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RV College of Engineering ®

Autonomous
Institution Affiliated
to Visvesvaraya
Technological
University, Belagavi

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New Delhi

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SCHEME & SYLLABUS
SECOND YEAR B.E. PROGRAMS

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

BACHELOR OF ENGINEERING (B.E.)
2022 SCHEME

ACADEMIC YEAR 2023-24

ABBREVIATIONS

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

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Bachelor of Engineering in
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
III Semester

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total			Theory	Lab		Theory	Lab
1	MAT231ET	Mathematics for Artificial Intelligence & Machine Learning	3	1	0	**4**	MAT	Theory	**100**	***	**3**	**100**	***
2	XX232XT	Basket Courses – **Group A**	3	0	0	**3**	CV/ ME/ BT	Theory	**100**	***	**3**	**100**	***
3	AI233AI	Fundamentals of Data Structures and Data Analysis	3	0	1	**4**	AI	Theory + Lab	**100**	**50**	**3**	**100**	**50**
4	AI234AI	Foundations of Cyber Physical Systems	3	0	1	**4**	AI	Theory + Lab	**100**	**50**	**3**	**100**	**50**
5	AI235AT	Statistics for Data Science	3	1	0	**4**	AI	Theory	**100**	***	**3**	**100**	***
6	AI237DL	Design Thinking Lab	0	0	2	**2**	AI	Lab	***	**50**	**2**	***	**50**
7	CS139DT	Bridge Course: C Programming	2(A)	0	0	**AUDIT**	CS	Theory	**50**	***	***	***	***
		Total				**21**							

BASKET COURSES - GROUP A (Students can select any ONE COURSE out of THREE COURSES in ODD Sem & ONE COURSE out of remaining courses in EVEN Sem)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	CV 232AT	Environment & Sustainability	**03**
2	ME 232AT	Material Science for Engineers	**03**
3	BT 232AT	Bio Safety Standards and Ethics	**03**

Bachelor of Engineering in
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
IV Semester

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total			Theory	Lab		Theory	Lab
1	CS241AT	Discrete Mathematical Structures and Combinatorics (Common to AI,CS,CD,CY,IS)	3	0	0	**3**	CS	Theory	**100**	***	**3**	**100**	***
2	XX232XT	Basket Courses – **Group A**	3	0	0	**3**	CV/ ME/ BT	Theory	**100**	***	**3**	**100**	***
3	CD343AI	Design and Analysis of Algorithms (Common to AI,CS,CD,CY,IS)	3	0	1	**4**	CD	Theory + Lab	**100**	**50**	**3**	**100**	**50**
4	AI244AI	Artificial Intelligence and Machine Learning	3	0	1	**4**	AI	Theory + Lab	**100**	**50**	**3**	**100**	**50**
5	CY245AT	Computer Networks (Common to AI,CS,CD,CY,IS)	3	0	0	**3**	CY	Theory	**100**	***	**3**	**100**	***
6	AI246XT	Professional Elective Courses **Group B**	2	0	0	**2**	AI	**NPTEL**	**50**	***	***	**50**	***
7	HS247XL	Ability Enhancement Courses **Group C**	0	0	2	**2**	HS	Lab	***	**50**	**2**	***	**50**
8	HS248AT	Universal Human Values	2	0	0	**2**	HS	Theory	**50**	***	**2**	**50**	***
9	MAT149DT	Bridge Course: Mathematics	2 (A)	1	0	**AUDIT**	MAT	Theory	**50**	***	***	***	***
		Total				**23**							

BASKET COURSES - GROUP A (Students can select any ONE COURSE out of THREE COURSES in ODD Sem & ONE COURSE out of remaining courses in EVEN Sem)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	CV232AT	Environment & Sustainability	**03**
2	ME232AT	Material Science for Engineers	**03**
3	BT232AT	Bio Safety Standards and Ethics	**03**

PROFESSIONAL ELECTIVE COURSES - GROUP B			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	IS246AT	Computer Graphics (Common to **IS** & AI)	**02**
2	AI246BT	Modern Algebra(Common to CS, IS, CD, **AI** & CY)	**02**
3	AI246CT	Operations Research	**02**
4	AI246DT	Introduction to Operating Systems	**02**
5	AI246ET	Theory of Computation	**02**

ABILITY ENHANCEMENT COURSES – Group C			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1	HS247AL	National Service Scheme	**02**
2	HS247BL	National Cadet Corps	**02**
3	HS247CL	Physical Education : Sports & Athletics	**02**
4	HS247DL	Music	**02**
5	HS247EL	Dance	**02**
6	HS247FL	Theater (Light Camera & Action)	**02**
7	HS247GL	Art Work & Painting	**02**
8	HS247HL	Photography & Film Making	**02**

Semester: III						
MATHEMATICS FOR ARTIFICIAL INTELLIGENCE & MACHINE LEARNING **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	**MAT231ET**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L+30T**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 Hrs**
Probability and Random Variable: Random experiment, Sample space, Events – equally likely events, mutually disjoint events, exhaustive events, Axioms of probability, Conditional probability, Partitions and law of total probability, Bayes theorem, Independence, Random variables - Discrete and continuous – Probability mass function (PMF), Probability density function (PDF), Cumulative distribution function (CDF), Expected value and variance of random variable, Markov and Chebyshev inequality. Implementation using MATLAB.	
Unit – II	**08 Hrs**
Probability Distributions: Discrete distributions - Bernoulli, Binomial, Geometric, Equally Likely and Poisson. Continuous distributions – Exponential, Uniform, Normal. Implementation using MATLAB.	
Unit –III	**09 Hrs**
Joint Distribution of Random Variables - Joint Probability mass function, Joint probability density function, Joint Cumulative distribution function, Marginals, Joint moments, Independence, Conditional PDF, Conditional PMF and Conditional mean and Conditional variance. Implementation using MATLAB.	
Unit –IV	**10 Hrs**
Linear Algebra - I: Vector spaces, subspaces, linear dependence and independence, basis, dimension, four fundamental subspaces of a matrix, Linear transformations - matrix representation, dilation, reflection, projection and rotation matrices. Implementation using MATLAB	
Unit –V	**10 Hrs**
Linear Algebra - II: Inner Products, Orthogonally - Orthogonal complement subspace, orthogonal matrices, orthogonal and orthonormal bases, Gram-Schmidt process, QR-factorization, eigenvalues and eigenvectors, matrix diagonalization, Real symmetric matrices, singular value decomposition. Implementation using MATLAB.	

Course Outcomes: After completing the course, the students will be able to	
CO1	Illustrate the fundamental concepts of probability, random variables, probability distributions, linear algebra.
CO2	Apply the acquired knowledge of probability, discrete and continuous random variables, probability distributions, linear algebra to solve the problems of engineering applications.
CO3	Analyze the solution of the problems obtained from appropriate techniques of probability, random variables, probability distributions, linear algebra to the real-world problem.
CO4	Interpret the overall knowledge of probability, random variables, probability distributions, linear algebra gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	Introduction to Probability and Statistics for Engineers and Scientists, Sheldon Ross, 5th Edition, 2014, Academic Press, ISBN: 13-978-0123948113.
2	Michael Baron, "Probability and Statistics for Computer Scientists", CRC Press, 2nd Edition, 2014, ISBN- 13: 978-1-4822-1410-9.
3	Linear Algebra and its Applications, David C. Lay, 3rd Edition, 2002, Pearson Education India, ISBN:13: 978-81-7758-333-5.
4	Practical Linear Algebra: A Geometry Toolbox, Gerald Farin and Dianne Hansford, 3rd Edition, 2014, CRC Press, ISBN: 13: 978-1-4665-7958-3.

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

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

Semester: III/ IV

ENVIRONMENT & SUSTAINABILITY
Category: PROFESSIONAL CORE COURSE
(Common to all Programs)
(Theory)

Course Code	**:**	**CV232AT / CV242AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity.

ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollution. Solid, Hazardous and E-Waste management.

Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

Unit – II — **09Hrs**

RENEWABLE SOURCES OF ENERGY

Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources.

Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

Applications of - Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

Unit –III — **09 Hrs**

SUSTAINABILITY AND MANAGEMENT

Introduction to Environmental Economics, Environmental Audit, Development, GDP, Sustainability - concept, needs and challenges-economic, social and aspects of sustainability - from unsustainability to sustainability-millennium development goals and protocols

Sustainable Development Goals - targets, indicators and intervention areas Climate change - Global, Regional and local environmental issues and possible solutions. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry.

Unit –IV — **09 Hrs**

SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment.

Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports.

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Unit –V	**08 Hrs**
Corporate Social Responsibility (CSR) - Meaning & Definition of CSR, History & evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management. Relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India. Sustainability Reporting: Flavor of GRI, Dow Jones Sustainability Index, CEPI. Investor interest in Sustainability.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the basic elements of Environment and its Biodiversity.
CO2	Explain the various types of pollution and requirement for sustainable strategy for present scenario.
CO3	Evaluate the different concepts of sustainability and its significance for welfare of all life forms.
CO4	Recognize the role of Corporate social responsibility in conserving the Environment.

Reference Books	
1.	Environmental Science and Engineering, Benny Joseph, Tata McGraw-Hill, New Delhi, 2016. ISBN-13 - 978-9387432352
2.	Introduction to Environmental Engineering and Science, Gilbert M.Masters, Wendell P Ela, 3rd edition, Pearson Education, 2006. ISBN-13 - 978-0132339346
3.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4.	A Handbook of Corporate Governance and Social Responsibility (Corporate Social Responsibility), David Crowther and Guler Aras, Gower Publishing Ltd, ISBN - 13 - 978-0566088179

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

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

Semester: III						
MATERIALS SCIENCE FOR ENGINEERS **Category: Professional Core** **(Theory)**						
Course Code	**:**	ME232AT		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
The Fundamentals of Materials The electronic structure of atoms, types of atomic and molecular bonds: ionic bond, covalent bond, metallic bond, secondary bonds, mixed bonding, hybridization. Energy bands in metals, insulators, and semiconductors. Basic crystallography. Defects and dislocations. Types of materials: polymers, metals and alloys, ceramics, semiconductors, composites.	
Unit – II	**10 Hrs**
Material behaviour Thermal properties: thermal conductivity, thermoelectric effects, heat capacity, thermal expansion coefficient, thermal shock, thermocouple. Electrical Properties: dielectric behaviours and temperature dependence of the dielectric constant, insulating materials, ferroelectricity, piezoelectricity, super conductor. Optical properties: luminescence, optical fibers, Mechanical Properties: Stress-strain diagram, elastic deformation, plastic deformation, hardness, viscoelastic deformation, impact energy, fracture toughness, fatigue.	
Unit –III	**10 Hrs**
Materials and their Applications Semiconductors, dielectrics, optoelectronics, structural materials, ferrous alloys, nonferrous alloys, cement, concrete, ceramic, and glasses. Polymers: thermosets and thermoplastics, composites: fibre-reinforced, aggregated composites, electronic packaging materials, biomaterials, processing of structural materials.	
Unit –IV	**07 Hrs**
Heat Treatment Post processing heat treatment of electronic devices: thermal oxidation, diffusion, rapid thermal processing. Heat treatment of ferrous materials: annealing, spheroidizing, normalizing, hardening, tempering. formation of austenite, construction of Time Temperature Transformation (TTT) curves. Special heat treatment processes: carburizing, nitriding, cyaniding, flame, and induction hardening. Defects in heat treatment.	
Unit-V	**07 Hrs**
Nanomaterials Synthesis of nanomaterials: ball milling, sol-gel, vapour deposition growth, pulse laser, magnetron sputtering, lithography. Nano porous materials: zeolites, mesoporous materials, carbon nanotubes, graphene, nano FRPs, nano fabrics, bioresorbable and bio-erodable materials, nano ceramic, nano glasses, nano biomaterials, nano implant associated materials. Characterisation of nano structures, spectroscopic techniques, automatic force microscopy.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the classification of materials, their atomic structure, and properties.
CO2	Investigate the properties and applications of different materials.
CO3	Analyse the effect of different heat treatment processes.
CO4	Recognize different types of nanomaterials, synthesis methods and characterisation techniques.

Reference Books	
1.	Material Science and Engineering, William D Callister, 6th Edition, 1997, John Wiley and Sons, ISBN: 9812-53-052-5
2.	Introduction to Physical Metallurgy, Sydney H Avner, 1994, Mc. Graw Hill Book Company, ISBN: 0-07-Y85018-6
3.	Material Science and Engineering, William F Smith, 4th Edition, 2008, Mc. Graw Hill Book Company, ISBN: 0-07-066717-9
4.	A.S. Edelstein and R.C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, CRC Press 1996, ISBN:978-0849322749

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

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

Semester: III/IV						
BIO SAFETY STANDARDS AND ETHICS **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**BT232AT/ BT242AT**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Biohazards, Bio safety levels and cabinets: Introduction to Biohazards, Biological Safety levels, Bio safety Cabinets, Study of various types of Bio safety cabinets. Various parameters for design of Biosafety cabinets (Materials used for fabrication, sensors, filters, pumps, compressors)	
Unit – II	**08 Hrs**
Biosafety Guidelines: Biosafety guidelines of Government of India, GMOs & LMOs, Roles of Institutional Biosafety Committee, RCGM (Review Committee on Genetic Manipulation), GEAC (Genetic Engg Approval Committee) for GMO applications in food and agriculture. Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	
Unit –III	**10 Hrs**
Food safety standards: FSSAI (Food Safety and Standards Authority of India), Functions, License, types of FSSAI Licences and compliance rules. **Food Hygiene:** General principles of food microbiology and overview of foodborne pathogens, sources of microorganisms in the food chain (raw materials, water, air, equipment, etc.) Quality of foods, Microbial food spoilage and Foodborne diseases, Overview of beneficial microorganisms and their role in food processing and human nutrition, Food Analysis and Testing, General principles of food safety management systems, Hazard Analysis Critical Control Point (HACCP).	
Unit –IV	**09 Hrs**
Food Preservations, processing, and packaging Food Processing Operations, Principles, Good Manufacturing Practices HACCP, Good production, and processing practices (GMP, GAP, GHP, GLP, BAP, etc) Overview of food preservation methods and their underlying principles including novel and emerging methods/principles Overview of food packaging methods and principles including novel packaging materials.	
Unit-V	**09 Hrs**
Food safety and Ethics: Food Hazards, Food Additives, Food Allergens Drugs, Hormones, and Antibiotics in Animals. Factors That Contribute to Foodborne Illness, Consumer Lifestyles and Demand, Food Production and Economics, History of Food Safety, The Role of Food Preservation in Food Safety. Ethics: Clinical ethics, Health Policy, Research ethics, ethics on Animals. Biosafety and Bioethics.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Have a comprehensive knowledge of Biohazards and bio safety levels
CO2	Understand the biosafety guidelines and their importance to the society
CO3	Acquire knowledge with respect to the Food standards, Hygiene, food processing and packing
CO4	Appreciate the food safety, Ethics, biosafety and bio ethics

Reference Books	
1.	Deepa Goel, Shomini Parashar IPR, Biosafety and Bioethics 1st Edition, 2013, ISBN: 978-8131774700.
2.	Cynthia A Roberts, The Food Safety, Oryx Press, first edition, 2001, ISBN: 1–57356–305–6.
3.	Hal King, Food Safety Management Systems, Springer Cham, 2020, ISBN: 978-3-030-44734-2.
4.	Alastair V. Campbell , Bioethics: The Basics, Routledge; 2nd edition, 2017, ISBN: 978-0415790314.

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

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

Semester: III						
FUNDAMENTALS OF DATA STRUCTURES AND DATA ANALYSIS **Category :PROFESSIONAL CORE COURSE** **(Theory and Practice)**						
Course Code	**:**	**AI233AI**		**CIE**	**:**	**100+50 Marks**
Credits: L: T: P	**:**	**3:0:1**		**SEE**	**:**	**100+ 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs.**

Introduction:
Data Structure, Classifications of Data Structures, Application of Data Structures, Abstract Data Type, Operations Perform on Data Structure, Overview of Different Data Structures

Pointers:
Pointer Declaration, Address of Operator, Indirection Operator, Null Pointer, void Pointer, Generic Functions , Dangling Pointer, Arithmetic Operation with Pointer, Pointer to pointer Pointers and Arrays, Array of Pointers, Pointer to an Array, Pointer to Function, Passing addresses to Function, Function returning Pointer, Dynamic Memory Allocation

Linked Lists:
Limitations of Array, Linked List, Singly Linked list, Operations on Singly linked list, Representation of polynomials using linked list, Circular Linked list, Operation on Circular Link List, Josephus Problem, Doubly Linked list, Operation on Doubly Link List, Circular Doubly Linked List, Disadvantages of Linked List

Unit – II	**09 Hrs.**

Stacks and Queues:
Stack, Operations on Stack, Stack Representation with Array, Stack Representation with Linked List, Processing of function calls, Evaluation of Arithmetic expressions; Queue, Operations on Queue, Queue Representation with Array, Queue Representation with Linked List, Application of Queue, Drawback of Linear Queue, Circular Queue, Circular Queue Representation with Array, Dequeue, Operation on De Queue, Priority Queue, Representation of Priority Queue

Trees:
Terminology of Tree, Binary Tree, Strictly Binary Tree, Extended Binary Tree, Complete Binary Tree, Full Binary Tree, Skewed Binary Tree, Binary Expression Tree, Balanced Binary Tree, Threaded Binary Tree, Properties of Binary Tree, Representation of Binary Tree, Binary Tree Traversal, Binary Search Tree, Operations on Binary Search Tree, Heaps

Unit –III	**09 Hrs.**

Graphs:
Terminology of Graph, Terminology of a Directed Graph, Operations on Graph, Representation of Graph, Graph Traversal, Shortest Paths, Dijkstra's Algorithm, Bellman-Ford Algorithm

Hashing:
Hash Table, Hash Function, Division Method, Mid Square method, Folding method, Collision Resolution, Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining, Load Factor

Unit –IV	**09 Hrs.**

Introduction to Data-Analytic Thinking:
The ubiquity of data opportunities, Examples: Hurricane Fraces, Predicting Churn, Data Science, Engineering and Data-Driven Decision Making, Data Processing and Big Data, From Big Data 1.0 to Big Data 2.0, Data-Analytic Thinking

Business Problems and Data Science Solutions: From Business Problems to Data Mining Tasks, Supervised and Unsupervised Methods, Data mining and its results, The Data mining process: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation and Deployment, Implications of managing the data science team	
Unit –V	**09 Hrs.**
Introduction to Predictive Modeling: Models, Induction and Prediction, Supervised Segmentation: Selecting informative attributes, Attribute selection with information gain, supervised segmentation with Tree-structured models, Visualizing segmentations, Tress as sets of rules, probability estimation, Example of churn problem.	

List of Laboratory Experiments

Exp. No.	Data Structure Name	Application to be coded using C
1	Stack	• Arithmetic Expression Evaluation o Evaluating the given postfix expression by considering the priority of the operators. o Identify the invalid expression o Operators: +,/,* and - o Nested Parenthesis: (())
2	Queues	• Simulating a shared resource management o Create a simulated version of a shared memory. o Generate N random requests for memory. o Use queues to manage the resource requests.
3	Singly Linked List	• Polynomial Arithmetic o Adding two polynomials of any degrees.
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 Trees	• 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 OF LAB

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.

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the knowledge of data structures in providing solutions to some software development requirements.
CO2	Identify appropriate data structures and understand requirements in solving some problems of industry and society.
CO3	Perform data analysis of some real-world scientific/business use cases and present the analysis results.
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	Data Structures and Algorithms with C, Debdutta Pal and Suman Halder, Alpha Science International Ltd, Oxford, UK, 2018. ISBN 978-1-78332-368-5, E-ISBN 978-1-78332-427-9
2	Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking 1st Edition, Foster Provost and Tom Fawcett, O'Reilly Media, 2013. ISBN: 978-1449361327
3	Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahni, Illustrated Edition, Computer Science Press.

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

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

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

Semester: III						
FOUNDATIONS OF CYBER PHYSICAL SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)**						
Course Code	**:**	**AI234AI**		**CIE**	**:**	**100+50 Marks**
Credits: L: T: P	**:**	**3:0:1**		**SEE**	**:**	**100+ 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**9Hrs.**
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	**9Hrs.**
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	**9Hrs.**
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	**9Hrs.**
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	**9Hrs**
Actuators Actuators, Actuator Types: Hydraulic actuators, Pneumatic actuators, Electric actuators, Thermal or magnetic actuators, Mechanical actuators, soft actuator, Shape memory polymers, Actuator Characteristics. **Robotic Application** Introduction, Robotic Arm, Sensing, Actuation, Automation and Autonomy.	

PART A	
Exp. No	**Experiment Description**
1.	Write a program with ESP8266 to calculate the distance of an obstacle. If the distance calculated is less than a certain value turns on a buzzer /beeper and display the distance in LCD / OLED.
2.	Write a program with ESP8266 to capture the temperature and relative humidity from the environment and display the same using LCD/ LED.
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 Jetson Nano and send it as notification
7.	Write a program to capture the live image using the USB Camera on Jetson Nano development kit and mark the region of interest and display using Open CV
8.	Write a program to show the communication between client and server.
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.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the concept of Cyber-Physical Systems and apply it to address complex engineering problems
CO2	Analyze the various Cyber-Physical System Components used in solving the real-world problem
CO3	Design and implement data acquisition and processing techniques to extract meaningful information from CPS
CO4	Demonstrate the use of modern tools in solving day-to-day problems by exhibiting teamwork through oral presentations and reports
CO5	Collaborate in a group to design, develop, and evaluate Cyber-Physical Systems

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	Introduction to IoT, Sudip Misra, Anandarup Mukherjee and Arijit Roy, Cambridge University Press, 1st Edition, 2020, ISBN 978-1-108-84295-2, ISBN 978-1-108-95974-2.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**

3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10) **Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE(THEORY+LAB)	**150**

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

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

Semester: III						
STATISTICS FOR DATA SCIENCE **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	**AI235AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**03:01:00**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L+30T**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Descriptive Statistics - Describing data sets - Frequency tables and graphs, relative frequency tables and graphs, Grouped data, histograms, Summarising data sets - Sample Mean, sample median, sample mode, sample variance and sample standard deviation, percentiles and box-plots	
Unit – II	**08 Hrs**
Sampling and Sampling Distributions - Types of sampling, Sample Mean, Sample Variance, Sampling distributions from a normal population, sampling from a finite population, Normal Distribution, approximating binomial, Poisson distributions using normal distribution	
Unit –III	**08 Hrs**
Correlation, Covariance and Independent Random Variables: Joint behavior of random variables, Correlation, Covariance, variance-covariance matrix, Independent random variables, Sums of independent random variables, Law of Large Numbers, Central Limit Theorem	
Unit –IV	**10 Hrs**
Large Sample Estimation – Statistical Inference, Types of Estimators, Point estimation - Point estimation of a population parameter, Interval Estimation - Constructing a confidence interval, Large-Sample Confidence Interval for a Population Mean Interpreting the confidence interval, Large sample confidence interval for a population proportion, Estimating the difference between two population means, Estimating the difference between two binomial distributions, One-sided confidence bounds, Choosing the Sample size.	
Unit –V	**11 Hrs**
Hypothesis Testing - Testing of hypothesis about population parameters, Statistical Test of hypothesis, A large-sample test about the population mean - Essentials of the test, calculating the *p*-value, two types of errors, power of a statistical test, A large-sample test of hypothesis for the difference between two population means - Hypothesis testing and confidence intervals, Hypothesis testing for the binomial, Some comments on testing of hypothesis	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply the knowledge of statistics in providing solutions to some common real-life and business problems.
CO2	Visualize data better, make logical inferences about the data in real-world scientific/business use cases, and present the analysis results.
CO3	Make inferences about a population from samples through various statistical techniques.
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 AI&ML engineer, work in teams, and communicate their ideas effectively.

Reference Books	
1.	Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press, 2014
2.	David Freedman, Robert Pisani and Roger Purves, Statistics, 4th Edition, Nortan & Company, 2007
3.	Richard A. Johnson, Miller & Freund's - Probability And Statistics For Engineers, 9th Edition, Pearson, 2018
4.	William Mendenhall, R J Beaver, B M Beaver, Introduction to Probability and Statistics - Cengage Learning, 2019.
5.	The R Book, Michael J. Crawley, Second Edition, John Wiley Publications, 2013

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

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

Semester: III						
DESIGN THINKING LAB **Category: PROFESSIONAL CORE COURSE** **(Lab)**						
Course Code	**:**	**AI237DL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**00:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**3Hours**

Guidelines

Guidelines for Design Thinking Lab:

1. 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 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

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

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply the knowledge of engineering science to empathize with the stake holder needs and draw insights trough effective communication
CO2	Formulate, analyze and ideate sustainable solutions considering societal and environmental needs
CO3	Demonstrate knowledge effectively and work in intra-disciplinary or interdisciplinary groups to develop prototypes
CO4	Apply project management skills to enhance the solutions by engaging in lifelong learning

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
Phase	**Activity**	**Marks**
1.	Empathy and Define Phase	**20**
2.	Ideate Phase	**20**
3.	Prototype & Testing Phase	**10**
	MAXIMUM MARKS FOR THE CIE	**50**
RUBRIC FOR SEMESTER END EXAMINATION		
Q.NO.	**CONTENTS**	**MARKS**
1.	Write Up	**10**
2.	Presentation and Demonstration	**30**
3.	Viva	**10**
	TOTAL	**50**

Semester: III						
BRIDGE COURSE: C PROGRAMMING (Mandatory Audit Course) (Common to all Programs)						
Course Code	**:**	**CS139DT**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0(Audit)**		**SEE**	**:**	**--**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**--**

Unit-I	**6 Hrs**
Introduction to Programming Definition of a computer. Components of computer system, Programming Languages. Design and implementation of efficient programs. Program Design Tools: Algorithms, Flowcharts and Pseudo codes. Types of Errors.	
Unit – II	**6 Hrs**
Introduction to C Introduction, structure of a C program, Writing the first program, Files used in a C program. Compiling and executing C Programs using comments, C Tokens, Character set in C, Keywords, Identifiers, Basic Data Types in C, Variables, Constants, I/O statements in C. Operators in C, Type conversion and type casting, scope of variables.	
Unit –III	**6 Hrs**
Decision Control and Looping Statements Introduction to decision control, conditional branching statements, iterative statements, Nested loops, Break and continue statements, goto statements **Arrays** Introduction, Declaration of Arrays, Accessing elements of an array, Storing values in arrays, Operations on Arrays- Traversing, Inserting and Deletion of element in an array. Two dimensional arrays- Operations on two dimensional arrays.	
Unit –IV	**6 Hrs**
Strings Introduction, Operations on strings- finding length of a string, converting characters of a string into uppercase and lowercase, Concatenating two strings, appending a string to another string, comparing two string, reversing a string. String and character Built in functions. **Functions** Introduction, Using functions, Function declaration/function prototype, Function definition, Function call, Return statement.	
Unit-V	**6 Hrs**
Functions Passing parameters to a function, Built-in functions. Passing arrays to functions. Recursion. **Structures and Pointers** Introduction: Structure Declaration, Typedef declaration, initialization of structures, accessing members of a structures, Introduction to pointers, declaring pointer variables.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Analyse problems and design solution using program design tools.
CO 2	Evaluate the appropriate method/data structure required in C programming to develop solutions by investigating the problem.
CO 3	Design a sustainable solution using C programming with societal and environmental concern by engaging in lifelong learning for emerging technology
CO 4	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, Reema Thareja, 2018, Oxford University Press. ISBN: 9780199492282.
2.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2015, 2nd Edition, Prentice Hall, ISBN (13): 9780131103627.
3.	Turbo C: The Complete Reference, H. Schildt, 2000, 4th Edition, Mcgraw Hill Education, ISBN-13: 9780070411838.
4.	Algorithmic Problem Solving, Roland Backhouse, 2011, Wiley, ISBN: 978-0-470-68453-5

PRACTICE PROGRAMS

Implement the following programs using cc/gcc compiler

1. Familiarization with programming environment: Concept of creating, naming and saving the program file in gedit/vi editor, Concept of compilation and execution, Concept of debugging in GDB environment.
2. Implementation and execution of simple programs to understand working of
   - Formatted input and output functions- printf() and scanf().
   - Escape sequences in C.
   - Using formula in a C program for specific computation: For example: computing area of circle, converting Celsius to Fahrenheit, area of a triangle, converting distance in centimeters to inches, etc.
   - Preprocessor directives (#include, #define).
3. Execution of erroneous C programs to understand debugging and correcting the errors like:
   - Syntax / compiler errors.
   - Run-time errors.
   - Linker errors.
   - Logical errors.
   - Semantical errors.
4. Implementation and execution of simple programs to understand working of operators like:
   - Unary.
   - Arithmetic.
   - Logical.
   - Relational.
   - Conditional.
   - Bitwise.
5. Develop a C program to compute the roots of the equation ax2 + bx + c = 0.
6. Develop a C program that reads N integer numbers and arrange them in ascending or descending order using selection sort and bubble sort technique.
7. Develop a C program for Matrix multiplication.
8. Develop a C program to search an element using Binary search and linear search techniques.

9. 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.
10. 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'.
11. Develop a C program using pointers to function to find given two strings are equal or not.
12. Develop a C program using recursion, to determine GCD , LCM of two numbers and to perform binary to decimal conversion.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 05 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	10
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO** tests will be conducted. Each test will be evaluated for 25 Marks, adding upto 50 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 20 MARKS.**	20
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (10) & Phase II (10) ADDING UPTO 20 MARKS.**	20
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

Semester: IV						
DISCRETE MATHEMATICAL STRUCTURES AND COMBINATORICS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to AI ,CS, IS, CD & CY)**						
Course Code	**:**	**CS241AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**9 Hrs**
Fundamental Principles of Counting and Combinatorics The Rule of Sum and Product, Permutations, Combinations, Principle of Inclusion and Exclusion, Derangements, The Binomial Theorem, Combinations with repetition. **Recursive Definitions, Recurrence Relations** Recursive definition, First order linear recurrence relation- Formulation problems and examples, Second order linear recurrence relations with constant coefficients- Homogeneous and Non homogeneous, Generating functions.	
Unit – II	**9 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	**9 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	**9 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	
Unit-V	**9 Hrs**
Introduction to Graph Theory: Graphs and their basic properties - degree, path, cycle, complement, subgraphs, isomorphism, Computer representations of graphs. Eulerian and Hamiltonian graphs, Graph coloring, Planar graphs. **Trees:** Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Spanning trees.	

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Apply the concepts of discrete mathematical structures for effective computation and relating problems in the computer science domain.
CO 2:	Analyze the concepts of discrete mathematics to various fields of computer science.
CO 3:	Design solutions for complex problems using different concepts of discrete mathematical structure as a logical predictable system.
CO 4:	Explore/Develop new innovative ideas to solve some open problems in theoretical computer science.
CO 5:	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.	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, 6th Edition, 7 edition 2017, ISBN-(13): 978-0070681880

EXPERIENTIAL LEARNING

Based on the concepts learnt in this course like relations, functions- problems on graph theory such as graph coloring, 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.

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

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

Semester: III/ IV						
ENVIRONMENT & SUSTAINABILITY **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**CV232AT / CV242AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.0 Hours**

Unit-I	**10 Hrs**

ENVIRONMENT AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity.

ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollution. Solid, Hazardous and E-Waste management.

Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

Unit – II	**09Hrs**

RENEWABLE SOURCES OF ENERGY

Energy management and conservation, New Energy Sources: Need of new sources. Different types of new energy sources.

Energy Cycles, carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio economical and technological change.

Applications of - Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

Unit –III	**09 Hrs**

SUSTAINABILITY AND MANAGEMENT

Introduction to Environmental Economics, Environmental Audit, Development, GDP, Sustainability - concept, needs and challenges-economic, social and aspects of sustainability - from unsustainability to sustainability-millennium development goals and protocols

Sustainable Development Goals - targets, indicators and intervention areas Climate change - Global, Regional and local environmental issues and possible solutions. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry.

Unit –IV	**09 Hrs**

SUSTAINABILITY PRACTICES

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment.

Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports.

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Unit –V	08 Hrs
Corporate Social Responsibility (CSR) - Meaning & Definition of CSR, History & evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management. Relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India. Sustainability Reporting: Flavor of GRI, Dow Jones Sustainability Index, CEPI. Investor interest in Sustainability.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the basic elements of Environment and its Biodiversity.
CO2	Explain the various types of pollution and requirement for sustainable strategy for present scenario.
CO3	Evaluate the different concepts of sustainability and its significance for welfare of all life forms.
CO4	Recognize the role of Corporate social responsibility in conserving the Environment.

Reference Books	
1.	Environmental Science and Engineering, Benny Joseph, Tata McGraw-Hill, New Delhi, 2016. ISBN-13 - 978-9387432352
2.	Introduction to Environmental Engineering and Science, Gilbert M.Masters, Wendell P Ela, 3rd edition, Pearson Education, 2006. ISBN-13 - 978-0132339346
3.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4.	A Handbook of Corporate Governance and Social Responsibility (Corporate Social Responsibility), David Crowther and Guler Aras, Gower Publishing Ltd, ISBN - 13 - 978-0566088179

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

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

Semester: IV						
MATERIALS SCIENCE FOR ENGINEERS **Category: Professional Core** **(Theory)**						
Course Code	**:**	ME242AT		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
The Fundamentals of Materials The electronic structure of atoms, types of atomic and molecular bonds: ionic bond, covalent bond, metallic bond, secondary bonds, mixed bonding, hybridization. Energy bands in metals, insulators, and semiconductors. Basic crystallography. Defects and dislocations. Types of materials: polymers, metals and alloys, ceramics, semiconductors, composites.	
Unit – II	**10 Hrs**
Material behaviour Thermal properties: thermal conductivity, thermoelectric effects, heat capacity, thermal expansion coefficient, thermal shock, thermocouple. Electrical Properties: dielectric behaviours and temperature dependence of the dielectric constant, insulating materials, ferroelectricity, piezoelectricity, super conductor. Optical properties: luminescence, optical fibers, Mechanical Properties: Stress-strain diagram, elastic deformation, plastic deformation, hardness, viscoelastic deformation, impact energy, fracture toughness, fatigue.	
Unit –III	**10 Hrs**
Materials and their Applications Semiconductors, dielectrics, optoelectronics, structural materials, ferrous alloys, nonferrous alloys, cement, concrete, ceramic, and glasses. Polymers: thermosets and thermoplastics, composites: fibre-reinforced, aggregated composites, electronic packaging materials, biomaterials, processing of structural materials.	
Unit –IV	**07 Hrs**
Heat Treatment Post processing heat treatment of electronic devices: thermal oxidation, diffusion, rapid thermal processing. Heat treatment of ferrous materials: annealing, spheroidizing, normalizing, hardening, tempering. formation of austenite, construction of Time Temperature Transformation (TTT) curves. Special heat treatment processes: carburizing, nitriding, cyaniding, flame, and induction hardening. Defects in heat treatment.	
Unit-V	**07 Hrs**
Nanomaterials Synthesis of nanomaterials: ball milling, sol-gel, vapour deposition growth, pulse laser, magnetron sputtering, lithography. Nano porous materials: zeolites, mesoporous materials, carbon nanotubes, graphene, nano FRPs, nano fabrics, bioresorbable and bio-erodable materials, nano ceramic, nano glasses, nano biomaterials, nano implant associated materials. Characterisation of nano structures, spectroscopic techniques, automatic force microscopy.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Understand the classification of materials, their atomic structure, and properties.
CO2	Investigate the properties and applications of different materials.
CO3	Analyse the effect of different heat treatment processes.
CO4	Recognize different types of nanomaterials, synthesis methods and characterisation techniques.

Reference Books	
1.	Material Science and Engineering, William D Callister, 6th Edition, 1997, John Wiley and Sons, ISBN: 9812-53-052-5
2.	Introduction to Physical Metallurgy, Sydney H Avner, 1994, Mc. Graw Hill Book Company, ISBN: 0-07-Y85018-6
3.	Material Science and Engineering, William F Smith, 4th Edition, 2008, Mc. Graw Hill Book Company, ISBN: 0-07-066717-9
4.	A.S. Edelstein and R.C. Cammarata, Nanomaterials: Synthesis, Properties and Applications, CRC Press 1996, ISBN:978-0849322749

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

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

Semester: III/IV						
BIO SAFETY STANDARDS AND ETHICS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to all Programs)**						
Course Code	**:**	**BT232AT/BT243AT**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Biohazards, Bio safety levels and cabinets: Introduction to Biohazards, Biological Safety levels, Bio safety Cabinets, Study of various types of Bio safety cabinets. Various parameters for design of Biosafety cabinets (Materials used for fabrication, sensors, filters, pumps, compressors)	
Unit – II	**08 Hrs**
Biosafety Guidelines: Biosafety guidelines of Government of India, GMOs & LMOs, Roles of Institutional Biosafety Committee, RCGM (Review Committee on Genetic Manipulation), GEAC (Genetic Engg Approval Committee) for GMO applications in food and agriculture. Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	
Unit –III	**10 Hrs**
Food safety standards: FSSAI (Food Safety and Standards Authority of India), Functions, License, types of FSSAI Licences and compliance rules. **Food Hygiene:** General principles of food microbiology and overview of foodborne pathogens, sources of microorganisms in the food chain (raw materials, water, air, equipment, etc.) Quality of foods, Microbial food spoilage and Foodborne diseases, Overview of beneficial microorganisms and their role in food processing and human nutrition, Food Analysis and Testing, General principles of food safety management systems, Hazard Analysis Critical Control Point (HACCP).	
Unit –IV	**09 Hrs**
Food Preservations, processing, and packaging Food Processing Operations, Principles, Good Manufacturing Practices HACCP, Good production, and processing practices (GMP, GAP, GHP, GLP, BAP, etc) Overview of food preservation methods and their underlying principles including novel and emerging methods/principles Overview of food packaging methods and principles including novel packaging materials.	
Unit-V	**09 Hrs**
Food safety and Ethics: Food Hazards, Food Additives, Food Allergens Drugs, Hormones, and Antibiotics in Animals. Factors That Contribute to Foodborne Illness, Consumer Lifestyles and Demand, Food Production and Economics, History of Food Safety, The Role of Food Preservation in Food Safety. Ethics: Clinical ethics, Health Policy, Research ethics, ethics on Animals. Biosafety and Bioethics.	

Course Outcomes: After completing the course, the students will be able to:	
CO1	Have a comprehensive knowledge of Biohazards and bio safety levels
CO2	Understand the biosafety guidelines and their importance to the society
CO3	Acquire knowledge with respect to the Food standards, Hygiene, food processing and packing
CO4	Appreciate the food safety, Ethics, biosafety and bio ethics

Reference Books	
1.	Deepa Goel, Shomini Parashar IPR, Biosafety and Bioethics 1st Edition, 2013, ISBN: 978-8131774700.
2.	Cynthia A Roberts, The Food Safety, Oryx Press, 1st Edition, 2001, ISBN: 1–57356–305–6.
3.	Hal King, Food Safety Management Systems, Springer Cham, 2020, ISBN: 978-3-030-44734-2.
4.	Alastair V. Campbell , Bioethics: The Basics, Routledge; 2nd Edition, 2017, ISBN: 978-0415790314.

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
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1	Objective type questions covering entire syllabus	20
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3 & 4	Unit 2 : Question 3 or 4	16
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7 & 8	Unit 4 : Question 7 or 8	16
9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

Semester: IV						
DESIGN AND ANALYSIS OF ALGORITHMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to AI ,CS, IS, CD, & CY)**						
Course Code	**:**	**CD343AI**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**8Hrs**
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	**10Hrs**
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	**10Hrs**
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, 0/1 Knapsack Problem and Memory Functions. **Greedy Technique:** Prim's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes, Fractional Knapsack Problem.	
Unit-V	**7 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 completing the course, the students 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.

Laboratory Component

Note: The following programs should be implemented in C++ language

Practice Programs:

- Implementation and execution of simple programs to understand running time analysis of non-recursive algorithms
  - Finding maximum element in a given array.
  - Linear search,
  - Bubble sort,
  - Determine whether all the elements in a given array are distinct.
  - Given 2 NXN matrices, perform matrix multiplication using bruteforce approach.
- Implementation and execution of simple programs to understand running time analysis of recursive algorithms
  - Find the Factorial of a given number.
  - Print Fibonacci series
  - Given a positive decimal integer n, find the number of binary digits in n's binary representation.
  - To solve tower of Hanoi problem.
  - Recursive linear search.

Lab Programs:(At-least one application from each of the following group)

1. Apply divide and conquer strategy to solve sorting problem
   - Merge sort
   - Quicksort
2. Apply decrease and conquer strategy to solve graph problem
   - Breadth first search
   - Topological sorting using depth first search

3. Apply transform and conquer strategy
   - Heapsort
   - Checking element uniqueness after presorting
4. Apply input enhancement strategy to solve string-matching problem
   - Horspool's algorithm
   - Boyer – Moore's algorithm
5. Apply dynamic programming strategy to solve optimization problem
   - Warshall - Floyd's Algorithms,
   - Knapsack problem solution using memory function.
6. Apply greedy strategy to solve graph problem
   - Dijkstra's algorithm
   - Prim's algorithm
7. Apply backtracking strategy to solve combinatorial problem
   - N- Queen's problem
   - Subset – sum problem
8. Apply branch and bound strategy to solve combinatorial problem
   - Travelling salesperson problem
   - Assignment problem

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
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3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10)**Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks),lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE(THEORY+LAB)	**150**

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

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

Semester: IV						
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)**						
Course Code	**:**	**AI244AI**		**CIE**	**:**	**100+50 Marks**
Credits: L: T: P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**9Hrs.**
Introduction: What is AI? **Intelligent agents:** Intelligent Agents: Agents and environment; Rationality; the nature of environments; the structure of agents **Problem Solving & Uninformed Search Strategies:** Problem-solving agents, Breadth-first Search, Depth-first Search, Depth-limited Search and Iterative Deepening Depth First Search	
Unit – II	**9Hrs.**
Informed (Heuristic) Search Strategies: A* Search, Heuristic Functions **Beyond Classical Search:** Local Search Algorithms and Optimization Problems, Hill-climbing Search, Simulated Annealing, Local-beam Search, Genetic Algorithms **Adversarial search:** Games, Optimal decision in games, Alpha-Beta Pruning	
Unit –III	**9Hrs.**
Supervised Learning: Basic Concepts, General Framework for Classification **Decision Tree Classifier**-A Basic Algorithm to Build a Decision Tree, Methods for Expressing Attribute Test Conditions, Measures for Selecting an Attribute Test Condition, Algorithm for Decision Tree Induction, Characteristics of Decision Tree Classifiers, **Model Overfitting**- Reasons for Model Overfitting **Model Selection** - Using a Validation Set, Incorporating Model Complexity, Estimating Statistical Bounds, Model Selection for Decision Trees, Model Evaluation	
Unit –IV	**9 Hrs.**
Nearest Neighbor Classifiers-Characteristics of Nearest Neighbor Classifiers **Naive Bayes Classifier**-Basics of Probability Theory, Naive Bayes assumption **Logistic Regression**-Logistic Regression as a Generalized Linear Model, Learning Model Parameters, Characteristics of Logistic Regression **Ensemble Methods** – Methods for constructing Ensemble classifier, Bagging, Boosting, Random Forests	
Unit –V	**9 Hrs**
Unsupervised Learning- Overview, What Is Cluster Analysis, Different Types of Clustering's, Different Types of Clusters **K-means**-The Basic K-means Algorithm, Additional Issues, Bisecting K-means, K-means and Different Types of Clusters, Strengths and Weaknesses, K-means as an Optimization Problem **Cluster Evaluation**-Overview, Unsupervised Cluster Evaluation Using Cohesion and Separation, Unsupervised Cluster Evaluation Using the Proximity Matrix, Determining the Correct Number of Clusters, Supervised Measures of Cluster Validity, Assessing the Significance of Cluster Validity Measures, Choosing a Cluster Validity Measure	

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

PART-B

Two students from the same batch must develop a Machine Learning model on the problem statements chosen from Agriculture, Health Care, Manufacturing, and Process Control/Automation Domains related to Indian Scenarios.

- The data collected should be cleansed and pre-processed.
- The complete EDA process has to be demonstrated
- Selection of the suitable algorithms and model-building
- Model evaluation has to be carried out by selecting the proper metrics
- Prediction/classification results have to be obtained and should be demonstrated through visualizations

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain and apply AI and ML algorithms to address various requirements of real-world problems.
CO2	Design and develop AI and ML solutions to benefit society, science, and industry.
CO3	Use modern tools to create AI and ML solutions.
CO4	Demonstrate effective communication through team presentations and reports to analyze the impact of AI and ML solutions on society and nature.
CO5	Conduct performance evaluation, modeling, and validation of AI and ML solutions benefiting lifelong learning.
Reference Books	
1.	AI – A Modern Approach ,Stuart Russel, Peter Norvig, 3rd Edition, 2010, Pearson, ISBN-13: 978-0136042594
2.	Artificial Intelligence Basics: A Self Teaching Introduction, Neeru Gupta and Ramita Mangla, Mercury Learning and Information, 1st Edition, 2020, ISBN: 978-1-68392-516-3.
3.	Machine Learning ,Tom M. Mitchell, Indian Edition, 2013, McGraw Hill Education, ISBN – 10 – 1259096955
4.	Introduction to Data Mining ,Pang-Ning Tan, Michael Steinbach, Vipin Kumar,2nd Edition, 2019,Pearson , ISBN-10-9332571406, ISBN-13 -978-9332571402

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10)**Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
4.	**LAB:** Conduction of laboratory exercises, lab report, observation, and analysis (30 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (10 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50 MARKS	**50**
	MAXIMUM MARKS FOR THE CIE(THEORY+LAB)	**150**
RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
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9 & 10	Unit 5: Question 9 or 10	16
	TOTAL	**100**

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

Semester: IV						
COMPUTER NETWORKS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to AI ,CS, IS, CD & CY)**						
Course Code	**:**	**CY245AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**10Hrs**
Introduction-Perspectives **Business Domains:** Networks. **Applications**: Resource Sharing, Client Server programming, e-commerce 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	**09Hrs**
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	**09 Hrs**
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	**09Hrs**
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 completing the course, the students will be able to:-	
CO1	Apply the algorithms/techniques of routing and congestion control to solve problems related to Computer Networks.
CO2	Analyse 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

To work on Problems similar to following aspects of Networks: Modern Networking tools usage to solve problems in Networking (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).

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

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

Semester: IV						
NATIONAL SERVICE SCHEME **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247AL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 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	**30 Hrs**

Students must take up any one activity on below mentioned topics and must 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 completing the course, the students 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.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
NATIONAL CADET CORPS **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247BL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

Unit-I	**14Hrs.**
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 – II	**06Hrs.**
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts	
Unit –III	**05Hrs.**
Adventure activities: Trekking and obstacle course	
Unit –IV	**05Hrs**
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 completing the course, the students 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**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
PHYSICAL EDUCATION : SPORTS AND ATHLETICS **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247CL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

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

Course Outcomes: After completing the course, the students 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.	Health, Exercise and Fitness, Muller, J. P. (2000), Delhi: Sports.
2.	Play Field Manual, Anaika ,2005, Friends Publication New Delhi.
3.	IAAF Manual.
4.	Track and Field Marking and Athletics Officiating Manual, M.J Vishwanath,2002, 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 with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
MUSIC **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247DL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

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 completing the course, the students 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) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
DANCE **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247EL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

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 completing the course, the students 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) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
THEATER (LIGHT CAMERA & ACTION) **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247FL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

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. Its 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 completing the course, the students 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 choices in process and performance.
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) Justification for Importance, need of the hour with surveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**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**

Semester: IV						
ART WORK & PAINTING **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247GL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**
Contents						**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 completing the course, the students 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, David Lynch
2	Art & Fear: Observations on the Perils (and Rewards) of Artmaking, David Bayles & Ted Orland

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

Semester: IV						
PHOTOGRAPHY AND FILM MAKING **Category: ABILITY ENHANCEMENT COURSE** **(Lab)**						
Course Code	**:**	**HS247HL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.00 Hours**

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 completing the course, the students 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) 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**

Semester: IV						
UNIVERSAL HUMAN VALUES **Category: HUMANITIES AND SOCIAL SCIENCE** **(Theory)**						
Course Code	**:**	**HS248AT**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**28L**		**SEE Duration**	**:**	**2.00 Hours**

Unit-I	**10Hrs.**
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, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility **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', Understanding the Body as an instrument of 'I' , Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; Practice Sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life	
Unit – II	**10Hrs.**
Understanding Harmony in the Family and Society- Harmony in 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. 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 –III	**08 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. 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.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	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	Understand human relationships and human nature in mind so that they will have better critical ability.

CO3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life.

Reference Books	
1.	Human Values and Professional Ethics, R. R. Gaur, R Sangal, G P Bagaria, 1st Edition, 2010, Excel Books, New Delhi, ISBN: 9788174467812.
2.	Human Values, A.N. Tripathi, 3rd Edition, 2019, New Age Intl. Publishers, New Delhi, ISBN: 9788122425895.
3.	India Wins Freedom, Maulana Abdul Kalam Azad, 1st Edition, 1988, Orient Blackswan, ISBN: 97881250051481.
4.	The Story of My Experiments with Truth, Mohandas Karamchand Gandhi, 1st Edition, 2011, Create Space Publishing platform, ISBN: 9781463694876.
5.	Small is Beautiful, E. F Schumacher, 1st Edition, 2011, (PBD)VINTAGE, ISBN: 9780099225614.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	
1.	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	
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

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

Semester: IV						
Bridge Course: MATHEMATICS **Category : AUDIT COURSE** **(Common to all Programs)**						
Course Code	**:**	**MAT149DT**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**2:0:0(Audit)**		**SEE**	**:**	**---**
Total Hours	**:**	**30L**				

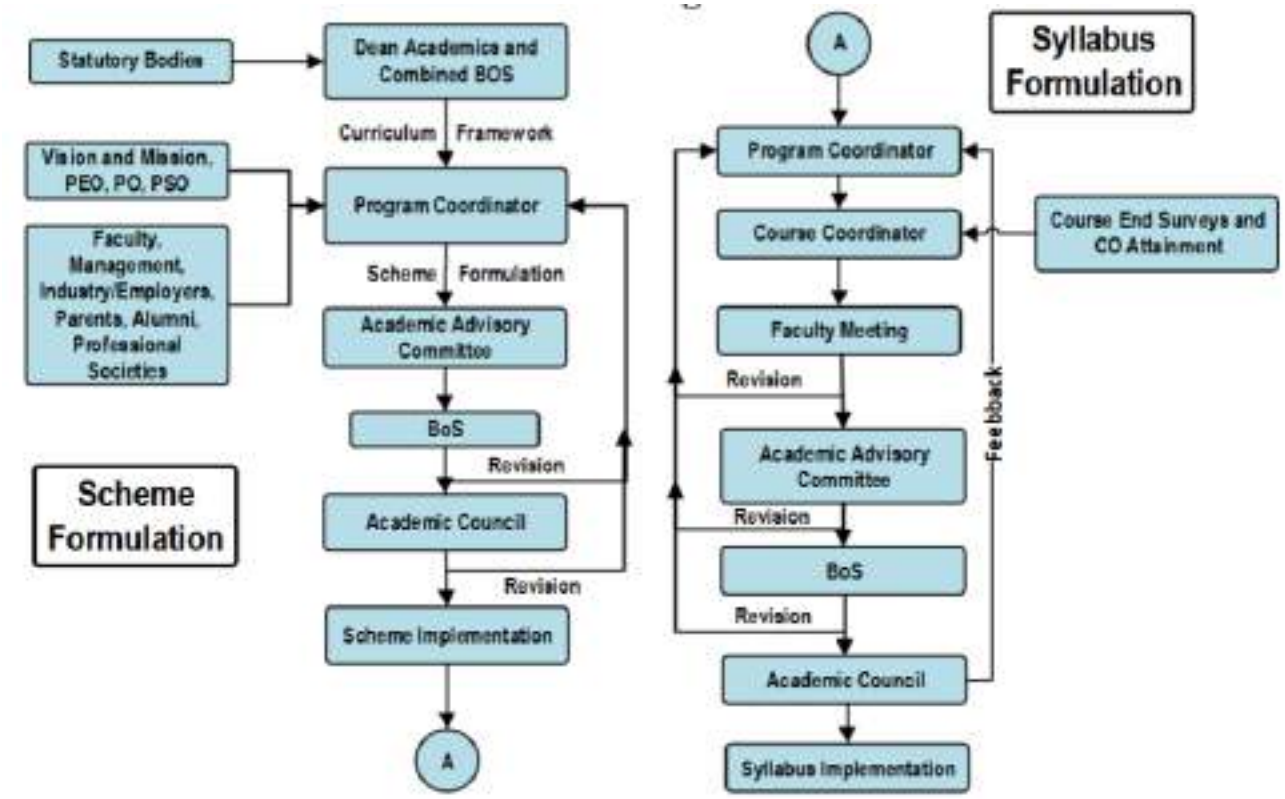
Unit-I	**10 Hrs**
Multivariable Calculus: **Partial Differentiation:** Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems. **Vector Differentiation:** Introduction, velocity and acceleration, gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.	
Unit – II	**10 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 –III	**10 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 4^{th} order Runge-Kutta methods. Numerical integration – Simpson's $1/3^{rd}$, $3/8^{th}$ and Weddle's rules. (All methods without proof)**.**	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of partial differentiation, vector differentiation, higher order linear differential equations and numerical methods.
CO2:	Derive the solution by applying the acquired knowledge of differential calculus, differential equations, velocity, and acceleration vectors to the problems of engineering applications.
CO3:	Evaluate the solution of the problems using appropriate techniques of differential calculus, vector differentiation, differential equations, and numerical methods.
CO4:	Compile the overall knowledge of differential calculus, vector differentiation, differential equations and numerical methods gained to engage in life – long learning.

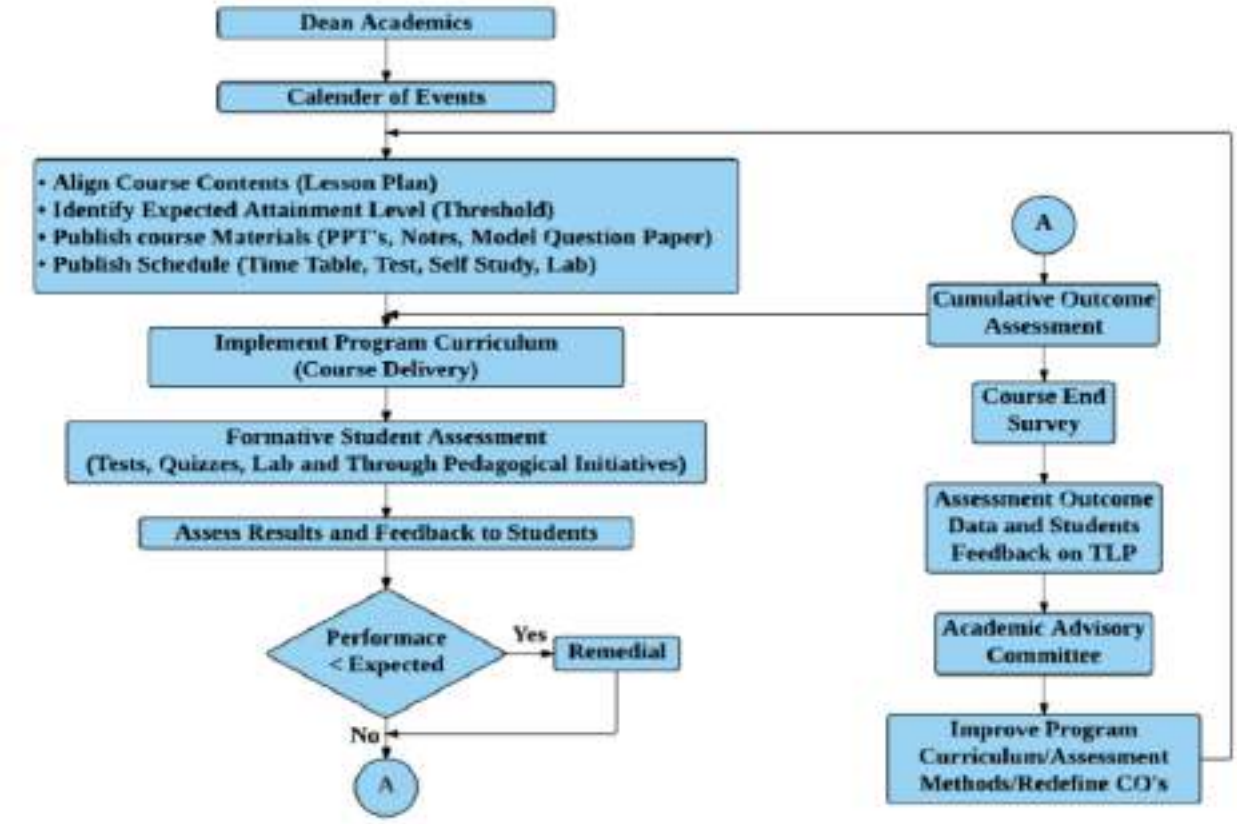
Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44^{th} Edition, 2015, Khanna Publishers, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11^{th} Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	A Textbook of Engineering Mathematics, N.P. Bali & Manish Goyal, 7^{th} Edition, 2010, Lakshmi Publications, ISBN: 978-81-31808320.
4	Advanced Engineering Mathematics, E. Kreyszig, 10^{th} Edition (Reprint), 2016. John Wiley & Sons, ISBN: 978-0470458365.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO TESTS will be conducted. Each test will be evaluated for 30 Marks, adding upto 60 Marks. **FINAL TEST MARKS WILL BE AVERAGE OF TWO TESTS.**	**30**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

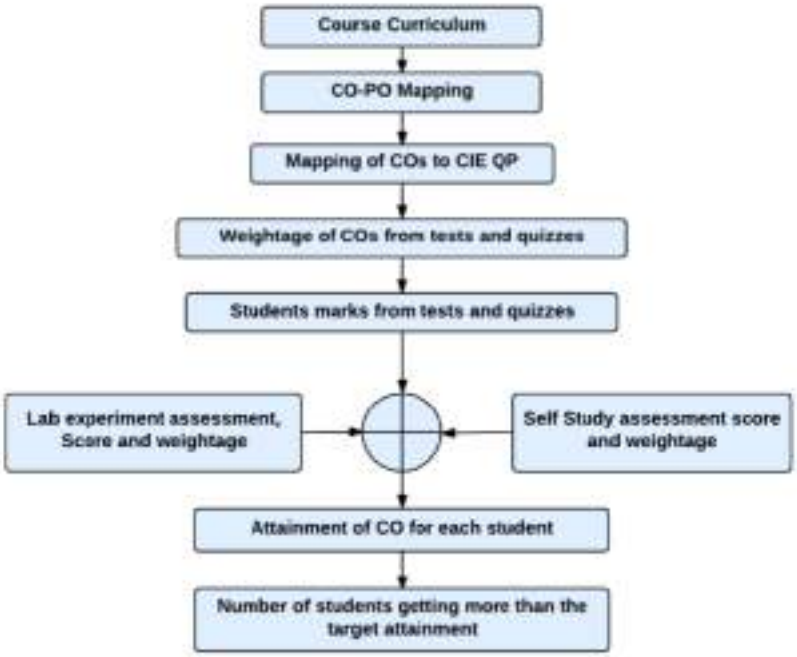
Curriculum Design Process



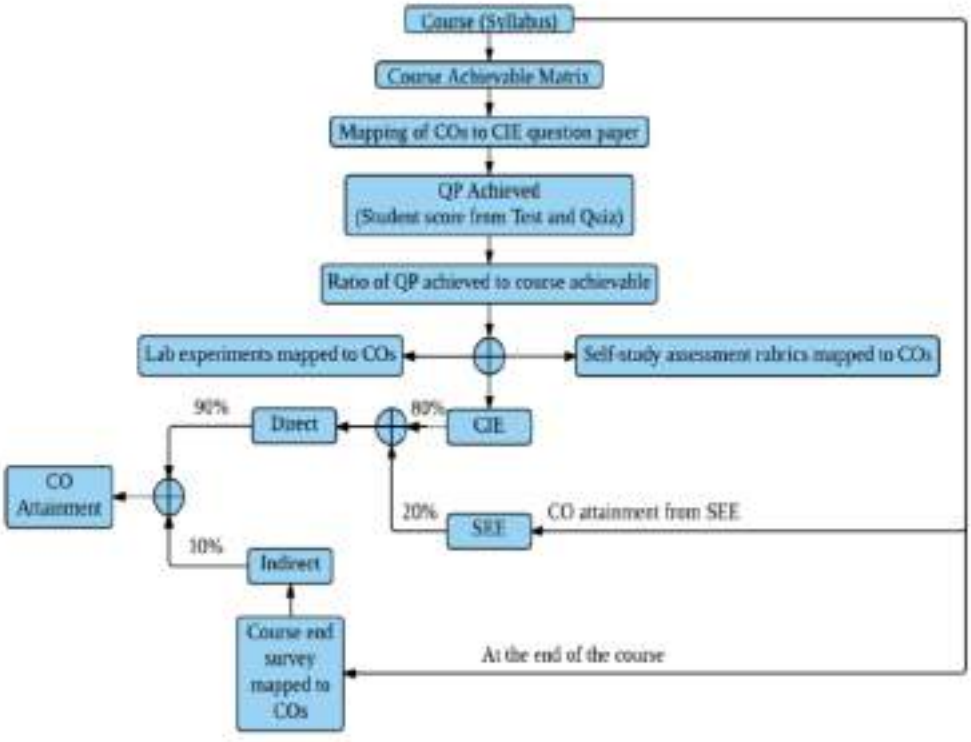
Academic Planning and Implementation



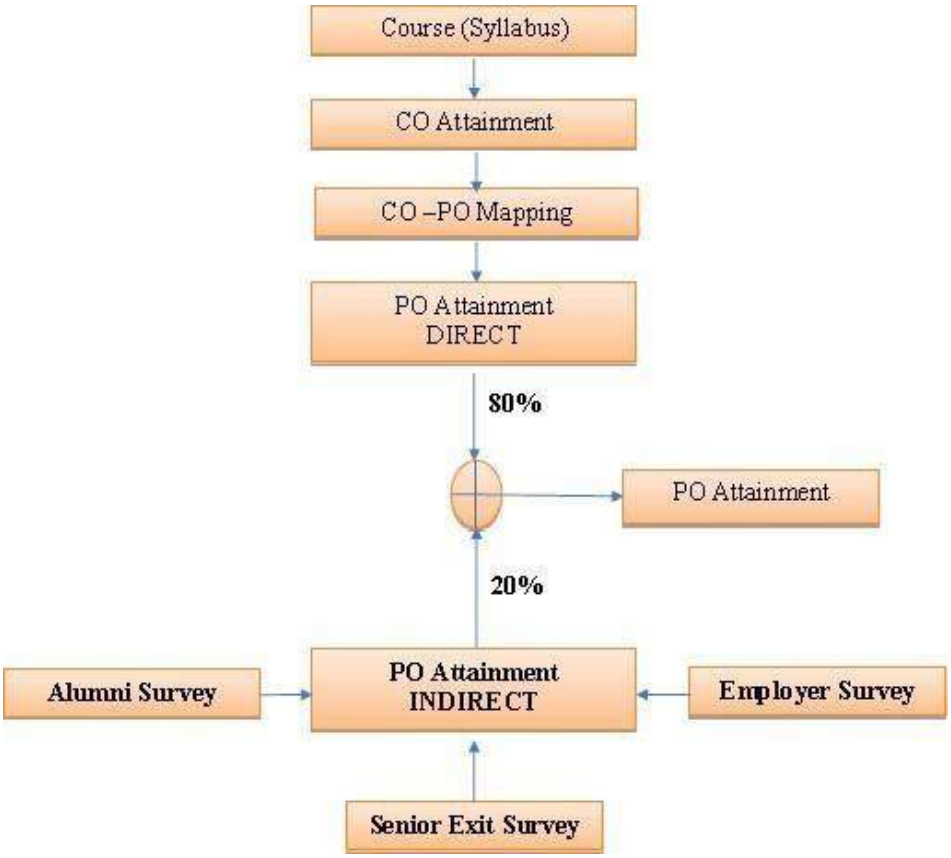
Process For Course Outcome Attainment



Final CO 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 solutionsin 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 inindependent and life-long learning in the broadest context of technological change.