students are required to form a team, with constraint of maximum 3 persons in a team. Students have to select the problem/application of their choice and get confirmed with faculty handling the course.

Some sample topics could be

- Implement a complex open-ended project with case studies on various OS like Embedded OS, Mobile OS etc.
- Implement kernel concepts in OS

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
Case Study-based Teaching-Learning	**10**	
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ITeS)	**20**	
Video based seminar (4-5 minutes per student)	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**150 MARKS**	**150 MARKS**

Course Code	:	**21CS36**	**Discrete Mathematical Structures**	**CIE Marks**	:	**100**
Credits L-T-P	:	**3:00:00**	***(Common to AI, CS & IS)***	**SEE Marks**	:	**100**
Hours	:	**45L**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**10 Hrs**
Introduction- Perspectives **Business Domains & Applications: Application of discrete mathematics in coding theory, job scheduling, routing in networking, network security etc.** **Fundamental Principles of Counting :The Rule of Sum and Product, Permutations, Combinations, The Binomial Theorem, Combinations with repetition** **Recursive Definitions, Recurrence Relations :Recursive definition, First order linear recurrence relation- Formulation problems and examples. Second order linear homogeneous recurrence relations with constant coefficients**	
UNIT - II	**08 Hrs**
Fundamentals of Logic :Basic Connectives and Truth Tables, Tautologies, Logical Equivalence: The laws of logic, Logical Implications, Rules of inference. Open Statement, Quantifiers, Definition and the use of Quantifiers, Definitions and the proofs of theorems.	
UNIT - III	**09 Hrs**
Relations :Properties of relations, Composition of Relations, Partial Orders, Hasse Diagrams, Equivalence Relations and Partitions. **Functions :Functions-plain, One-to-one, onto functions, Stirling numbers of the second kind, Function composition and Inverse function, Growth of function.**	
UNIT - IV	**09Hrs**
Language and Finite State Machine :Set Theory of strings, Finite State machine, Introduction to Finite Automata, Basic concepts of Automata theory, Deterministic Finite Automata, Non-Deterministic Finite Automata, Finite Automata with epsilon-transitions, Equivalence of NFA & DFA	
UNIT - V	**09 Hrs**
Groups theory :Definition, Examples and Elementary properties, Abelian groups, Homomorphism isomorphism, cyclic groups, cosets and Lagrange's theorem. **Coding Theory :Elementary coding theory, the hamming metric, the parity-Check and generator Matrices**	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the concepts of discrete mathematical structures for effective computation and relating problems in the computer science domain.
CO2	:	Analyse the concepts of discrete mathematics to various fields of computer science.
CO3	:	Design solutions for complex problems using different concepts of discrete mathematical structure as a logical predictable system.
CO4	:	Explore/Develop new innovative ideas to solve some open problems in theoretical computer science.
CO5		Effectively communicate, work in groups in order to accomplish a task and engage in continuing professional development

Reference Books:

1. Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, 5th Edition – 2017, ISBN 978-0321385024

2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 1st Edition 2017, ISBN 13:978-0074631133

3. UNIX System Programming Using C++, Terrence Chan, 2011, Prentice Hall India, ISBN: 9788120314689 978-8120314689.

4.Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, 6th Edition, 7 edition 2017, ISBN-(13): 978-0070681880

5.John Martin, Introduction to Languages and the Theory of Computation, 4th Edition, John C Martin, ISBN 978–0–07–319146–1

EXPERIENTIAL LEARNING

Based on the concepts learnt in this course like relations, functions- problems on graph theory such as graph colouring, scheduling problems could be given for Experiential learning. Also using the concepts of logical reasoning and group theory some of the NLP problems could also be given for Experiential learning

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS.**	
Test – II		
EXPERIENTIAL LEARNING	**40 MARKS**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**

Course Code	:	**21DCS37**	**Bridge Course: C Programming (Theory)**	**CIE Marks**	:	**100**
Credits L-T-P	:	**2:00:00**	***(Common to all branches)***	**SEE Marks**	:	**_**
Hours	:	**30L**		**SEE Durations**	:	

UNIT - I	**08 Hrs**

Introduction-Perspectives
Business Domains: Programming.
Applications: Design games,GUI,DBMS, Embedded Systems, Compilers and Operating Systems.
Introduction to Computer Concepts:Introduction to Computer Hardware, Software and its Types. Introduction to C programming: Programming paradigms, Basic structure of C program, Process of compiling and running a C program, Features of C language, Character set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Pre-processor directives. Handling Input and Output operations and operators: Formatted input/output functions, Unformatted input/output functions with programming examples using all functionsirst order linear recurrence relation- Formulation problems and examples, Second order linear homogeneous recurrence relations with constant coefficients

UNIT - II	**10Hrs**

Operators: Introduction to operator set, Arithmetic operators, Relational operators, Logical Operators, Assignment operators, Increment and Decrement operators, Conditional operators, Bit-wise operators, Special operators. Expressions: Arithmetic expressions, evaluation of expressions, Precedence of arithmetic operators, Type conversion in expressions, Operator precedence and associativity.
Decision Making and Branching: Decision making with 'if' statement, Simple 'if' statement, the 'if…else' statement, nesting of 'if…else' statements, The 'else if' ladder, The 'switch' statement, The '?:' operator, The 'goto' statement.

UNIT - III	**12 Hrs**

Programming Constructs: Decision making and looping: The 'for','while','do-while' statements with examples, Jumps in loops. Arrays: Introduction to Arrays, Types of arrays, Declaration arrays, Initializing dimensional arrays (One Dimensional and Multidimensional Array) with examples.
String Operations: Introduction, Declaration and Initializing String Variables using arrays, String operations and functions with examples.
Functions: Need for Functions, Types of functions (User Defined and Built –In), working with functions, Definition, declaration and its scope.
Pointers: Introduction, Benefits of using pointers, Declaration and Initialization of pointers, Obtaining a value of a variable

Practice Programs	**09Hrs**

Implement the following programs using cc/gcc compiler
1. Develop a C program to compute the roots of the equation ax2 + bx + c = 0.
2. Develop a C program that reads N integer numbers and arrange them in ascending or descending order using selection sort and bubble sort technique.
3. Develop a C program for Matrix multiplication.
4. Develop a C program to search an element using Binary search and linear search techniques.
5. Using functions develop a C program to perform the following tasks by parameter passing to read a string from the user and print appropriate message for palindrome or not palindrome.
6. Develop a C program to compute average marks of 'n' students (Name, Roll_No, Test Marks) and search a particular record based on 'Roll_No'.
7. Develop a C program using pointers to function to find given two strings are equal or not.
8. Develop a C program using recursion, to determine GCD , LCM of two numbers and to perform binary to decimal conversion.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply logical skills to solve the engineering problems using C programming constructs..
CO2	:	Evaluate the appropriate method/data structure required in C programming to develop solutions by investigating the problem
CO3	:	Design a sustainable solution using C programming with societal and environmental concern by engaging in lifelong learning for emerging technology
CO4	:	Demonstrate programming skills to solve inter-disciplinary problems using modern tools effectively by exhibiting team work through oral presentation and written reports.

Reference Books:

1. Programming in C, P. Dey, M. Ghosh, 2011, 2nd Edition, Oxford University press, ISBN (13): 9780198065289.

2. Algorithmic Problem Solving, Roland Backhouse, 2011, Wiley, ISBN: 978-0-470-68453-5

3. The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2015, 2nd Edition, Prentice Hall, ISBN (13): 9780131103627.

4.Turbo C: The Complete Reference, H. Schildt, 2000, 4th Edition, Mcgraw Hill Education, ISBN-13: 9780070411838

5.Rasberry pi: https://www.raspberrypi.org/documentation/

6.Nvidia: https://www.nvidia.com/en-us/

7. Ardunio: https://www.arduino.cc/en/Tutorial/BuiltInExamples
8.Scratch software: https://scratch.mit.edu/

Course Code	**:**	**21AI39**	**DESIGN THINKING LAB**		**CIE Marks**	**:**	**50**
Credits L-T-P	**:**	**0:00:02**	***(Practice)***		**SEE Marks**	**:**	**50**
Hours	**:**	**26L**			**SEE Durations**	**:**	**03 Hrs**

Guidelines for Design Thinking Lab:
The Design Thinking Lab (DTL) is to be carried out by a team of two-three students.
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a theme that will provide s

Guidelines for Design Thinking Lab:
The Design Thinking Lab (DTL) is to be carried out by a team of two-three students.
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a theme that will provide solutions to the challenges of societal concern. Normally three to four themes would be identified by the by the department
4. Each group should follow the stages of Empathy, Design, Ideate, prototype and Test for completion of DTL.
5. After every stage of DTL, the committee constituted by the department along with the coordinators would evaluate for CIE. The committee shall consist of respective coordinator & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The team should prepare a Digital Poster and a report should be submitted after incorporation of any modifications suggested by the evaluation committee.

Design Thinking Lab Tasks

Carry out the detailed questionnaire to arrive at the problem of the selected theme.
The empathy report shall be prepared based on the response of the stake holders.
2. For the problem identified, the team needs to give solution through thinking out of the box innovatively to complete the ideation stage of DTL
3. Once the idea of the solution is ready, detailed design has to be formulated in the Design stage considering the practical feasibility.
4. If the Design of the problem is approved, the team should implement the design and come out with prototype of the system.
5. Conduct thorough testing of all the modules in the prototype developed and carry out integrated testing.
6. Demonstrate the functioning of the prototype along with presentations of the same.
7. Prepare a Digital poster indicating all the stages of DTL separately. A Detailed project report also should be submitted covering the difficulties and challenges faced in each stage of DTL.
8. Methods of testing and validation should be clearly defined both in the Digital poster as well as the report.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Interpreting and implementing the empathy, ideate and design should be implemented by applying the concepts learnt.
CO2	:	The course will facilitate effective participation by the student in team work and development of communication and presentation skills essential for being part of any of the domains in his / her future career.
CO3	:	Appling project life cycle effectively to develop an efficient prototype.
CO4	:	Produce students who would be equipped to pursue higher studies in a specialized area or carry out research work in an industrial environment.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	SEE
WEIGHTAGE	50%	50%
PRACTICALS	50	50
TOTAL MARKS FOR THE COURSE	50	50

Phase	Activity	Weightage
I	Empathy, Ideate evaluation	10M
II	Design evaluation	15M
III	Prototype evaluation, Digital Poster presentation and report submission	25M
	Total	**50M**

Scheme of Evaluation for SEE Marks:

Sl. No.	Evaluation Component	Marks
1.	Written presentation of synopsis: Write up	5M
2.	Presentation/Demonstration of the project	15M
3.	Demonstration of the project	20M
4.	Viva	05M
5.	Report	05M
	Total	**50M**

Course Code	:	**21AII310**	**SUMMER INTERNSHIP-I**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:02**	***(Practice)***	**SEE Marks**	:	**50**
Hours	:	**3 Weeks**		**SEE Durations**	:	**1Hrs**

1. A minimum of 1 credit of internship after I year may be counted towards B.E. degree program.
2. During II semester to III semester transition, Three weeks of internship is mandatory.
3. Internship report and certificate need to be submitted at the end of the internship to the concerned department for the evaluation.
4. Internship evaluation will be done during III semester for 1 credit in two phases.

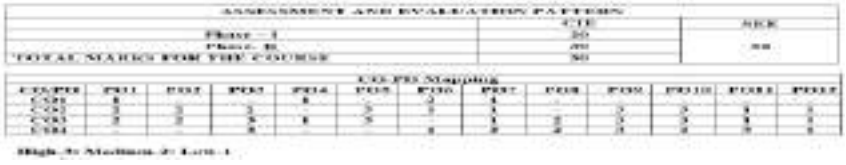
Students can opt the internship with the below options	**3 Weeks**

A. **Within the respective department at RVCE (Inhouse)**
Departments may offer internship opportunities to the students through the available tools so that the students come out with the solutions to the relevant societal problems that could be completed within THREE WEEKS.
B. **At RVCE Center of Excellence/Competence**
RVCE hosts around 16 CENTER OP EIXCELLENCE in various domains and around 05 CENTER OP COMPETENCE. The details of these could be obtained by visiting the website https:/ /rvce.edu.in / rvce-center-excellence. Each center would be providing the students relevant training/internship that could be completed in three weeks.
C. **At Intern Shala**
Intern Shala is India's no.1 internship and training platform with 40000+ paid internships in Engineering. Students can opt any internship for the duration of three weeks by enrolling on to the platform through https: / /internsha1a.com
D. **At Engineering Colleges nearby their hometown**
Students who are residing out of Bangalore, should take permission from the nearing Engineering College of their hometown to do the internship. The nearby college should agree to give the certificate and the letter/email stating the name of the student along with the title of the internship held with the duration of the internship in their official letter head.
E**. At Industry or Research Organizations**
Students can opt for interning at the industry or research organizations like BEL, DRDO, ISRO, BHEL, etc.. through personal contacts. However, the institute/industry should provide the letter of acceptance through hard copy/email with clear mention of the title of the work assigned along with the duration and the name of the student.

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

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Develop communication, 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 societal problems with affinity towards the environment and involve in professional ethical practice.
CO4	:	Compile, document and communicate effectively on the internship activities with the engineering community.



Course Code	**:**	**21AI41**	**Statistics for Data Science**	**CIE Marks**	**:**	**100**
Credits L-T-P	**:**	**2:01:00**	***(Theory)***	**SEE Marks**	**:**	**100**
Hours	**:**	**30L+30T**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**06 Hrs**
Exploratory Data Analysis: Elements of structured Data, Rectangular Data, Data frames and Indexes, Nonrectangular Data Structures, Estimates of location (mean, weighted mean, median, percentile, weighted median, trimmed mean, robust, outlier), Estimates of variability (deviations, variance, standard deviation, range, order statistics, etc.), Estimates based on Percentiles	
UNIT - II	**06 Hrs**
Exploring the data distribution: Percentiles and Boxplots, Frequency tables and histograms, density plots and estimates Exploring Binary and Categorical Data: Mode, expected value, probability, Correlation, Scatterplots Exploring Two or More variables: Hexagonal Binning and Contours, Two Categorical Variables, Categorical and Numeric Data, Visualizing Multiple Variables	
UNIT - III	**06 Hrs**
Data Sampling: Random sampling and Sample Bias, Bias, Random selection, Size versus Quality, Simple mean versus population mean, Selection Bias, Regression to the mean Sampling Distribution of a Statistic: Central Limit Theorem, Standard Error, Bootstrap, Confidence intervals	
UNIT - IV	**06Hrs**
Distributions: Normal Distribution, Long-tailed distribution, Student's t-Distribution, Binomial Distribution, Chi-Square Distribution, F-Distribution, Poisson Distribution, Exponential Distribution, Estimating the Failure Rate, Weibull Distribution.	
UNIT - V	**06 Hrs**
Statistical Experiments and Significance Testing: A/B testing, Hypothesis Tests, Null Hypothesis, Alternative Hypothesis, One-way versus Two-way hypothesis tests, Resampling, Permutation test, p-Values, t-Tests	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the knowledge of statistics in providing solutions to some common business problems.
CO2	:	Perform statistical inferencing on some real-world scientific/business use cases and present the analysis results.
CO3	:	Investigate the need for distributions, statistical experiments, and significance testing in solving some problems of industry and society.
CO4	:	Use statistical tools to illustrate the principles of data distribution, data sampling, and data visualization.
CO5		Appraise the knowledge of statistics in data science to build a successful career as an AIML engineer, work in teams, and communicate their ideas effectively.

Reference Books:

1. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce and Peter Gedeck, O'Reilly Publications, Second Edition, 2020.

2Think Like a Data Scientist, Brian Godsey, 2017

3. The R Book, Michael J. Crawley, Second Edition, John Wiley Publications, 2013.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
Identify and explore the role of statistics in business case studies and prepare a report.	**10**	
Apply statistical inferencing on the data collected and demonstrate various statistical concepts using statistical tools like R, SPSS, MATLAB, etc.	**20**	
Video-based seminar (4-5 minutes per Student) – the topic will be allotted by the faculty	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**

Course Code	:	**21BT42**	**BIOINSPIRED ENGINEERING**		**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(Theory)*** ***(Common to AI, BT, CS & IS)***		**SEE Marks**	:	**50**
Hours	:	**28L**			**SEE Durations**	:	**2 Hours**

UNIT - I	**09 Hrs**
Introduction to Bio-inspired Engineering Stem cells; types and applications. Synthetic Biology. Synthetic/ artificial life. Biological Clock, Biological and synthetic materials, Biopolymers; Bio-steel, Bio-composites, multi-functional biological materials. Inimitable Properties of biomaterials. Antireflection and photo-thermal, Microfluidics in biology.	
UNIT - II	**10 Hrs**
Lesson from Nature-Bioinspired Materials and mechanism Firefly-Bioluminescence, Cockleburs –Velcro, Lotus leaf - Self-cleaning materials, Gecko - Gecko tape, Whale fins - Turbine blades, Box Fish / Bone - Bionic car, Shark skin - Friction reducing swim suits, Kingfisher beak - Bullet train, Coral - Calera cement, Forest floor / Ecosystem functioning - Flooring tiles, Morpho butterfly- Photonics and Iridescence, Namib beetle- Water collecting, Termite/ ant hill-passive cooling, Birds/Insects- flights/ aerodynamics, Mosquito inspired micro needle	
UNIT - III	**09 Hrs**
Biomedical Inspiration-Concept and applications **Organ system- Circulatory- artificial blood, artificial heart, pacemaker. Respiratory- artificial lungs. Excretory- Artificial kidney. Artificial Support and replacement of human organs: Artificial Skin, artificial liver and pancreas. Total joint replacements- artificial limbs. Visual prosthesis -bionic eye.**	
Course Outcomes: **After going through this course the student will be able to:**	
CO1 :	Elucidate the concepts and phenomenon of natural processes.
CO2 :	Apply the basic principles for design and development of bioinspired structures.
CO3 :	Analyse and append the concept of bio-mimetics for diverse applications.
CO4 :	Designing technical solutions by utilization of bio-inspiration modules.

Reference Books:

1Yoseph Bar-Cohen. Biomimetics: Biologically Inspired Technologies D. Floreano and C. Mattiussi, Bio-Inspired Artificial Intelligence, CRC Press, 2018. ISBN: 1420037714, 9781420037715.

2. Guang Yang, Lin Xiao, and Lallepak Lamboni. Bioinspired Materials Science and Engineering. John Wiley, 2018. ISBN: 978-1-119-390336.

3.M.A. Meyers and P.Y. Chen. Biological Materials, Bioinspired Materials, and Biomaterials Cambridge University Press, 2014 ISBN 978-1-107-01045.

4.Tao Deng. Bioinspired Engineering of Thermal Materials. Wiley-VCH Press, 2018. ISBN: 978-3-527-33834-4.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZES		
Quiz-I	Each quiz is evaluated for 10 marks and the total marks obtained from two quizzes will be reduced to **10 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		*****
Test – I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to **30 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING (Maximum of 40 Marks)		*****
Photosynthesis and Photovoltaic cells. Bionic/Artificial leaf. 3D-Bioprinting. Biosensors: e-tongue and e-nose. Echolocation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bees and Honeycomb Structure. Artificial Intelligence-Travelling Salesman Problem (TSP), Artificial Neural Networking and bio-robotics.	**05**	*****
Video based seminar (4-5 minutes per student)	**05**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**50**	**50**

Course Code	:	**21CS43**	**DESIGN AND ANALYSIS OF ALGORITHMS (Theory and Practice)**	**CIE Marks**	:	**150**
Credits L-T-P	:	**3:00:01**	***(Common to AI, CS & IS)***	**SEE Marks**	:	**150**
Hours	:	**45L+30P**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**08 Hrs**
Introduction- Perspectives **Business domain: Banking, Finance services, IT, Manufacturing, e-Commerce, Online services and marketing, Logistics and Supply Chain Management, Telecommunication.** **Applications: Communication & Networking, Search engines, Machine learning, Database management, Software tools development, Data organization, GPS navigation systems** **Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms.** **Brute Force: Selection Sort and Bubble Sort.**	
UNIT - II	**10Hrs**
Divide and Conquer: Merge sort, Quicksort, Multiplication of Long Integers, Strassen's Matrix Multiplication. **Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Application of DFS and BFS**	
UNIT - III	**10 Hrs**
Transform and Conquer:Presorting, Heapsort, Problem reduction. **Space and Time Tradeoffs: Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.**	
UNIT - IV	**10 Hrs**
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, Knapsack Problem and Memory Functions. **Greedy Technique: Prim's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes.**	
UNIT - V	**07 Hrs**
Backtracking: N-Queen's Problem, Sum of Subset Problem. **Branch-and-Bound: Travelling Salesperson Problem, Assignment Problem** **Decision Trees: Decision Trees for Sorting** **NP and NP-Complete Problems: Basic Concepts, Non- Deterministic Algorithms, P, NP, NP Complete, and NP-Hard classes**	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply knowledge of computing and mathematics to algorithm analysis and design
CO2	:	Analyze a problem and identify the computing requirements appropriate for a solution
CO3	:	Apply algorithmic principles and computer science theory to the modeling for evaluation of computer-based solutions in a way that demonstrates comprehension of the trade-offs involved in design choices.
CO4	:	Investigate and use optimal design techniques, development principles, skills and tools in the construction of software solutions of varying complexity.
CO5	:	Demonstrate critical, innovative thinking, and display competence in solving engineering problems.
CO6	:	Exhibit effective communication and engage in continuing professional development through experiential learning

Reference Books:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, University, 3rd Edition, 2012, Pearson, ISBN 13: 978-0-13-231681-1.

2. Introduction to Algorithms, Cormen T.H., Leiserson C.E., Rivest R.L., Stein C., 3rd Edition, 2010, PHI, ISBN:9780262033848.

3. Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S., 2nd Edition, 2006, Galgotia Publications, ISBN:9780716783169.

EXPERIENTIAL LEARNING

The students in a team of two, must solve, implement and analyze for time and space efficiency, any one engineering problem from the identified business domain and application. The team has to submit a detailed report on the work done.

Lab Component		
Expt.No		**Experiments**
PART A		
Practice Programs		
1. Implementation and execution of simple programs to understand running time analysis of non-recursive algorithms **(a)Finding maximum element in a given array.** **(b)Linear search, (c)Bubble sort,** **(d)Determine whether all the elements in a given array are distinct.** **(e) Given 2 nXn matrices, perform matrix multiplication using bruteforce approach.**		
II.Implementation and execution of simple programs to understand running time analysis of recursive algorithms **(a)Find the Factorial of a given number.** **(b)Print Fibonacci series** **(c)Given a positive decimal integer n, find the number of binary digits in n's binary representation.** **(d)To solve tower of Hanoi problem.** **(e)Recursive linear search** **Lab Programs: (At-least one application from each of the following group)** **1. Apply divide and conquer strategy to solve the sorting problem** **(a)Merge sort** **(b)Quicksort** **2. Apply decrease and conquer strategy to solve the graph problem** **(a)Breadth first search** **(b)Topological sorting using depth first search** **3. Apply transform and conquer strategy to solve the problem** **(a)Heapsort** **(b)Checking element uniqueness after pre sorting** **4. Apply input enhancement strategy to solve the string-matching problem** **(a)Horspool's algorithm** **(b)Boyer – Moore's algorithm** **5. Apply dynamic programming strategy to solve the problem** **(a)Warshall - Floyd's Algorithms, (b)Knapsack problem solution using memory function.** **6. Apply greedy strategy to solve the minimum spanning tree problem** **(a)Dijkstra's algorithm** **(b)Prim's algorithm** **7. Apply backtracking strategy to solve the combinatorial problem** **(a)N- Queen's problem** **(b)Subset – sum problem** **8. Apply branch and bound strategy to solve the combinatorial problem** **(a)Travelling salesperson problem** **(b)Assignment problem**		
PART B		
Students have to solve a given problem using different design technique. The analysis with the comparison of the implemented algorithm has to be demonstrated. The problem types will be one among the following: (Any other problem can be included) : Sorting, Searching, String matching, Graph problem, Combinatorial / Optimization problem.		

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		

Test – I Test – II	Each test will be conducted for 50 Marks adding upto 100 marks. Final test marks will be reduced to **40 MARKS**	
EXPERIENTIAL LEARNING	**40**	
Case Study-based Teaching-Learning	**10**	
Coding challenge	**20**	
Video based seminar (4-5 minutes per student)	**10**	
MAXIMUM MARKS FOR THE THRORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50**	**50**
TOTAL MARKS FOR THE COURSE	**150**	**150**

Course Code	**:**	**21AI44**	**DATA BASE MANAGEMENT SYSTEM (Theory and Practice)**	**CIE Marks**	**:**	**150**
Credits L-T-P	**:**	**3:00:01**		**SEE Marks**	**:**	**150**
Hours	**:**	**45L+30P**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**09 Hrs**
Applications: E-commerce applications and all applications related to Computer Science domain **Introduction to Databases, Database Languages Introduction, An example information, Characteristics of database approach, Actors on the scene, Workers behind the scene, Advantages of using the DBMS approach, When not to use DBMS, Data models, Schema and instances, Three schema architecture and Data Independence,Database Languages and Interfaces**	
UNIT - II	**09Hrs**
Conceptual Data Modelling -A Sample Database Application, Entity Types, Entity Sets, Attributes and keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design for the Company Database, ER Diagrams, Naming ,Conventions and Design Issues **Relations Model- Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Relational Database Design Using ER-to-Relational Mapping**	
UNIT - III	**09 Hrs**
Structured Query Language **Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL,** **INSERT, DELETE, and UPDATE Statements in SQL, Additional Features of SQL, More Complex SQL Retrieval Queries, Views (Virtual Tables) in SQL, Schema Change Statements in SQL, Discretionary Access Control Based on Granting and Revoking Privileges, Transaction Support in SQL (Commit, Rollback, Save point)**	
UNIT - IV	**09 Hrs**
An Overview of NoSQL - Characteristics of NoSQL, NoSQL Storage types - Column oriented databases, Document Store, Key Value store, Graph Store, CAP Theorem. **Interfacing and interacting with MongoDB -Storing data in and accessing data from MongoDB, Querying**	
UNIT - V	**07 Hrs**
Understanding the Storage Architecture - Working with column-oriented databases- Using tables and columns in relational databases, contrasting column databases with RDBMS, Column databases as nested maps of key-value pair, Laying out the Web table Interfacing and Interacting with Apache Cassandra - Storing data in and accessing data from Apache Cassandra, Querying	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand and Apply Database Management Systems concepts to solve the given problem
CO2	:	Design solutions with societal and environmental concerns using modern tools to solve problems in Database Design domain
CO3	:	Analyse and develop Database Applications using SQL and NoSQL features by engaging in lifelong learning for emerging technology
CO4	:	Exhibit effective communication and engage in continuing professional development through experiential learning
CO5	:	Demonstrate skills like investigation, effective communication, working in team/Individual practices by implementing Database Design concepts and applications

Reference Books:

1. Fundamentals of Database Systems, Ramez Elmasri, Shamkant B. Navathe, 7th Edition, 2016,Pearson Addison Wesley, ISBN-13: 978-0-13-397077-7

2. Professional NOSQL, Shashank Tiwari, 2011, Inc.WROXPress, John Wiley & Sons, ISBN:978-0-470-94224-6

3. Getting started with NoSQl, Gaurav Vaish, 2013,PACKD Publishing, ISBN: 978-1-84969-4-988

4, MongoDB: The Definitive, Guide Kristina Chodorow and Michael Dirof, 1st Edition, 2010 O'Reilly Media, ISBN: 978-1-449-38156-1

Lab Component

PART A

1. Explore all SQL Language commands related to DDL, DML, DCL, TCL
2. Design, Create and Implement the databases for the Domains like
(a)Health Care
(b)Energy
(c)Agriculture
(d)Telecom
(e)Tourism
(f) Others
3. Create and implement CRUD operations using non-relational databases for the above mentioned domains

Note

During regular practice sessions, students will be executing any 6 defined queries for any above four domains.
During Examination (CIE and SEE) Students are required to execute minimum 6 Queries asked by the examiners.
Exercise 1 is for practice session only. Exercise 2 and Exercise 3 will be considered for CIE and SEE.

PART B

A batch of two students should develop a real time application with all the CRUD operations and validations. The students should provide the Graphical User Interface for demonstration.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING ON DATA ANALYSIS (40 marks)		
Presenting a case-study on Structured and No Sql Databases	**10**	
Student are required develop a web application in the given domain. The task would involve • Understand the complete domain knowledge of application and derive the complete data requirement specification. • Design of the application with integrated database solution (SQL, NOSQL and emerging techniques) • Normalization of the Relational design up to 3NF. • Minimum 5 tables to be considered • Documentation and submission of report.	**20**	
Video-based seminar (4-5 minutes per student) – topic allotted by the faculty	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**
PRACTICALS	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**150 MARKS**	**150 MARKS**

Course Code	:	**21CS45**	**COMPUTER NETWORKS**	**CIE Marks**	:	**100**
Credits L-T-P	:	**3:00:00**	***(Common to AI & CS)***	**SEE Marks**	:	**100**
Hours	:	**45L**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**10 Hrs**

Introduction-Perspectives
Business Domains: Networks.
Applications: Resource Sharing, Client Server programming, eCommerce and digital communications.
Introduction: Networks, Network types. Network Models: TCP / IP protocol suite, Addressing, The OSI Model. Transmission Modes: Parallel Transmission and Serial Transmission. Link Layer: Data Link Control (DLC): DLC Services, Data Link Layer Protocols, High Level Data Link Control (HDLC), Point-to-Point Protocol (PPP): Framing, Transition phases. Media Access Control (MAC): Random Access: CSMA/CD, CSMA/CA.

UNIT - II	**09 Hrs**

Network layer design issues: Store and Forward packet Switching, Services Provided to the Transport Layer Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram Subnets; Routing algorithms: Shortest Path Routing, Flooding, Distance Vector Routing, Link state Routing, Hierarchical Routing Broadcast Routing, and Multicast Routing.

UNIT - III	**08 Hrs**

Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control; Quality Of Service: Requirements, Techniques for Achieving Good Quality of Service Integrated Services Differentiated Services.

UNIT - IV	**09Hrs**

Internetworking: How networks differ, How networks can be connected Connectionless Internetworking, Tunnelling Internetwork Routing, Fragmentation
The Network Layer in the Internet: The IP Protocol, IP Addresses, Internet Control Protocols, OSPF- Interior Gateway Routing Protocol, BGP- Exterior Gateway Routing Protocol, IPv6.

UNIT - V	**09 Hrs**

The Internet Transport Protocols: Introduction to UDP, Introduction to TCP. The TCP Service Model.
The TCP Protocol: TCP protocol, TCP Segment Header, TCP Connection Establishment, TCP Connection Release. TCP Transmission Policy, TCP Congestion Control, TCP Timer Management. Application Layer: World Wide web and HTTP, Telnet.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the algorithms/techniques of routing and congestion control to solve problems related to Computer Networks
CO2	:	Analyze the services provided by various layers of TCP/IP model to build effective solutions.
CO3	:	Design sustainable networking solutions with societal and environmental concerns by engaging in lifelong learning for emerging technology.
CO4	:	Exhibit network configuration, protocol usage and performance evaluation in networks.
CO5		Demonstrate the solutions using various algorithms/protocols available to address networking issues using modern tools by exhibiting team work and effective communication.

Reference Books:

1. Data Communications and Networking, Behrouz A Forouzan, 5th Edition, 2013, Tata McGraw-Hill, ISBN – 9781259064753.

2.Computer Networks, Andrew S Tanenbaum, 5th Edition, 2014, Pearson Education; ISBN– 978-81-7758-165-2.

3. Computer Networking, A Top-Down Approach, James Kurose and Keith Ross, 6th Edition, 2013, ISBN-13: 978-0-13-285620-1.

4.Data and Computer Communications, William Stallings, 8th Edition, 2009, Pearson Education, ISBN-13: 978-0131392052

EXPERIENTIAL LEARNING
Problem statement and modern networking tools usage (Path Characterization & Bandwidth Estimation, Analysing Real-time information about the global routing system, Measure latency and packet loss reason in wired and wireless network, Online data Privacy, Host/Network Intrusion detection, Detection of potential DDoS attacks, Network analysis to monitor Ethernet and WLAN traffic in real time, IP Spoofing, TCP Off path attacks, Privacy Preserving network log data, wireless security)

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZZES		
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 MARKS.**	
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		
Test – I	Each test will be conducted for 50 Marks adding up to 100 marks. Final test marks will be reduced to **40 MARKS**	
Test – II		
EXPERIENTIAL LEARNING	**40**	
Problem statement and modern networking tools usage.	**10**	
Design and implementation of solution.	**20**	
Demonstration and report.	**10**	
MAXIMUM MARKS FOR THE THEORY	**100 MARKS**	**100 MARKS**
TOTAL MARKS FOR THE COURSE	**100**	**100**

Course Code	:	**21AI4A1**	**OBJECT ORIENTED ANALYSIS AND DESIGN**	**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(MOOC COURSE)***	**SEE Marks**	:	**50**
Hours	:	**40L**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**10 Hrs**
Challanges in Software Engineering, Complexity of Software, Structure and Attributes of a Complex System	
UNIT - II	**10 Hrs**
Object-Oriented Analysis and Design Object Model: Defining the primitives of the OO paradigm, Evolution of Object Models - Programming Languages and Paradigms Classes and Objects: Bringing in the broader perspectives	
UNIT - III	**10 Hrs**
Unified Modeling Language, Unified Modeling Language, Use-Case Diagrams, use case Diagram, Sequence Diagram, Unified Modeling Language OOAD Case Studies: Applying OOAD in different contexts	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the knowledge of object-oriented analysis and design in software engineering to build complex software systems
CO2	:	Perform analysis on the advantages of object-oriented models in some scientific and business use cases.
CO3	:	Investigate the suitability of Universal Modeling Language in building designs for real-world problems.
CO4	:	Appraise the knowledge of object-oriented analysis and design to build a successful career as an AIML engineer, work in teams, and communicate ideas effectively.

Reference Books:

1. Object Oriented Design and analysis by Prof. Partha Prathim Das IIT Kharagpur

2. Object-Oriented Analysis and Design with Applications ,Addison-Wesley Object Technology Series by Ph.D. Young, Bobbi , Grady Booch , Jim Conallen , Kelli Houston , Michael Engle , Robert Maksimchuk , John Fuller

3.Object-Oriented Analysis, Design and Implementation An Integrated Approach Authors: Brahma Dathan , Sarnath Ramnath ISBN: 978-3-319-24280-4

4. Head First Object-Oriented Analysis and Design by Brett McLaughlin, Gary Pollice, David West Released November 2006 Publisher(s): O'Reilly Media, Inc.ISBN: 9780596008673

Course Code	:	**21AI4A2**	**THEORY OF COMPUTATION**	**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(MOOC COURSE)***	**SEE Marks**	:	**50**
Hours	:	**40L**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**10 Hrs**

Introduction to the course, DFA
Introduction to the course, DFAs, Regular Languages, NFAs, Equivalence of DFAs and NFAs.
Closure properties, regular expressions, Pumping Lemma for regular languages
Myhill-Nerode Theorem, DFA Minimization Context free grammar, Chomsky Normal Form, CYK Algorithm

UNIT - II	**10 Hrs**

Closure properties of CFL, Pushdown Automata, Equivalence Pumping Lemma for CFLs. Turing Machines, Decidable (recursive) languages, Turing-Recognizable (recursively enumerable) languages. (i) Equivalence of NTM and DTM, Church Turing thesis, Algorithms, Decidable languages from regular and context-free languages
(ii) Halting Problem and undecidability. Reductions and other undecidable languages. Post Correspondence Problem (PCP) is undecidable, Rice's theorem

UNIT - III	**10 Hrs**

Introduction to Complexity Theory-Asymptotic notation, Classes P and NP, Verifier model for NP.NP Completeness, Polynomial Time reductions, Cook-Levin Theorem,NP Complete problems like Vertex Cover, Hamiltonian Path, Subset Sum, ILP Space Complexity, Relation with time bounded complexity classes, introduction to classes like L, NL, PSPACE and overview of results in space complexity

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the fundamentals concepts of theory of computation to solve the engineering problems
CO2	:	Analyze the tools of finite automata to various fields of computer science.
CO3	:	Design solution model using modern tools for complex problems, using the appropriate skills of automata theory for better results.
CO4	:	Demonstrate skills like effective communicaion, working in team/individual effectively and efficiently by implementing theory of computation concepts and applications.

Reference Books:

1. Introduction to the Theory of Computation by Michael Sipser
2. Introduction to Automata Theory, Languages and Computation by John E. Hopcroft and Jeffrey D. Ullman
3.Introduction to the Theory of Computation ,3rd edition Publisher Cengage India Private Limited,ISBN-13 978-8131525296
4. Linear Algebra and its Applications, David C Lay, 4th Edition, 2012, Pearson Education India, ISBN-13: 970321385178, ISBN-10: 0321385171

Course Code	**:**	**21AI4A3**	**EMBEDDED SYSTEM DESING WITH ARM**	**CIE Marks**	**:**	**50**
Credits L-T-P	**:**	**2:00:00**	***(MOOC COURSE)***	**SEE Marks**	**:**	**50**
Hours	**:**	**40L**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**10 Hrs**
Introduction to Embedded Systems and Microcontrollers, Instruction Set Architecture of ARM microcontrollers, and Assembly Language Programming **D/A and A/D converter, Sensors, Actuators, and their Interfacing**	
UNIT - II	**10 Hrs**
Microcontroller Development Boards and Embedded Programming platforms **Hands-on and Demonstration onTemperature sensing unit, Light sensing unit, the Sound sensing unit** **Hands-on and Demonstration on Feedback control system, Relay control unit, Driving electrical appliances like motors, bulbs, pumps, etc.**	
UNIT - III	**10 Hrs**
Hands-on and Demonstration on Object tracking using GPS and GSM **Hands-on and Demonstration on Introduction to Internet of Things, Smart home concepts, Motion sensing using accelerometer, control of appliances over SMS**	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the knowledge of Embedded Systems and ARM Controllers to address the complex engineering problems
CO2	:	Analyze the various components of Embedded Systems used in solving the real-world problem
CO3	:	Design embedded solutions for complex engineering problems
CO4	:	Communicate efficiently and collaborate in groups to carry out Embedded System tasks
CO5		Demonstrate Embedded System design skills to solve interdisciplinary problems using modern tools effectively by exhibiting teamwork through an oral presentation and written reports.

Reference Books:

1. F. Vahid and T. Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India Pvt. Ltd., 2002

2. A.N. Sloss, D. Symes, and C. Wright, “ARM System Developer’s Guide: Design and Optimizing System Software”, Morgan Kaufman Publishers, 2004

Course Code	:	**21AI4A4**	**MODERN ALGEBRA**	**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(MOOC COURSE)***	**SEE Marks**	:	**50**
Hours	:	**40L**		**SEE Durations**	:	**03 Hrs**

UNIT - I	**10 Hrs**
Introduction to abstraction, Introduction to Groups Subgroups and homomorphism, Isomorphis, Quotienting, Structure Theorem Properties of Finite Groups,Applications of Groups, Introduction to Rings,Properties of Finite Rings, Failure of Unique Factorization	
UNIT - II	**10 Hrs**
Introduction to Ideals Properties of Ideals, Birth of Ideals, Ideal Arithmetic, Special Ideals, Dedekind Domains, Quotient Rings, Applications of Ideals and Rings	
UNIT - III	**10 Hrs**
Introduction to Fields, Applications of Finite Fields, Cauchy sequences and real numbers, Properties of Fields, Finite Fields	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Effectively write abstract mathematical proofs in a clear and logical manner.
CO2	:	Locate and use theorems to solve problems in number theory and theory of polynomials over a field.
CO3	:	Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines.
CO4	:	Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system.

Reference Books:

1. Abstract Algebra: Theory and Applications by Thomas W. Judson

2. Abstract Algebra by I. N. Herstein

3Modern Algebra Hardcover ,A.K. Vasishtha & A.R. Vasishtha

3. Modern Algebra,Qazi Zameeruddin & Surjeet Singh ISBN : 9789352718849,Vikas Publishing

Course Code	**:**	**21AI4A5**	**COMPUTER GRAPHICS**	**CIE Marks**	**:**	**50**
Credits L-T-P	**:**	**2:00:00**	***(MOOC COURSE)***	**SEE Marks**	**:**	**50**
Hours	**:**	**40L**		**SEE Durations**	**:**	**03 Hrs**

UNIT - I	**10 Hrs**

Introduction to Computer Graphics
CRT display devices, Transformation, Three Dimensional (3D) graphics, Projection Transformations And Viewing Pipeline 3d Viewing - Projection Transformations And Viewing Pipeline Scan Converting Lines, Circles And Ellipses Clipping - Lines And Polygons Clipping Lines

UNIT - II	**10 Hrs**

Solid modelling and Illumination, Illumination and shading, curve representation, curve and surface representation , graphics programming using Open GL

UNIT - III	**10 Hrs**

Image Enhancement- Advanced Topics: Anti Aliasing,Color,Soft Objects,Animation,Visual Effects,System Architectur
Digital Image Processing Image Compression-Jpeg-Enhancements, Digital Image Processing What is an Image? Digital image file formats, Image compression standard – JPEG, Image Processing - Digital image enhancement, contrast stretching, Histogram Equalization, smoothing and median Filtering

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Apply the knowledge of basic graphics operations in providing solutions to applications involving graphics interventions
CO2	:	Perform analysis on some scientific and business use cases where the graphics play a pivotal role.
CO3	:	Investigate the suitability of digital image processing techniques in solving real-world problems.
CO4	:	Appraise the knowledge of computer graphics to build a successful career as an AIML engineer, work in teams, and communicate ideas effectively

Reference Books:

1. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics - Principles and Practice, Second Edition in C, Pearson Education, 2003.
2. D. Hearn and M. Pauline Baker, Computer Graphics (C Version), Pearson Education, 2nd Edition, 2004
3. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, 2nd Edition, McGraw-Hill International Edition, 1990
4. F. S. Hill Jr., Computer Graphics using OpenGL, Pearson Education, 2003.

Course Code	**:**	**21HSAE39A/ 21HSAE46A**	**National Service Scheme**	**CIE Marks**	**:**	**50**
Credits L-T-P	**:**	**0:00:01**	***(Practical)***	**SEE Marks**	**:**	**50**
Hours	**:**	**13P**		**SEE Durations**	**:**	**2 Hours**

Prerequisites:

1. Students should have service-oriented mindset and social concern.
2. Students should have dedication to work at any remote place, any time with available resources and proper time management for the other works.
3. Students should be ready to sacrifice some of the timely will and wishes to achieve service-oriented targets on time.

Content	**13 Hrs**

Students must take up any one activity on below mentioned topics and has to prepare contents for awareness and technical contents for implementation of the projects and has to present strategies for implementation of the same. Compulsorily must attend one camp.

CIE will be evaluated based on their presentation, approach, and implementation strategies. (Any one of the below mentioned activity)

1. Helping local schools to achieve good result and enhance their enrolment in Higher/technical/ vocational education.
2. Preparing an actionable business proposal for enhancing the village/ farmer income and approach for implementation.
3. Developing Sustainable Water management system for rural/ urban areas and implementation approaches.
4. Setting of the information imparting club for women leading to contribution in social and economic issues.
5. Spreading public awareness/ government schemes under rural outreach program. (Minimum 5 programs)
6. Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swachh Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc..
7. Social connect and responsibilities
8. Plantation and adoption of plants. Know your plants
9. Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing
10. Waste management – Public, Private and Govt organization, 5 R's
11. Water conservation techniques – Role of different stakeholders - Implementation
12. Govt. School Rejuvenation and assistance to achieve good infrastructure.
13. Organize National integration and social harmony events/ workshops / seminars. (Minimum 2 programs)

AND ONE NSS-CAMP

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand the importance of his/her responsibilities towards society.
CO2	:	Analyze the environmental and societal problems/ issues and will be able to design solutions for the same.
CO3	:	Evaluate the existing system and to propose practical solutions for the same for sustainable development.
CO4	:	Implement government or self-driven projects effectively in the field.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour withsurveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementationmethodologies.	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementation strategies of the project with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Course Code	:	**21HSAE39B/ 21HSAE46B**	**National Cadet Corps**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**15P**		**SEE Durations**	:	**2 Hours**

Unit 1	**7 Hrs**
Drill (Contact Hrs. 12). Foot Drill- Drill ki Aam Hidayaten, Word ki Command, Savdhan, Vishram, Aram Se, Murdna, Kadvar Sizing, Teen Line Banana, Khuli Line, Nikat Line, Khade Khade Salute Karna	
Unit 2	**3 Hrs**
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts	
Unit 3	**3 Hrs**
Adventure activities: Trekking and obstacle course	
Unit 4	**2 Hrs**
Social Service and Community Development (SSCD): Students will participate in various activities throughout the semester e.g., Blood donation Camp, Swachhata Abhiyan, Constitution Day, All National Festival	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand that drill as the foundation for discipline and to command a group for common goal.
CO2	:	Understand the importance of a weapon its detailed safety precautions necessary for prevention of accidents and identifying the parts of weapon.
CO3	:	Understand that trekking will connect human with nature and cross the obstacles to experience army way of life.
CO4	:	Understand the various social issues and their impact on social life, Develop the sense of self-less social service for better social & community life.

Reference Books:

1.NCC Cadet Hand Book by R K Gupta, Ramesh Publishing House, New Delhi, Book code:R- 1991, ISBN: 978-93-87918-57-3, HSN Code: 49011010

2. nccindia.ac.in

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	SEE
Drill Skill Test	20	*****
Weapon Training	10	*****
Adventure activities	10	Report on adventure and social service activities
Social service activities	10	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3	2	1	1			2
CO2	2	3	3	2		1	2		3	2	1	2
CO3			2	2		2	1	2	2	1	2	2
CO4	2		2			2	2	1	3	3	2	2

High-3: Medium-2: Low-1

Course Code	:	**21HSAE39C/ 21HSAE46C**	**PHYSICAL EDUCATION (SPORTS & ATHLETICS)**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**30P**		**SEE Durations**	:	**2:30 Hours**
Content						**30 Hrs**

Introduction of Physical Education and Sports			
General & Specific warm up exercises Conditioning exercises Any 2 Major Games Intramural Competitions			
Choose any one according to serial no			
1. Kho-Kho	Giving Kho, Single chain, Pole dive, Pole turning, 3-6 Up	**6. Kabaddi**	Hand touch, Chain hold, Ankle hold, Thigh hold, Getting bonus
2. Throwball	Service, Receive, Spin pass, Simple pass, Jump throw	**7. Volleyball**	Attack, Block, Service, Upper hand pass, Lower hand pass
3. Netball	Step with ball, Shooting, Passing, Blocking	**8. Handball**	Step with ball, Shooting, Passing,Blocking, Dribbling
4. Softball	Catching, Pitching, Slugging, Base Running, Stealing	**9. Football**	Dribbling, Chest Drop, Ball Control, Thigh Drop, Shooting
5. Ball badminton	Service, Fore hand receive, Back hand receive, Spin smash, Rally	**10. Table Tennis**	Service, Fore hand receive, Back hand receive, Smash, Rally

Topics for Viva:
1. On rules and regulations pertaining to the games / sports

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the basic principles and practices of Physical Education and Sports
CO2	:	Instruct the Physical Activities and Sports practices for Healthy Living
CO3	:	To develop professionalism among students to conduct, organize & Officiate Physical Education and Sports events at schools and community level

Reference Books:

1. Muller, J. P. (2000). Health, Exercise and Fitness. Delhi: Sports.
2.Vanaik.A (2005) Play Field Manual, Friends Publication New Delhi
3.IAAF Manual
4. M.J Vishwanath, (2002) Track and Field Marking and Athletics Officiating Manual, Silver Star Publication, Shimoga
5.Steve Oldenburg (2015) Complete Conditioning for Volleyball, Human Kinestics.

Note: Skills of Sports and Games (Game Specific books) may be referred

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour withsurveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementationmethodologies.	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementation strategies of the project with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Course Code	:	**21HSAE39D1 / 21HSAE46D1**	**MUSIC**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**13P**		**SEE Durations**	:	**2 Hours**

Prerequisites:

1. Students should know basics of music.

2. Students should have dedication to learn and improve on their musical skills.

3. Students should have participated in musical events and have basic knowledge on how to present their music.

Content	**13 Hrs**

1. Introduction to different genres of music
2. Evolution of genres in India: Inspiration from the world
3. Ragas, time and their moods in Indian Classical Music
4. Identification of ragas and application into contemporary songs
5. Adding your touch to a composition
6. Maths and Music: A demonstration
7. Harmonies in music
8. Chords: Basics and application into any song
9. Music Production-I
10. Music Production-II

Students have to form groups of 2-4 and present a musical performance/ a musical task which shall be given by the experts. The experts shall judge the groups and award marks for the same.

CIE will be evaluated based on their presentation, approach and implementation strategies. Students need to submit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand basics of Music and improve their skills.
CO2	:	Appreciate the impacts on health and well being.
CO3	:	Perform and present music in a presentable manner.
CO4	:	Develop skills like team building and collaboration.

Reference Books:

1.Music Cognition: The Basics by Henkjan Honing

2. Basic Rudiments Answer Book - Ultimate Music Theory: Basic Music Theory Answer Book by Glory St Germain

3. Elements Of Hindustani Classical Music by Shruti Jauhari

4. Music in North India: Experiencing Music, Expressing Culture (Global Music Series) by George E. Ruckert

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50 %**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1)	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2)	**10**	*****
Case Study based Teaching-Learning	**10**	Implementation strategies of the project with report
Sector wise study & conclidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	3	2	1	1	-	-	2
CO2	2	3	3	2	-	1	2	-	3	2	1	2
CO3	-	-	2	2	-	2	1	2	2	1	2	2
CO4	2	-	2	-	-	2	2	1	3	3	2	2

High-3; Medium-2; Low-1

RV Educational Institutions
RV College of Engineering

Course Code	:	**21HSAE39D2 / 21HSAE46D2**	**DANCE**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**13P**		**SEE Durations**	:	**2 Hours**

Prerequisites:

1. Students should have the will and interest to learn dancing.
2. Students should have a positive mindset.
3. Students should be willing to interact and cooperate in group activities.

Content	**13 Hrs**

1. Introduction to Dance
2. Preparing the body for dancing by learning different ways to warm up.
3. Basics of different dance forms i.e. classical, eastern, and western.
4. Assessing the interest of students and dividing them into different styles based on interaction.
5. Advancing more into the styles of interest.
6. Understanding of music i.e. beats, rhythm, and other components.
7. Expert sessions in the respective dance forms.
8. Activities such as cypher, showcase to gauge learning.
9. Components of performance through demonstration.
10. Introduction to choreographies and routines.
11. Learning to choreograph.
12. Choreograph and perform either solo or in groups.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Understand the fundamentals of dancing.
CO2	:	Adapt to impromptu dancing.
CO3	:	Ability to pick choreography and understand musicality.
CO4	:	To be able to do choreographies and perform in front of a live audience.

Reference Books:

1.Dance Composition: A practical guide to creative success in dance making by Jacqueline M. Smith-Autard

ASSESSMENT AND EVALUATION PATTERN

WEIGHTAGE	**50 %**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1)	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2)	**10**	*****
Case Study based Teaching-Learning	**10**	**Implementation strategies of the project with report**
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

CO-PO Mapping

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	3	2	1	1	-	-	2
CO2	2	3	3	2	-	1	2	-	3	2	1	2
CO3	-	-	2	2	-	2	1	2	2	1	2	2
CO4	2	-	2	-	-	2	2	1	3	3	2	2

High-3: Medium-2: Low-1

Course Code	:	21HSAE39D3 / 21HSAE46D3	Lights Camera Drama	CIE Marks	:	50
Credits L-T-P	:	0:00:01	*(Practical)*	SEE Marks	:	50
Hours	:	13P		SEE Durations	:	2 Hours

Prerequisites:

1. Students should have creative oriented mindset and social concern.
2. Students should have dedication to work with their classmates for long hours until a collective goal is reached.
3. Students should be ready to sacrifice some of the timely will and wishes to achieve targets on time.

Content	13 Hrs

1. Break the ICE
2. Introduction to freedom Talk to each and every single person for a period of 5 complete minutes. This is aimed at to make everyone in the room comfortable with each other. This helps everyone get over social anxiety, Shyness and Nervousness.
3. Ura
4. Rhythm Voice Projection, Voice Modulation, Weeping & Coughing Voice projection is the strength of speaking or singing whereby the voice is used powerfully and clearly. It is a technique employed to command respect and attention, as when a teacher talks to a class, or simply to be heard clearly, as used by an actor in a theatre.
5. It's Leviosa, Not Leviosaaa!
6. Speech work: Diction, Intonation, Emphasis, Pauses, Pitch and Volume Tempo Dialogues delivery. The art of dialogue delivery plays a vital role in in ensuring the efficacy of communication especially from the dramatic aspect of it, this unit discusses some tips to help the young actors improve their dialogue delivery skills:
7. Elementary, My dear Watson.
8. Responsibilities of an actor tools of an actor character analysis Observations aspects, Stage presence, concentration, conviction, confidence, energy and directionality.
9. Show time
10. Pick a genre: COMEDY, THRILLER, HORROR, and TRAGEDY: Showcase a performance. Stylized acting with reference to historical and mythological plays. Mime: conventional, occupational and pantomime Mono acting: different types of characters

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Develop a range of Theatrical Skills and apply them to create a performance.
CO2	:	Work collaboratively to generate, develop and communicate ideas.
CO3	:	Develop as creative, effective, independent and reflective students who are able to make inform ed choices in process and
CO4	:	Develop an awareness and understanding of the roles and processes undertaken in contemporary professional theatre practice.

Reference Books:

1.The Empty Space by Peter Brook

2.The Viewpoints Book: A Practical Guide to Viewpoints and Composition by Anne Bogart and Tina Landau

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	50 %	50%
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	10	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2)	10	*****
Case Study-based Teaching-Learning	10	Implementation strategies of the project with report
Sector wise study & consolidation	10	
Video based seminar (4-5 minutes per student)	10	
TOTAL MARKS FOR THE COURSE	50 MARKS	50 MARKS

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	1	1	-	-	2
CO2	2	3	3	2	-	1	2	-	3	2	1	2
CO3	-	-	2	2	-	2	1	2	2	1	2	2
CO4	2	-	2	-	-	2	2	1	3	3	2	2

Course Code	:	**21HSAE39D4 / ART**		**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**13P**		**SEE Durations**	:	**2 Hours**

Prerequisites:

Although there are no prerequisite qualifications for this subject, students must have a basic understanding of and interest in the fields of art and design in order to enroll in it.

Content	**13 Hrs**

1. Use points, line and curves to create various shapes and forms
2. Use of shapes and forms to create various objects and structures
3. Recognizing distinctions in objects when viewed from various perspectives and grasping basic notions of perspective
4. Students will be introduced to the significance of color in art, as well as the principles of color theory and application.
5. Applied the concepts of unity, harmony, balance, rhythm, emphasis and proportion, abstraction and stylization to create a composition.
6. Learn how to use which materials and for what types of art and textures.
7. Use of the above concepts to create art through the medium of collage, mosaic, painting, mural, batik, tie and dye.
8. Real world application of the above concepts in the form of book cover design and illustration, cartoon, poster, advertisements, magazine, computer graphics and animation
9. Familiarization with the many art forms and techniques of expression found throughout India.

AND

ONE EDUCATIONAL VISIT TO AN ART MUSEUM / INSTITUTE / GALLERY

Students must turn in assignments for each of the above said topics on a weekly basis and have to compulsorily take part in the museum visit. CIE will be evaluated based on a still life piece, a composition using any one of the media of composition and a presentation on Indian art styles and creation of a piece pertaining to the presented art style.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	To use lines, shapes, and colors to depict the various sentiments and moods of life and nature.
CO2	:	To use one's creativity to develop forms and color schemes, as well as the ability to portray them effectively in drawing and painting on paper.
CO3	:	To develop the ability to properly use drawing and painting materials (surfaces, tools and equipment, and so on).
CO4	:	To improve their observation abilities by studying everyday items as well as numerous geometrical and non- geometrical (i.e. organic) shapes found in life and nature and to hone their drawing and painting talents in response to these insights.

Reference Books:

1.Catching the Big Fish: Meditation, Consciousness, and Creativity by David Lynch

2.Art & Fear: Observations on the Perils (and Rewards) of Artmaking by David Bayles & Ted Orland

ASSESSMENT AND EVALUATION PATTERN

WEIGHTAGE	50 %	50%
	CIE	SEE
Presentation 1- Selection of topic- (phase 1)	10	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2)	10	*****
Case Study-based Teaching-Learning	10	Implementation strategies of the project with report
Sector wise study & consolidation	10	
Video based seminar (4-5 minutes per student)	10	
TOTAL MARKS FOR THE COURSE	50 MARKS	50 MARKS

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	2	1	1	-	-	2
CO2	2	3	3	2	-	1	2	-	3	2	1	2
CO3	-	-	2	2	-	2	1	2	2	1	2	2
CO4	2	-	2	-	-	2	2	1	3	3	2	2

High-3: Medium-2: Low-1

Course Code	:	**21HSAE39D5 / 21HSAE46D5**	**Photography**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Practical)***	**SEE Marks**	:	**50**
Hours	:	**13P**		**SEE Durations**	:	**2 Hours**

Prerequisites:

1. Students should know basics of photography and cinematography.
2. Students should have dedication to learn and improve on their photography and film making skills.
3. Students should have participated in photography events.
4. Students should have a DSLR camera.

Content	**13 Hrs**

1. Introduction to photography.
2. Understanding the terminologies of DSLR.
3. Elements of photography.
4. Introduction to script writing, storyboarding.
5. Understanding the visualization and designing a set.
6. Basics of film acting
7. Video editing using software
8. Introduction to cinematography.
9. Understanding about lighting and camera angles.
10. Shooting a short film.

Students must form groups of 2-4 and present a short film which shall be given by the experts. The experts shall judge the groups and award marks for the same.

CIE will be evaluated based on their presentation, approach and implementation strategies. Students need to submit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.

Course Outcomes:

After going through this course the student will be able to:

CO1	:	Understand basics of photography and videography and improve their skills
CO2	:	Appreciate the skills acquired from photography
CO3	:	Perform and present photos and films in a presentable manner
CO4	:	Develop skills like team building and collaboration

Reference Books:

1.Read This If You Want to Take Great Photographs – Henry Carroll

2. The Digital Photography Book: Part 1 – Scott Kelby

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50 %**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1)	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2)	**10**	*****
Case Study based Teaching-Learning	**10**	Implementation strategies of the project with report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	-	-	-	-	-	3	2	1	1	-	-	2
CO2	2	3	3	2	-	1	2	-	3	2	1	2
CO3	-	-	2	2	-	2	1	2	2	1	2	2
CO4	2	-	2	-	-	2	2	1	3	3	2	2

High-3; Medium-2; Low-1

Course Code	:	**21DMA47**	**Bridge Course: MATHEMATICS**	**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(Common to all branches)***	**SEE Marks**	:	**50**
Audit Course				**SEE Durations**	:	**2 Hr**

UNIT - I	**05 Hrs**
Differential Calculus - Partial derivatives – Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems.	
UNIT - II	05 Hrs
Vector Differentiation - Introduction, simple problems in terms of velocity and acceleration. Concepts of gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.	
UNIT - III	06 Hrs
Differential Equations - Higher order linear differential equations with constant coefficients, solution of homogeneous equations - Complementary functions. Non homogeneous equations –Inverse differential operator method of finding particular integral based on input function (force function).	
UNIT - IV	05 Hrs
Numerical Methods - Solution of algebraic and transcendental equations – Intermediate value property, Newton-Raphson method. Solution of first order ordinary differential equations – Taylor series and 4th order Runge-Kutta methods. Numerical integration – Simpson's 1/3rd, 3/8th and Weddle's rules. (All methods without proof).	
UNIT - V	05 Hrs
Multiple Integrals - Evaluation of double integrals, change of order of integration. Evaluation of triple integrals. Applications – Area, volume and mass – simple problems.	

Course Outcomes:
After going through this course the student will be able to:

CO1	:	Illustrate the fundamental concepts of partial differentiation, double integrals, vector differentiation, solutions of higher order linear differential equations and numerical methods.
CO2	:	Derive the solution by applying the acquired knowledge of total derivatives of implicit functions, Jacobians, homogeneous linear differential equations, velocity and acceleration vectors to the problems of engineering applications.
CO3	:	Evaluate the solution of the problems using appropriate techniques of differential and integral calculus, vector differentiation, differential equations and numerical methods to the real world problems arising in many practical situations.
CO4	:	Compile the overall knowledge of differential and integral calculus, vector differentiation, differential equations and numerical methods gained to engage in life – long learning

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2015, ISBN: 978-81-933284-9-1.
2. Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3. N.P. Bali & Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications, 7th Edition, 2010, ISBN: 978-81-31808320.

ASSESSMENT AND EVALUATION PATTERN		
	CIE	**SEE**
WEIGHTAGE	**50%**	**50%**
QUIZES		
Quiz-I	Each quiz is evaluated for 10 marks and the total marks obtained from two quizzes will be reduced to **10 MARKS.**	*****
Quiz-II		
THEORY COURSE (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)		*****
Test – I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to **30 MARKS**	*****
Test – II		
EXPERIENTIAL LEARNING (Maximum of 40 Marks)		*****
Photosynthesis and Photovoltaic cells, Bionic/Artificial leaf. 3D-Bioprinting. Biosensors: e-tongue and e-nose. Echolocation. Insect foot adaptations for adhesion. Thermal insulation and storage materials. Bees and Honeycomb Structure. Artificial Intelligence-Travelling Salesman Problem (TSP), Artificial Neural Networking and bio-robotics.	**05**	*****
Video based seminar (4-5 minutes per student)	**05**	
MAXIMUM MARKS FOR THE THEORY	**50 MARKS**	**50 MARKS**
TOTAL MARKS FOR THE COURSE	**50**	**50**

Course Code	:	**21HSU48**	**Universal Value and Professinal Ethics**	**CIE Marks**	:	**50**
Credits L-T-P	:	**2:00:00**	***(Theory)***	**SEE Marks**	:	**50**
Hours	:	**30L**		**SEE Durations**	:	**2 Hours**

UNIT - I	**05 Hrs**

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT - II	**06 Hrs**

Understanding Harmony in the Human Being - Harmony in Myself!: Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT - III	**06 Hrs**

Understanding Harmony in the Family and Society- Harmony in Human Human Relationship: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT - IV	**05 Hrs**

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT - V	**06 Hrs**

Implications of the above Holistic Understanding of Harmony on Professional Ethics, Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations, Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Course Outcomes:
After going through this course the student will be able to:

CO1	:	By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions,
CO2	:	While keeping human relationships and human nature in mind. They would have better critical ability.
CO3	:	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	:	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

Reference Books:
1.Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3.The Story of Stuff (Book).
4.The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.Small is Beautiful - E. F Schumacher.
6.Slow is Beautiful - Cecile Andrews.
ASSESSMENT AND EVALUATION PATTERN
This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation. Example: Assessment by faculty mentor: 10 marks Self-assessment: 10 marks Assessment by peers: 10 marks Socially relevant project/Group Activities/Assignments: 20 marks Semester End Examination: 50 marks. The overall pass percentage is 40%. In case the student fails, he/she must repeat the course

Course Code	:	**21CS49**	**Object Oriented Programming using Java**	**CIE Marks**	:	**50**
Credits L-T-P	:	**0:00:01**	***(Common to AI & CS)***	**SEE Marks**	:	**50**
Hours	:	**30P**		**SEE Durations**	:	**02Hrs**

Laboratory Component

Familiarization with IDE - compilation, debugging and execution considering simple Java programs.
Implement programs on Fundamentals of Java Programming: Data Types, Variables and Arrays, Operators, Control Statements.

Object Model -Explore the OO concepts behind Object Modeling. In completing this exercise, the students will be able to:

- **Identify entities, attributes, methods in an application domain**
- **Identify relationships among these entities.**
- **Design a Class Diagram for the given application.**

PART A

Write Java Program to demonstrate the following Object Oriented (OO) concepts and Java features: Data abstraction/Encapsulation -- Classes, Objects and Methods

Inheritance and Polymorphism.

- **The use of inheritance and its types.**
- **Overriding and constructor chaining.**

Package and Interfaces • Creation of simple package.

- **Accessing a package/ use of different Access Specifiers • Implementing interfaces**

Exception handling -using try, catch, throw, throws and finally block • Handling predefined exceptions.

- **Handling user defined exceptions**

Multithreading Create multiple threads: a) Using Thread class. b) Using Runnable interface

Collections framework and perform different operations:

- **Add elements of List to ArrayList**
- **Copy ArrayList to Array**
- **Reverse ArrayList content**
- **Get Sub list from an ArrayList.**
- **To sort a given ArrayList**
- **Clone an ArrayList to another ArrayList**

PART – B

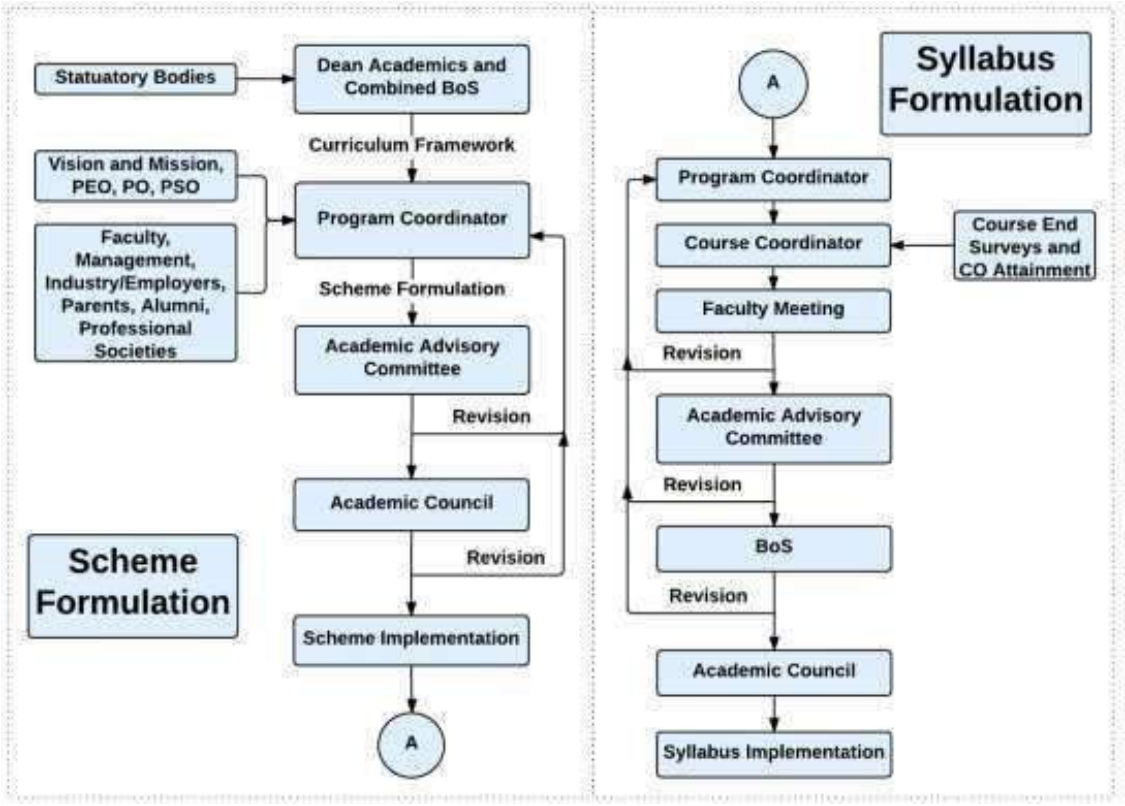
Design and develop an application to demonstrate the appropriate OO concepts and Java GUI programming:
Develop standalone Java application with neat UI using Swings framework to demonstrate the important features of Object-Oriented approach (Abstraction/Encapsulation/Data Hiding, Inheritance and Polymorphism) and also the important features of Java such as Inheritance, Interfaces, Packages, Exception Handling, Multithreaded Programming and Collection Framework

Course Outcomes: After going through this course the student will be able to:

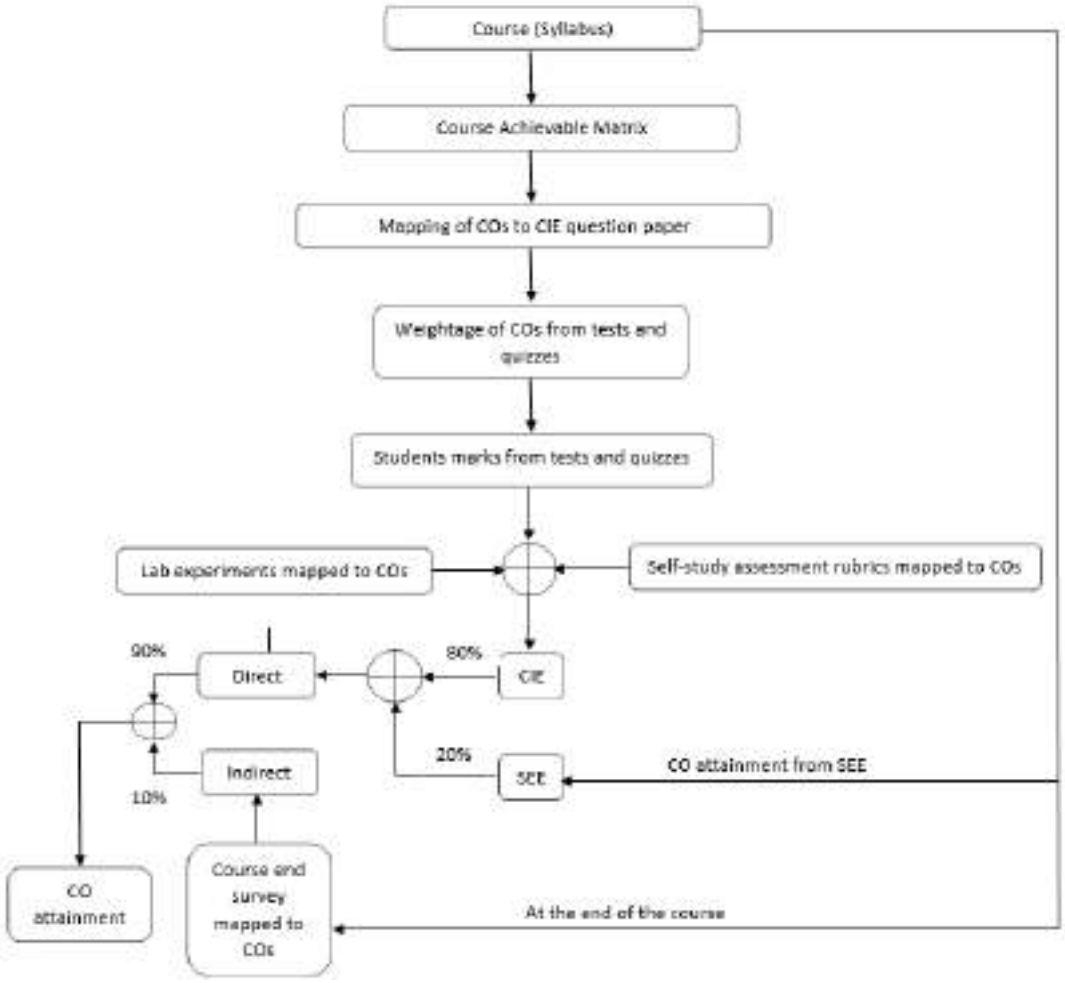
CO1	:	Apply the knowledge of object-oriented concepts with Java programming skills to solve given problems.
CO2	:	Design Classes and establish relationship among Classes for various applications from problem definition.
CO3	:	Analyze and develop Object-oriented applications with Java features such as Inheritance, Interfaces, Packages, Exception Handling, Multithreaded Programming, GUI Programming, using modern programming tools.
CO4	:	Exhibit team work and effective oral/written communication skills in order to accomplish a common goal of solving complex problems with the engineering community and society at large, and engage in continuing professional development.

Reference Books:
1. Object-Oriented Analysis And Design With applications, Grady Booch , Robert A Maksimchuk, Michael W Eagle, Bobbi J Young, 3rd Edition , 2009, Pearson education, ISBN-13: 978-81-317-2287-9, ISBN: 81-317-2287-2
2.Java: The Complete Reference -Herbert Schildt , 11th Edition , 2020, McGraw Hill Education Publications, ISBN: 978-9390491629.
3. Intro to Java Programming (Comprehensive Version), Y Daniel Liang, 10thEdition, 2018, Pearson education, ISBN 13: 978-9353065782

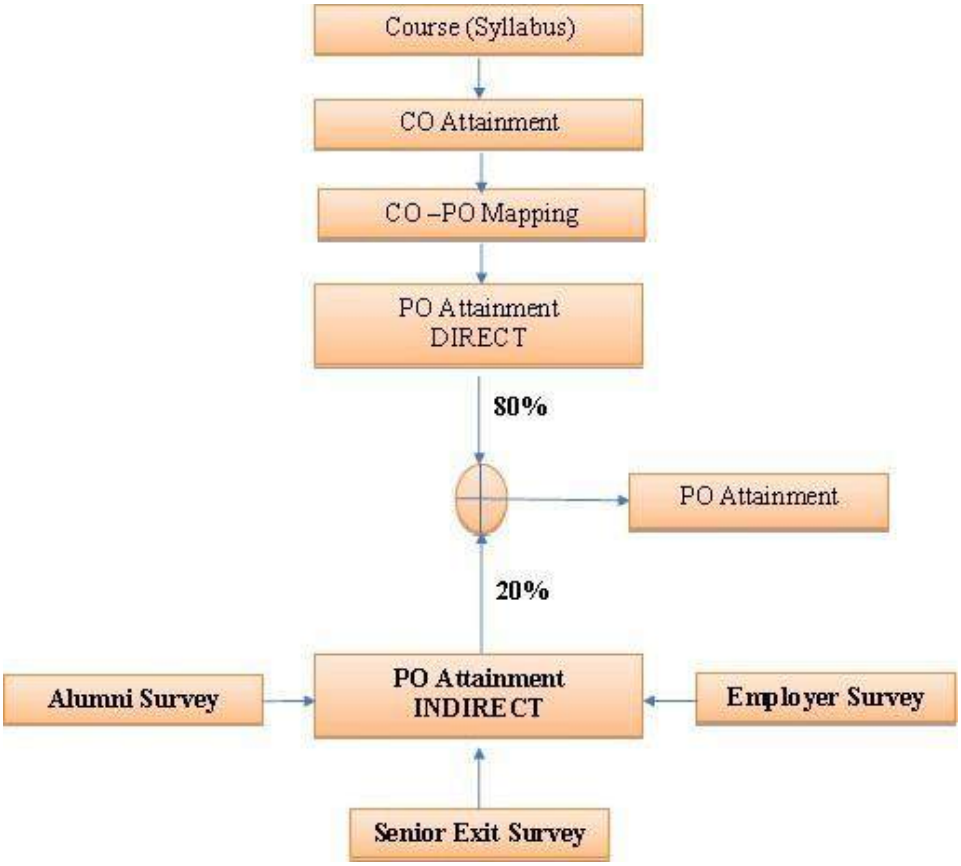
Curriculum Design Process



Final Course Outcomes(COs) Attainment Process



Program Outcomes (POs) Attainment Process



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.