



RV College of
Engineering®

Undergraduate
Programs



Bachelor of Engineering (B.E) in
Artificial Intelligence and Machine Learning

Scheme And Syllabus Of III & IV Semester
(2022 Scheme)

B.E. Programs : AS, BT, CH, CS, CS - AI, CS - CD, CS - CY, CV, EC, EE, EI, ET, IM, IS, ME.
M. Tech (13) MCA, M.Sc. (Engg.)
Ph.D. Programs : All Departments are recognized as Research Centres by VTU Except
AI & AS

2024

99TH
NIRF RANKING
IN ENGINEERING
(2024)

TIMES HIGHER EDUCATION WORLD UNIVERSITY
RANKINGS-2023

1501+
TIMES HIGHER EDUCATION WORLD UNIVERSITY
RANKINGS-2023 (ASIA)
501-600

EDUFUTURE EXCELLENCE AWARD

BEST PRIVATE ENGINEERING
UNIVERSITY (SOUTH)

BY ZEE DIGITAL

1001+
SUBJECT RANKING
(ENGINEERING)

801+
SUBJECT RANKING
(COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING INDIA

NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5



QS-IGUAGE
DIAMOND UNIVERSITY
RATING (2021-2024)

17
Centers of
Excellence

11
Centers of
Competence

212
Publications On
Web Of Science

669
Publications Scopus
(2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

11
Skill Based
Laboratories
Across Four Semesters

61
Published Patents

CURRICULUM STRUCTURE

61 CREDITS
PROFESSIONAL
CORES (PC)

23 CREDITS
BASIC SCIENCE

22 CREDITS
ENGINEERING
SCIENCE

18 CREDITS
PROJECT WORK /
INTERNSHIP

12 CREDITS*
OTHER ELECTIVES
& AEC

12 CREDITS
PROFESSIONAL
ELECTIVES

12 CREDITS
HUMANITIES &
SOCIAL SCIENCE

160
CREDITS
TOTAL

*ABILITY ENHANCEMENT COURSES (AEC),
UNIVERSAL HUMAN VALUES (UHV),
INDIAN KNOWLEDGE SYSTEM (IKS), YOGA.

MOUS: 90+ WITH
INDUSTRIES / ACADEMIC
INSTITUTIONS IN INDIA & ABROAD

EXECUTED MORE THAN
RS.40 CRORES WORTH
SPONSORED
RESEARCH PROJECTS &
CONSULTANCY WORKS
SINCE 3 YEARS



DEPARTMENT VISION

To develop sustainable solutions for the greater good of society, through quality engineering education in Artificial Intelligence and Machine Learning, with innovation, research, and consultancy activities.

DEPARTMENT MISSION

- To impart cutting-edge knowledge and skills in Artificial Intelligence and Machine Learning with a foundation in Computer Science and Engineering.
- To promote innovative research and development in Artificial Intelligence and Machine Learning and its allied fields in collaboration with industries.
- To prepare the students for solving real-world problems by imparting engineering skills through experiential learning mode.
- To provide a pleasant environment in pursuit of excellence by keeping high personal and professional values and ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Develop graduates capable of applying the principles of Mathematics, Science, core Computer Science Engineering with Artificial Intelligence, and Machine learning knowledge to solve real-world interdisciplinary problems.

PEO2: To develop the ability among graduates to analyse and understand the state-of-the-art technologies and industrial practices in the Artificial Intelligence and Machine-learning domain through experiential learning.

PEO3: Develop graduates who will exhibit cultural awareness, teamwork with professional ethics, and practical communication skills with an inspiration to understand the social and economic impact of Artificial Intelligence and Machine learning in the foreseeable future.

PEO4: Prepare employable graduates for the right roles in industries / to become entrepreneurs to achieve higher career goals or take up higher education to pursue lifelong learning.



PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Problem Solving and Analysis

The student will be able to:

1. Appreciate the importance of Mathematics, Electronics and Sensors, Data organization and Algorithms, Design thinking, and Software Engineering principles in building Intelligent Computational Systems.
2. Learn the applicability of Artificial Intelligence and Machine learning algorithms to solve real-world problems.
3. Identify the need for Deep learning, Computer vision, and Natural language processing to develop intelligent software products focusing on application performance.
4. Display team participation, good communication, project management, and documentation skills.

PSO2: Experiential Learning

The student will be able to:

1. Demonstrate the application of knowledge to develop intelligent software programs for various use case scenarios in industrial sectors like healthcare, agriculture, education and skilling, governance, energy, automotive, infrastructure, banking and finance, and manufacturing.
2. Participate in planning and developing enterprise-level solutions with cutting-edge technologies, displaying group dynamics and professional ethics.
3. Employ experiential learning throughout the program to enrich the practical aspects to reach state-of-the-art in the domain



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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	ME232TB	Material Science for Engineers	5
	BT232TC	Bio Safety Standards and Ethics	7
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	ME242TB	Material Science for Engineers	28
	BT242TC	Bio Safety Standards and Ethics	30
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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	MA231ET	Mathematics for Artificial Intelligence & Machine Learning	3	1	0	4	MAT	Theory	100	***	3	100	***
2	XX232TX	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	CS139AT	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 232TA	Environment & Sustainability	03
2	ME 232TB	Material Science for Engineers	03
3	BT 232TC	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	XX242TX	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	HS247LX	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	MA149AT	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	CV232TA	Environment & Sustainability	03
2	ME232TB	Material Science for Engineers	03
3	BT232TC	Bio Safety Standards and Ethics	03

PROFESSIONAL ELECTIVE COURSES - GROUP B			
Sl. No.	Course Code	Course Title	Credits
1	IS246TA	Computer Graphics (Common to IS & AI)	02
2	AI246TB	Modern Algebra(Common to CS, IS, CD, AI & CY)	02
3	AI246TC	Operations Research	02
4	AI246TD	Introduction to Operating Systems	02
5	AI246TE	Theory of Computation	02

ABILITY ENHANCEMENT COURSES – Group C			
During III Sem: AS, CH, CV, EC, EE, EI, ET, IM & ME.			
During IV Sem: AI, BT, CD, CS, CY & IS.			
Sl. No.	Course Code	Course Title	Credits
1	HS247LA	National Service Scheme	02
2	HS247LB	National Cadet Corps	02
3	HS247LC	Physical Education : Sports & Athletics	02
4	HS247LD	Music	02
5	HS247LE	Dance	02
6	HS247LF	Theater (Light Camera & Action)	02
7	HS247LG	Art Work & Painting	02
8	HS247LH	Photography & Film Making	02



Semester: III						
MATHEMATICS FOR ARTIFICIAL INTELLIGENCE & MACHINE LEARNING						
Category: PROFESSIONAL CORE COURSE						
(Theory)						
Course Code	:	MA231TE		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, 5 th Edition, 2014, Academic Press, ISBN: 13-978-0123948113.
2	Michael Baron, "Probability and Statistics for Computer Scientists", CRC Press, 2 nd Edition, 2014, ISBN- 13: 978-1-4822-1410-9.
3	Linear Algebra and its Applications, David C. Lay, 3 rd Edition, 2002, Pearson Education India, ISBN:13: 978-81-7758-333-5.
4	Practical Linear Algebra: A Geometry Toolbox, Gerald Farin and Dianne Hansford, 3 rd 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). THREE tests will be conducted (Two regular tests & One optional Improvement test). Each test will be evaluated for 50 Marks, adding upto 100 Marks. FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.	40
3.	EXPERIENTIAL LEARNING: Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (05), Program specific requirements (05), Video based seminar/presentation/ demonstration (10), MATLAB (20). ADDING UPTO 40 MARKS.	40
MAXIMUM MARKS FOR THE CIE THEORY		100

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



Semester: III			
ENVIRONMENT & SUSTAINABILITY			
Category: PROFESSIONAL CORE COURSE			
(Common to all Programs)			
(Theory)			
Course Code	:	CV232TA	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, 3 rd 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 COURSE						
(Common to all Programs)						
(Theory)						
Course Code	:	ME232TB		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, ferro electricity, 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, 6 th 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, 4 th 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			
BIO SAFETY STANDARDS AND ETHICS			
Category: PROFESSIONAL CORE COURSE			
(Common to all Programs)			
(Theory)			
Course Code	:	BT232TC	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 Frances, 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	<ul style="list-style-type: none"> • Arithmetic Expression Evaluation <ul style="list-style-type: none"> ○ Evaluating the given postfix expression by considering the priority of the operators. ○ Identify the invalid expression ○ Operators: +,/,* and - ○ Nested Parenthesis: (())
2	Queues	<ul style="list-style-type: none"> • Simulating a shared resource management <ul style="list-style-type: none"> ○ Create a simulated version of a shared memory. ○ Generate N random requests for memory. ○ Use queues to manage the resource requests.
3	Singly Linked List	<ul style="list-style-type: none"> • Polynomial Arithmetic <ul style="list-style-type: none"> ○ Adding two polynomials of any degrees.
4	Doubly Linked List	<ul style="list-style-type: none"> • Simple Text Editor <ul style="list-style-type: none"> ○ Browsing through the text, line by line in both directions ○ Insert New lines anywhere in the text ○ Delete line/s from the text
5	Binary Trees	<ul style="list-style-type: none"> • Arithmetic Expression Conversion <ul style="list-style-type: none"> ○ Building an expression tree ○ Infix to Prefix conversion ○ Infix to Postfix conversion
6	Binary Search Trees	<ul style="list-style-type: none"> • Creating a dictionary of words <ul style="list-style-type: none"> ○ Insert a new word into a dictionary ○ Delete a word from a dictionary ○ Print Dictionary
7	Graphs	<ul style="list-style-type: none"> • Implementing Dijkstra’s algorithm and finding the shortest route between nodes
8	Hash Table	<ul style="list-style-type: none"> • Implementing the Rabin-Karp algorithm for pattern matching using Hashing
9	Heaps	<ul style="list-style-type: none"> • 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.

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 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, 2 nd 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, 1 st Edition, 2020, ISBN 978-1-108-84295-2, ISBN 978-1-108-95974-2.

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
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, 4 th Edition, Norton & Company, 2007
3.	Richard A. Johnson, Miller & Freund's - Probability And Statistics For Engineers, 9 th 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					
<p>Guidelines for Design Thinking Lab:</p> <ol style="list-style-type: none"> 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					
<ol style="list-style-type: none"> 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 through 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	:	CS139AT		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, 2 nd Edition, Prentice Hall, ISBN (13): 9780131103627.
3.	Turbo C: The Complete Reference, H. Schildt, 2000, 4 th 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	
<ol style="list-style-type: none">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<ul style="list-style-type: none">• 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:<ul style="list-style-type: none">• 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:<ul style="list-style-type: none">• Unary.• Arithmetic.• Logical.• Relational.• Conditional.• Bitwise.5. Develop a C program to compute the roots of the equation $ax^2 + bx + c = 0$.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
<p>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.</p> <p>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.</p>	
Unit – II	9 Hrs
<p>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.</p>	
Unit –III	9 Hrs
<p>Relations Properties of relations, Composition of Relations, Partial Orders, Hasse Diagrams, Equivalence Relations, and Partitions.</p> <p>Functions Functions-plain, One-to-one, onto functions, Stirling numbers of the second kind, Function composition and Inverse function, Growth of function.</p>	
Unit –IV	9 Hrs
<p>Groups theory Definition, Examples and Elementary properties, Abelian groups, Homomorphism isomorphism, cyclic groups, cosets and Lagrange’s theorem.</p> <p>Coding Theory: Elementary coding theory, the hamming metric, the parity-Check and Generator Matrices</p>	
Unit-V	9 Hrs
<p>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.</p> <p>Trees: Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Spanning trees.</p>	



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: IV					
ENVIRONMENT & SUSTAINABILITY					
Category: PROFESSIONAL CORE COURSE					
(Common to all Programs)					
(Theory)					
Course Code	:	CV242TA		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, 3 rd 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) 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 COURSE					
(Theory)					
(Common to all Programs)					
Course Code	:	ME242TB		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, 6 th 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, 4 th 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: IV			
BIO SAFETY STANDARDS AND ETHICS			
Category: PROFESSIONAL CORE COURSE			
(Theory)			
(Common to all Programs)			
Course Code	:	BT242TC	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, 1 st 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; 2 nd 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 : 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			
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			
<p>Business domain: Banking, Finance services, IT, Manufacturing, e-Commerce, Online services and marketing, Logistics and Supply Chain Management, Telecommunication.</p> <p>Applications: Communication & Networking, Search engines, Machine learning, Database management, Software tools development, Data organization, GPS navigation systems</p> <p>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.</p> <p>Brute Force: Selection Sort and Bubble Sort.</p>			
Unit – II			10Hrs
<p>Divide and Conquer: Merge sort, Quicksort, Multiplication of Long Integers, Strassen’s Matrix Multiplication.</p> <p>Decrease and Conquer: Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Application of DFS and BFS.</p>			
Unit –III			10Hrs
<p>Transform and Conquer: Presorting, Heapsort, Problem reduction.</p> <p>Space and Time Tradeoffs: Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool’s and Boyer-Moore algorithm.</p>			
Unit –IV			10Hrs
<p>Dynamic Programming: Computing a Binomial Coefficient, Warshall’s and Floyd’s Algorithms, 0/1 Knapsack Problem and Memory Functions.</p> <p>Greedy Technique: Prim’s Algorithm, Dijkstra’s Algorithm, Huffman Trees and codes, Fractional Knapsack Problem.</p>			
Unit-V			07 Hrs
<p>Backtracking: N-Queen’s Problem, Sum of Subset Problem.</p> <p>Branch-and-Bound: Travelling Salesperson Problem, Assignment Problem</p> <p>Decision Trees: Decision Trees for Sorting</p> <p>NP and NP-Complete Problems: Basic Concepts, Non- Deterministic Algorithms, P, NP, NP Complete, and NP-Hard classes</p>			

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 brute force 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 <ul style="list-style-type: none"> • Travelling salesperson problem • Assignment problem
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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 (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	09Hrs.
<p>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</p>	
Unit – II	09Hrs.
<p>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</p>	
Unit –III	09Hrs.
<p>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</p>	
Unit –IV	09 Hrs.
<p>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</p>	
Unit –V	09 Hrs
<p>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</p>	



PART-A	
Sl. No	<ul style="list-style-type: none"> • 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	
<p>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.</p> <ul style="list-style-type: none"> • 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 	

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
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			
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
<p>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.</p>	
Unit – II	09Hrs
<p>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.</p>	
Unit –III	08 Hrs
<p>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.</p>	
Unit –IV	09 Hrs
<p>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.</p>	
Unit-V	09Hrs
<p>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.</p>	

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	:	HS247LA		CIE	:	50 Marks
Credits: L: T: P	:	0:00:02		SEE	:	50 Marks
Total Hours	:	13P		SEE Duration	:	02 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	
<p>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.</p> <p>CIE will be evaluated based on their presentation, approach, and implementation strategies. (Any one of the below mentioned activity)</p> <ol style="list-style-type: none"> Helping local schools to achieve good result and enhance their enrolment in Higher/technical/ vocational education. Preparing an actionable business proposal for enhancing the village/ farmer income and approach for implementation. Developing Sustainable Water management system for rural/ urban areas and implementation approaches. Setting of the information imparting club for women leading to contribution in social and economic issues. Spreading public awareness/ government schemes under rural outreach program. (Minimum 5 programs) 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... Social connect and responsibilities Plantation and adoption of plants. Know your plants Organic farming, Indian Agriculture (Past, Present and Future) Connectivity for marketing Waste management – Public, Private and Govt organization, 5 R's Water conservation techniques – Role of different stakeholders - Implementation Govt. School Rejuvenation and assistance to achieve good infrastructure. 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	:	HS247LB		CIE	: 50 Marks
Credits: L: T: P	:	0:00:02		SEE	: 50 Marks
Total Hours	:	15P		SEE Duration	: 02 Hours
Unit-I					07Hrs.
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					03Hrs.
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts					
Unit –III					03Hrs.
Adventure activities: Trekking and obstacle course					
Unit –IV					02Hrs
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	:	HS247LC	CIE	:	50 Marks
Credits: L: T: P	:	0:00:02	SEE	:	50 Marks
Total Hours	:	30P	SEE Duration	:	2.00 Hours
					30 Hrs

Topics for Viva:

1. On rules and regulations pertaining to the games / sports
2. On dimensions of the court, size / weight of the ball and standards pertaining to that sports / game
3. Popular players and legends at state level / National level/ International level
4. Recent events happened and winner / runners in that sport / game
5. General awareness about sport / game, sports happenings in the college campus

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	:	HS247LD		CIE	:	50 Marks
Credits: L: T: P	:	0:00:02		SEE	:	50 Marks
Total Hours	:	13P		SEE Duration	:	02 Hours
Content						13 Hrs
<ol style="list-style-type: none"> 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 <p>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.</p> <p>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.</p>						

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	:	HS247LE		CIE	: 50 Marks
Credits: L: T: P	:	0:00:02		SEE	: 50 Marks
Total Hours	:	13P		SEE Duration	: 02 Hours
Contents					13 Hrs
<ol style="list-style-type: none"> 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	:	HS247LF		CIE	: 50 Marks
Credits: L: T: P	:	0:00:02		SEE	: 50 Marks
Total Hours	:	30P		SEE Duration	: 02 Hours
Contents					13 Hrs
1. Break the ICE 2. Introduction to freedom Talk to each and every single person for a period of 5 complete minutes. This is aimed at to make everyone in the room comfortable with each other. This helps everyone get over social anxiety, Shyness and Nervousness. 3. Ura 4. Rhythm Voice Projection, Voice Modulation, Weeping & Coughing Voice projection is the strength of speaking or singing whereby the voice is used powerfully and clearly. It is a technique employed to command respect and attention, as when a teacher talks to a class, or simply to be heard clearly, as used by an actor in a theatre. 5. 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	:	HS247LG	CIE
	:		: 50 Marks
Credits: L: T: P	:	0:00:02	SEE
	:		: 50 Marks
Total Hours	:	13P	SEE Duration
	:		: 02 Hours
Contents			13 Hrs.
<p>1. Use points, line and curves to create various shapes and forms</p> <p>2. Use of shapes and forms to create various objects and structures</p> <p>3. Recognizing distinctions in objects when viewed from various perspectives and grasping basic notions of perspective</p> <p>4. Students will be introduced to the significance of color in art, as well as the principles of color theory and application.</p> <p>5. Applied the concepts of unity, harmony, balance, rhythm, emphasis and proportion, abstraction and stylization to create a composition.</p> <p>6. Learn how to use which materials and for what types of art and textures.</p> <p>7. Use of the above concepts to create art through the medium of collage, mosaic, painting, mural, batik, tie and dye.</p> <p>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</p> <p>9. Familiarization with the many art forms and techniques of expression found throughout India.</p> <p style="text-align: center;">AND</p> <p style="text-align: center;">ONE EDUCATIONAL VISIT TO AN ART MUSEUM / INSTITUTE / GALLERY</p> <p>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.</p>			

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 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					
PHOTOGRAPHY AND FILM MAKING					
Category: ABILITY ENHANCEMENT COURSE					
(Lab)					
Course Code	:	HS247LH		CIE	: 50 Marks
Credits: L: T: P	:	0:00:02		SEE	: 50 Marks
Total Hours	:	13P		SEE Duration	: 02 Hours
Contents					13 Hrs
<p>1. Introduction to photography.</p> <p>2. Understanding the terminologies of DSLR.</p> <p>3. Elements of photography.</p> <p>4. Introduction to script writing, storyboarding.</p> <p>5. Understanding the visualization and designing a set.</p> <p>6. Basics of film acting</p> <p>7. Video editing using software</p> <p>8. Introduction to cinematography.</p> <p>9. Understanding about lighting and camera angles.</p> <p>10. Shooting a short film.</p> <p>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.</p> <p>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.</p>					

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 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			
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 : 02 Hours

Unit-I	10Hrs.
<p>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.</p> <p>Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility</p> <p>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;</p> <p>Practice Sessions to discuss the role others have played in making material goods available to me. Identifying from one’s own life</p>	
Unit – II	10Hrs.
<p>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.</p> <p>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</p>	
Unit –III	08 Hrs.
<p>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.</p>	

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	While keeping human relationships and human nature in mind. They would have better critical ability.
CO3	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.



Reference Books	
1.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004
3.	The Story of Stuff (Book).
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.	Small is Beautiful - E. F Schumacher.

RUBRICS 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 5 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 up to 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

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	:	MA149AT		CIE	:	50 Marks
Credits: L: T: P	:	2:0:0		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).	

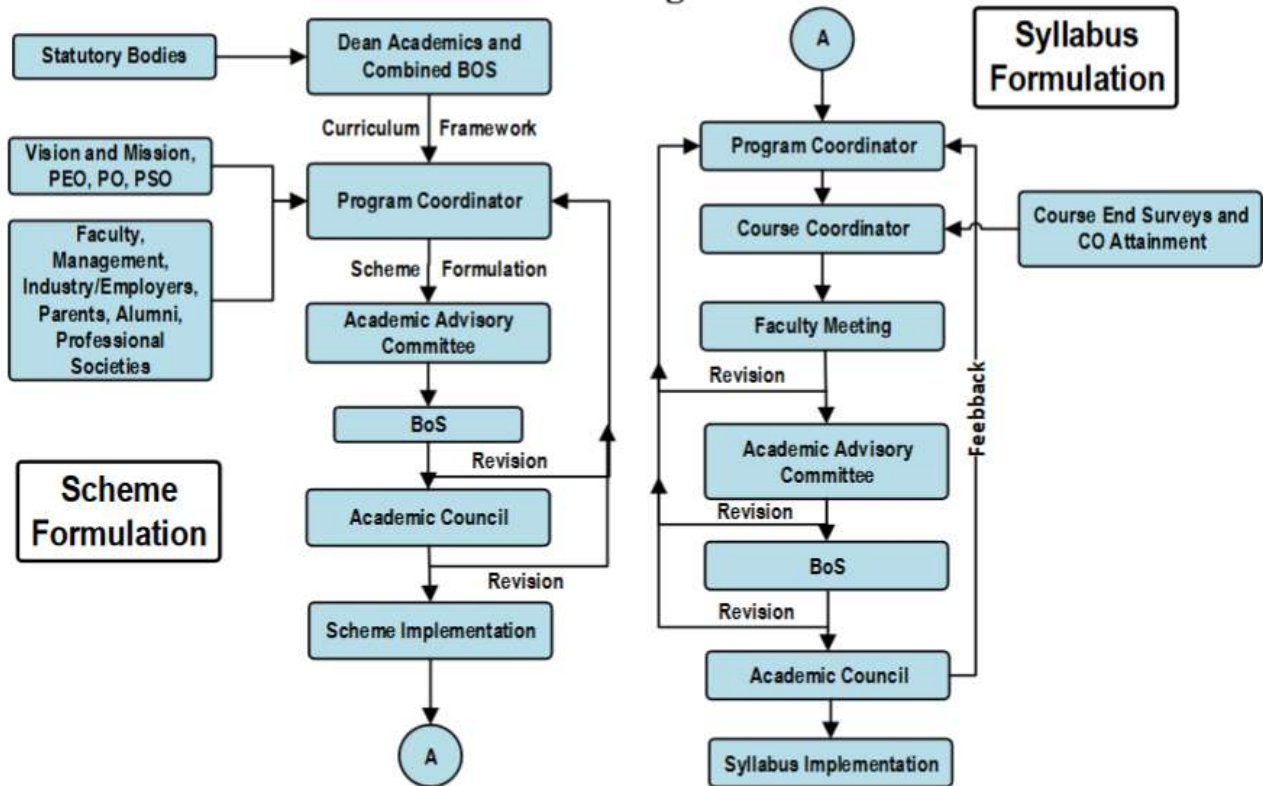
Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of partial differentiation, vector differentiation, higher order linear differential equations and numerical methods.
CO2:	Derive the solution by applying the acquired knowledge of differential 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.

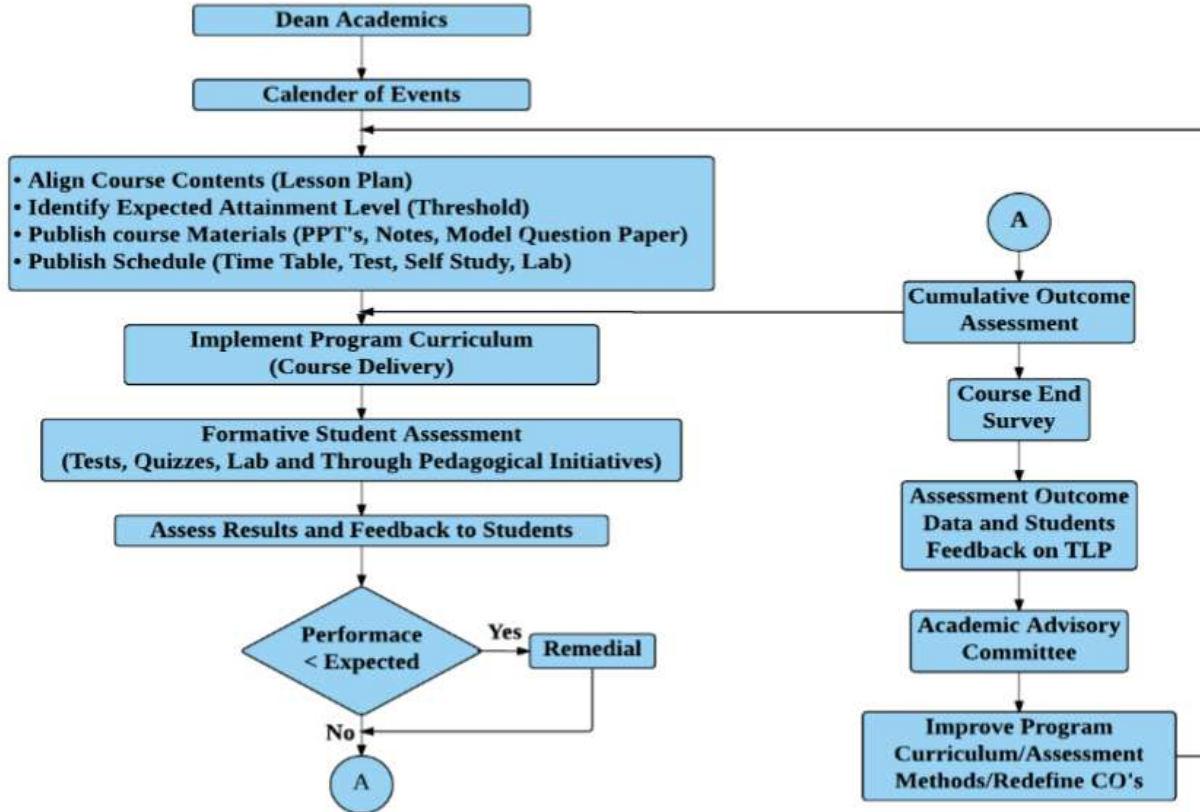


RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	QUIZZES: Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.	20
2.	TESTS: Students will be evaluated 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

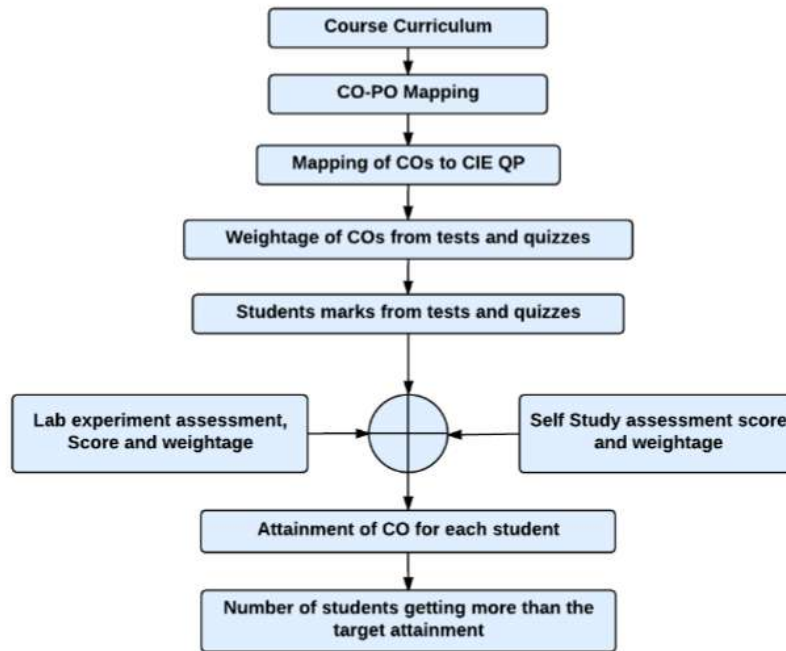
Curriculum Design Process



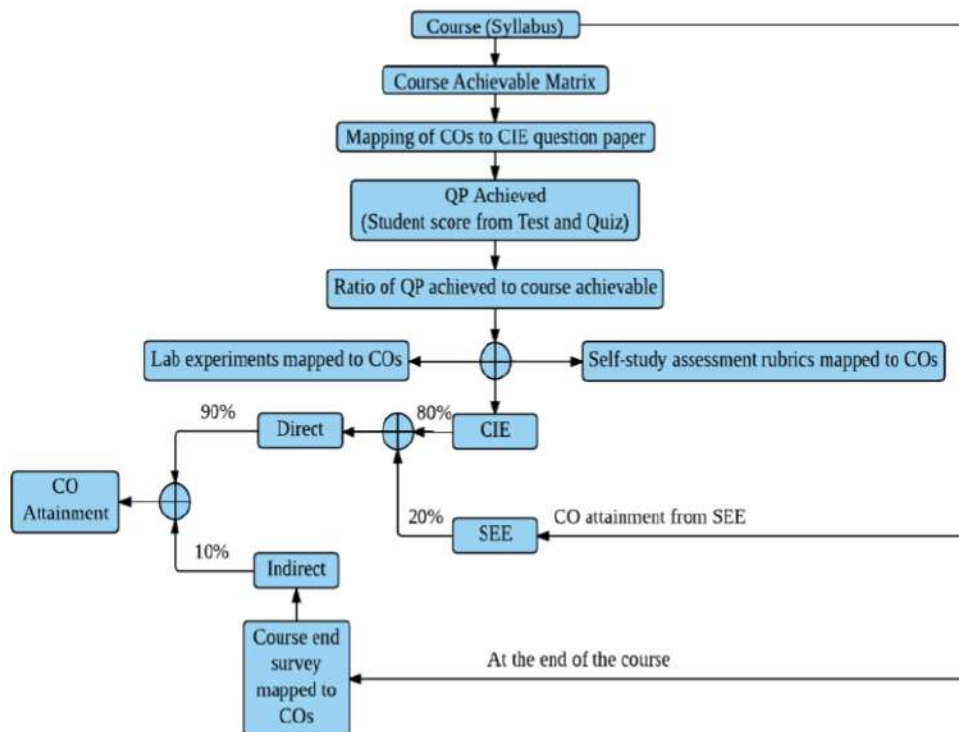
Academic Planning and Implementation



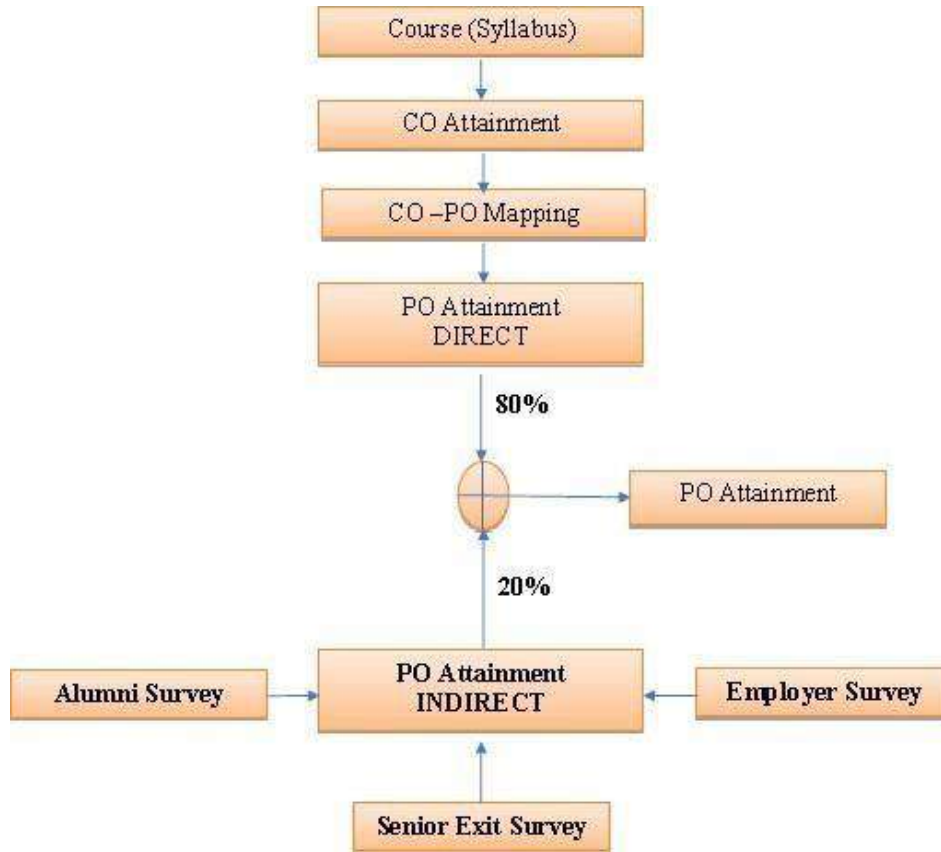
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcomes (POs) Attainment Process





Knowledge and Attitude Profile (WK)

- **WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- **WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- **WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- **WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- **WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- **WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- **WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- **WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- **WK9:** Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.



New Program Outcomes (PO)

- **PO1:** Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- **PO2:** Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- **PO3:** Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- **PO4:** Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- **PO5:** Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- **PO6:** The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- **PO7:** Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- **PO8:** Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- **PO9:** Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
- **PO10:** Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- **PO11:** Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

INNOVATIVE TEAMS OF RVCE

Ashwa Mobility Foundation (AMF): Designs and fabricates Formula-themed race cars and mobility solutions to address urban transportation issues.

Astra Robotics Team: Focuses on designing and building application-specific robots.

Coding Club: Helps students gain coding skills and succeed in competitions like GSoC and ACM-ICPC.

Entrepreneurship Development Cell (E-Cell): Promotes entrepreneurship through workshops, speaker sessions, and mentoring for startups.

Frequency Club Team: Works on software and hardware, emphasizing AI and Machine Learning.

Team Garuda: Develops a supermileage urban concept electric car and E-mobility products.

Team Jatayu: Builds low-cost UAVs with autonomous capabilities for various tasks.

Solar Car Team: Aims to create a solar electric vehicle for sustainable transportation.

Team Antariksh: Focuses on space technology and the development of operational rockets.

Team Chimera: Builds a Formula Electric Car through R&D in E-Mobility.

Helios Racing Team: Designs and tests All-Terrain Vehicles, participating in SAE's BAJA competitions.

Team Hydra: Develops autonomous underwater vehicles for tasks like water purification.

Team Krushi: Creates low-cost farming equipment to assist farmers in cultivation and harvesting.

Team Vyoma: Designs and tests radio-controlled aircraft and UAVs.

Team Dhruva: Engages in astronomy-related activities and collaborates on projects with organizations like ICTS and IIA.

Ham Club: Promotes Amateur Radio and explores technical innovations in communications, especially for disaster response.

Cultural Activity Teams

1. AALAP (Music club)
2. DEBSOC (Debating society)
3. CARV (Dramatics club)
4. FOOTPRINTS (Dance club)
5. QUIZCORP (Quizzing society)
6. ROTARACT (Social welfare club)
7. RAAG (Youth club)
8. EVOKE (Fashion team)
9. f/6.3 (Photography club)
10. CARV ACCESS (Film-making)



NSS of RVCE



NCC of RVCE

VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

MISSION

- To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

