RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

COMPUTER SCIENCE AND Engineering (DATA SCIENCE)

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)

THE HIGHER EDUCATION WORLD UNIVERSITY RANKINGS-2023
1501+
THE 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)

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.

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

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

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

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

ACADEMIC YEAR 2023-24

DEPARTMENT VISION

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

DEPARTMENTMISSION

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

PROGRAM EDUCATIONAL OBJECTIVES(PEOs)

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

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

ABBREVIATIONS

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

INDEX

III Semester			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	MAT231TC	Linear Algebra and Probability Theory	01
2.	XX232TX	Basket Courses - Group A	03-09
3.	IS233AI	Data Structures and Applications	10
4.	CS234AI	Applied Digital Logic Design and Computer Organization	13
5.	CS235AI	Operating Systems	17
6.	CS237DL	Design Thinking Lab	21
7.	CS139AT	Bridge Course: C Programming	23

IV Semester			
Sl. No.	**Course Code**	**Course Title**	**Page No.**
1.	CS241AT	Discrete Mathematical Structures and Combinatorics	25
2.	XX232TX	Basket Courses - Group A	28-35
3.	CD343AI	Design and Analysis of Algorithms	36
4.	CS344AI	IoT and Embedded Computing	40
5.	CY245AT	Computer Networks	44
6.	CS246TX	Professional Elective Courses - Group B	*****
7.	HS247LX	Ability Enhancement Course - Group C	46 – 59
8.	HS248AT	Universal Human Values	60
9.	MAT149AT	Bridge Course: Mathematics	62

Computer Science & Engineering [DATA SCIENCE]

THIRD SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	MAT	MAT231TC	Linear Algebra and Probability Theory	3	1	0	4	Theory	**100**	***	**3**	**100**	***
2	BT/ CV/ ME	XX232TX	Basket Courses - **Group A**	3	0	0	3	Theory	**100**	***	**3**	**100**	***
3	IS	IS233AI	Data Structure and Applications (Common to CS, IS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
4	CS	CS234AI	Applied Digital Logic Design and Computer Organisation (Common to CS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
5	CS	CS235AI	Operating Systems (Common to CS, IS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
6	CS	CS237DL	Design Thinking Lab	0	0	2	2	Practice	****	**50**	**2**	****	**50**
7	**CS**	**CS139AT**	**Bridge Course: C Programming**	**2**	**0**	**0**	**Audit**	**Audit Course**	**50**	***	***	***	***
				Total			**21**						

Slo. No.		Course Code	Course Title	Common to
1	MAT	MAT231TA	Linear algebra, fourier transforms and statistics	EC,EE, EI, ET
	MAT	MAT231TB	Statistics, laplace transform and numerical methods	AS, BT, CH, IM, ME
	MAT	MAT231TC	Linear algebra and probability theory	CD,CS,CY,IS
	MAT	MAT231TD	Applied mathematics for civil engineering	CV
	MAT	MAT231TE	Mathematics for artificial intelligence & machine learning	AI & ML

Group A: Basket Courses
(Students can select any ONE COURSE out of THREE COURSES in ODD Sem & ONE COURSE out of remaining courses in EVEN Sem)

2	CV	CV232TA	Environment & Sustainability	3	0	0	3	Theory
	ME	ME232TB	Material Science for Engineers	3	0	0	3	Theory
	BT	BT232TC	Bio Safety Standards and Ethics	3	0	0	3	Theory

Design Thinking Lab
During III Sem: AI, BT, CD, CS, CY & IS. During IV Sem: AS, CH, CV, EC, EE, EI, ET, IM & ME.

Computer Science & Engineering [DATA SCIENCE]

FOURTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	CS	CS241AT	Discrete Mathematical Structures and Combinatorics (Common to AI, CS, IS, CD & CY)	3	0	0	3	Theory	**100**	****	**3**	**100**	***
2	BT/CV/ME	XX232TX	Basket Courses - **Group A**	3	0	0	3	Thoery	**100**	****	**3**	**100**	***
3	CD	CD343AI	Design and Analysis of Algorithms (Common to AI, CS, IS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
4	CS	CS344AI	IoT and Embedded Computing (Common to CS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
5	CY	CY245AT	Computer Networks (Common to AI, CS, IS, CD & CY)	3	0	0	3	Theory	**100**	****	**3**	**100**	***
6	CS	CS246TX	Professional Elective Courses - **Group B**	2	0	0	2	NPTEL	**50**	****	**3**	**50**	***
7	HS	HS247LX	Ability Enhancement Course - **Group C**	0	0	2	2	Practice	****	**50**	**2**	****	**50**
8	HS	HS248AT	Universal Human Values	2	0	0	2	Theory	**50**	****	**2**	**50**	***
9	**MAT**	MAT149AT	**Bridge Course: Mathematics**	**2**	**0**	**0**	**Audit**	**Audit Course**	**50**	***	***	***	***
			Total				**23**						

Group A: Basket Courses (Students can select any ONE COURSE out of THREE COURSES in ODD Sem & ONE COURSE out of remaining courses in EVEN Sem)								
2	CV	CV242TA	Environment & Sustainability	3	0	0	3	Theory
	ME	ME242TB	Material Science for Engineers	3	0	0	3	Theory
	BT	BT242TC	Bio Safety Standards and Ethics	3	0	0	3	Theory

Group B: NPTEL COURSES (Professional Elective Courses)					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	CD	CD246TA	Machine Learning For Earth System Sciences (Common to CS, **CD**& CY)	NPTEL	2
	AI	AI246TB	Modern Algebra (Common to CS, IS, CD, **AI** & CY)	NPTEL	2
	CY	CY246TC	Distributed Systems (Common to CS, IS, CD &**CY**)	NPTEL	2
	IS	IS246TD	Introduction To Haskell Programming (Common to CS, **IS**, CD & CY)	NPTEL	2
	CS	CS246TE	Google Cloud Computing Foundations (Common to **CS**, IS, CD & CY)	NPTEL	2
	CS	CS246TF	Introduction to Graph Algorithm	NPTEL	2
	CS	CS246TG	Data Science for Engineers	NPTEL	2
	CS	CS246TH	Design Technology and Innovation	NPTEL	2

Group C: Ability Enhancement Courses During III Sem: AS, CH, CV, EC, EE, EI, ET, IM & ME. During IV Sem: AI, BT, CD, CS, CY & IS.					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
7	HS	HS247LA	National Service Scheme	LAB	2
	HS	HS247LB	National Cadet Corps	LAB	2
	HS	HS247LC	Physical Education : Sports & Athletics	LAB	2
	HS	HS247LD	Music	LAB	2
	HS	HS247LE	Dance	LAB	2
	HS	HS247LF	Theater (Light Camera & Action)	LAB	2
	HS	HS247LG	Art Work & Painting	LAB	2
	HS	HS247LH	Photography & Film Making	LAB	2

Semester: III						
LINEAR ALGEBRA AND PROBABILITY THEORY **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(Common to CD, CS, CY, IS)**						
Course Code	**:**	**MAT231TC**		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	**3:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L+30T**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Linear Algebra – I: Vector spaces, subspaces, linear dependence and independence, basis, dimension, four fundamental subspaces, rank-nullity theorem. Linear transformations - matrix representation, kernel and image of a linear transformation, dilation, reflection, projection, and rotation matrices. Implementation using MATLAB.	
Unit – II	**09 Hrs**
Linear Algebra - II: Inner Products, orthogonal matrices, orthogonal and orthonormal bases, Gram-Schmidt process, QR-factorization. Eigen values and Eigen vectors (recapitulation), diagonalization of a matrix (symmetric matrices) and singular value decomposition. Implementation using MATLAB.	
Unit –III	**09 Hrs**
Random Variables: Random variables-discrete and continuous, probability mass function, probability density function, cumulative distribution function, mean and variance. Two or more random variables - Joint probability mass function, joint probability density function, conditional distribution and independence, Covariance and Correlation. Implementation using MATLAB.	
Unit –IV	**09 Hrs**
Probability Distributions and Sampling Theory: Discrete and continuous distributions - Binomial, Poisson, Exponential and Normal. Sampling theory - Sampling, sampling distributions - Simple random sampling (with replacement and without replacement). Standard error, sampling distributions of means ($\int$ known), sampling distributions of proportions, sampling distribution of differences and sums. Implementation using MATLAB.	
Unit –V	**09 Hrs**
Inferential Statistics: Principles of Statistical Inference, Test of hypothesis - Null and alternative hypothesis, Procedure for statistical testing, Type I and Type II errors, level of significance, Tests involving the normal distribution, one –tailed and two – tailed tests, P – value, Special tests of significance for large and small samples (F, Chi – square, Z, t – test). Implementation using MATLAB.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of linear algebra, random variables, distributions, sampling and inferential statistics.
CO2:	Compute the solution by applying the acquired knowledge of linear algebra, random variables, distributions, sampling and inferential statistics to the problems of engineering applications.
CO3:	Analyze the solution of the problems obtained from appropriate linear algebra and probability techniques to the real-world problems arising in many practical situations.
CO4:	Interpret the overall knowledge of linear algebra, random variables, probability distributions, sampling theory and inferential statistics gained to engage in life – long learning.

Reference Books	
1	Linear Algebra and its Applications, David C. Lay, 3rd Edition, 2002, Pearson Education India, ISBN-13: 978-81-7758-333-5.
2	Linear Algebra with Applications, Steven J. Leon, 9th Edition, 2014, Pearson, ISBN: 13:978-0321962218.
3	Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th Edition, 2016, Pearson Education, ISBN-13: 978-0134115856.
4	Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, 6th Edition, 2014, John Wiley & Sons, ISBN:13 9781118539712, ISBN (BRV):9781118645062.
5	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 13-978-07-063419-0; ISBN: 10-0-07-063419-X.

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 (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/ IV

ENVIRONMENT & SUSTAINABILITY

Category: BASKET COURSES - GROUP A

(Theory)

(Common to all Programs)

Course Code	**:**	**CV232TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I — **10 Hrs**

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 Pollutions. Solid, Hazardous and E-Waste management.

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

Unit – II — **08 Hrs**

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- Socioeconomical and technological change.

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

Unit –III — **08 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.

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 –IV — **08 Hrs**

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.

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.

Unit –V — **08 Hrs**

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

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

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

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

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

Semester: III / IV						
MATERIALS SCIENCE FOR ENGINEERS **Category: BASKET COURSES - GROUP A** **(Theory)** **(Common to all Programs)**						
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 behavior: 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: fiber-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. Characterization 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	Analyze the effect of different heat treatment processes.
CO4	Recognize different types of nanomaterials, synthesis methods and characterisation techniques.

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

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

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

Semester: III / IV						
BIO SAFETY STANDARDS AND ETHICS **Category: BASKET COURSES - GROUP A** **(Theory)** **(Common to all Programs)**						
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 food borne pathogens, sources of microorganisms in the food chain (raw materials, water, air, equipment, etc.) Quality of foods, Microbial food spoilage and Food borne 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 Food borne 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,-978 :ISBN ,2013 8131774700.
2.	Cynthia A Roberts, The Food Safety, Oryx Press, 1st Edition, 2001, ISBN: 1–57356–305–6.
3.	Hal King, Food Safety Management Systems, Springer Cham, 2020, ISBN: 978-3-030-44734-2.
4.	Alastair V. Campbell , Bioethics: The Basics, Routledge; 2nd Edition, 2017, ISBN: 978-0415790314.

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	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						
DATA STRUCTURES AND APPLICATIONS **Category: PROFESSIONAL CORE COURSE** **(Theory and Lab)** **(Common to CS, IS, CD &CY)**						
Course Code	**:**	**IS233AI**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**09 Hrs**
Introduction: Introduction to Data structures, Types of Data Structures, Linear & non-linear Data Structures **Stacks:** Stack definitions & concepts, Representing stacks in C, Operations on stacks, Applications of Stacks: Infix to Postfix, Infix to Prefix, Postfix expression evaluation **Recursion:** Introduction to Recursion, Factorial function, Binary search, Towers of Hanoi problem, Role of the stack during execution	
Unit – II	**09 Hrs**
Queues: Representation of queue, operations, circular queues. Application of Queue: Message queue using circular queue. **Dynamic Memory allocation:** malloc(), calloc(),free(), realloc() **Linked Lists:** Definition and terminology, Singly Linked List (SLL), Various operations on SLL: insertion, deletion and display, getnode, freenode, and header node.	
Unit –III	**09 Hrs**
Circular Singly Linked List (CSLL): Definition, Various operations, Application: Queue implementation. Doubly Linked List (DLL), Circular Doubly Linked List (CDLL). Applications: Polynomial multiplication, Addition of long positive integers. **Trees:** Recursive Definition, Terminology, Binary Trees (BT), Binary Search Trees (BST), Expression Trees (ET).	
Unit –IV	**09 Hrs**
Various Operations on BT, BST, ET: Insertion, Deletion, Display and Traversals. Applications: Tree Sort, Infix, Postfix and Prefix. **Heap:** Definition, Construction, Applications of Heap: Heap Sort, Priority Queue.	
Unit –V	**09 Hrs**
Threaded Binary Tree: Types and application. Balanced tree: AVL trees, B+ tree, Splay and Tries. Graph: Preliminaries; Matrix and Adjacency List representation of Graphs. **Hashing:** Open Hashing, Closed Hashing, Collision and Collision Resolution Strategies.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Apply the knowledge of computing to define the various data structures and its operations.
CO 2	Analyse a problem and identify the suitable data structure to develop solution.
CO 3	Investigate &Design solution to a given problem using modern tools and appropriate data structure
CO 4	Implement solutions for real-time applications
CO 5	Demonstrate Good Coding Practices engaging in lifelong learning

Reference Books	
1.	Data Structures using C and C++, Yedidyah Langsam Moshe J. Augenstein and Aaron M. Tenenbaum, 2nd Edition, 2009, PHI/Pearson.
2.	Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4th Revised Edition, 2013, AddisonWesley, ISBN-13: 9780132847377
3.	Data Structures Using C, Reema Thareja, 1st Edition, 2011, Oxford Higher Education
4.	Fundamentals of Data Structures, Ellis Horowitz, Sartaj Sahni, Illustrated Edition, Computer Science Press.

LABORATORY COMPONENT

PART A

Note: The following programs can be executed on C/C++/Python/Java or any equivalenttool/language

Practice Programs:

Implementation and execution of following programs to understand basic concept and working of various data structures.

1. To solve tower of Hanoi problem.
2. To Implement a Stack using an Array
3. To Implement a Queue using an Array
4. To implement Stack using multiple Queues
5. To implement Queue using multiple Stacks
6. To Search for an Element in a Linked List
7. To reverse a Linked List
8. To Detect the Cycle in a Linked List
9. To Print Height and Depth of given Binary Tree
10. To Implement Binary Search Tree and tree traversals

Lab Programs:(At-least two application from each of the following data structure)

1. **Application of Stack**
   a) Implementation of Infix to Postfix conversion
   b) Implementation of Infix to Pretfix conversion
   c) Implementation of evaluation of postfix expression
   d) Implementation of evaluation of prefix evaluation

2. **Application of Queue**
   a) Implement Circular Buffer or Ring Buffer
   b) Implement Priority Queue to Add and Delete Elements
   c) Implementation of multiple stacks and queues
   d) Implementation of maze problem

3. **Application of List**
   a) Implementation of sparse matrix multiplication.
   b) Implementation of polynomials operations (addition, subtraction) using Linked List.
   c) Implementation of Linked Lists menu driven program (stack and queue)
   d) Implementation of Double ended queue using Linked Lists.

4. **Application of Heap, Tries and Hash Table**
   a) Implementation of Double hashing technique
   b) Implementation of priority queue using Binary Heap
   c) Implementation of Heapsort
   d) Implementation of dictionary using Tries

5. **Application of Trees**
   a) Implementation of conversion of Prefix to Postfix / Infix to Postfix /Postfix to Prefix using Expression Tree.

b) Implementation of various operations on Binary Tree like – creating a tree, displaying a tree, copying tree, mirroring a tree, counting the number of nodes in the tree, counting only leaf nodes in the tree.
c) Implementation of various operations on Binary Search Tree like – Inserting a node, Deleting A node, Displaying a tree, Tree Sort
d) ImplementationofB+tree

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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						
APPLIED DIGITAL LOGIC DESIGN AND COMPUTER ORGANISATION **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to CS, CD & CY)**						
Course Code	**:**	**CS234AI**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3: 0 : 1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L + 30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**9 Hrs**
Arithmetic: Addition and Subtraction of Signed Numbers, Multiplication of Unsigned Numbers, Multiplication of Signed Numbers, Fast Multiplication, Bit-Pair Recoding of Multipliers, Integer Division, Floating-Point Numbers and their single precision representation. **Simplification:** Karnaugh Maps and Quine Mc-Cluskey method to obtain minimal Expressions for Complete Boolean and Incomplete Boolean Expressions.	
Unit – II	**9 Hrs**
Binary Adders and Subtractors: Binary parallel adder, Carry Look Ahead Adders, decimal adder, Magnitude Comparator, Decoders,Encoders, Multiplexers. **Logic Design Using Sequential Circuits:** Flip-Flops and Applications - The Basic Bistable Elements, Latches, Timing Considerations, Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops), EdgeTriggered Flip-Flops, Characteristic Equations, Registers - SISO, SIPO, PISO, PIPO and Universal Shift Register.	
Unit –III	**9 Hrs**
Applications of FlipFlops: Binary Ripple Counters, Synchronous Binary Counters, Counters basedon Shift Registers. Design of Synchronous Counters and Self-Correcting Counters **Study and design of Synchronous Sequential Networks:** Synchronous Sequential Networks - Structure and operation of Clocked synchronous Sequential Networks, Analysisof Clocked Synchronous Sequential Networks, Modelling clocked synchronous sequential network behaviour, StateTable Reduction, The State Assignment.	
Unit –IV	**9 Hrs**
Basic Structure of Computers: Functional Units, Basic Operational Concepts, Performance – Technology and Parallelism. **Instruction Set Architecture:** Memory Locations and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language- Assembler Directives, Assembly and Execution of Programs. Stacks, Subroutines- Subroutine Nesting and the Processor Stack, Parameter Passing, The Stack Frame	
Unit –V	**9 Hrs**
Basic Processing Unit: Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control. **The Memory System:** Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Memory Hierarchy, Cache Memories- Mapping Functions, Examples of Mapping Techniques, Performance Considerations.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Apply design requirements for digital systems and Computer organization
CO 2	Analyse the models used for designing various Combinational and Sequential circuits
CO 3	Develop applications of synchronous sequential networks using flip flops, registers and counters
CO 4	Design optimized modern processors and memories for given specifications
CO 5	Investigate techniques of digital system design for building industry relevant real-world systems usingelectronic components and modern tools

Reference Books	
1	Carl Hamacher ,ZvonkoVranesic, SafwatZaky, NaraigManjikian "Computer Organization and Embedded Systems", Mc Graw Hill, 6th Edition, 2012, ISBN-13: 978-0-07-338065-0
2	Donald D.Givone, "Digital Principles and Design", Tata McGraw-Hill, 2003 ISBN-13: 0-07- 252503-7
3	David A. Patterson and John L. Hennessy, "Computer Organization and Design", Elsevier, 5th Edition, 2014, ISBN-13: 978-0-12-407726-3.
4	M. Morris Mano, "Digital Logic and Computer Design", 2016 Pearson India Education Services

LABORATORY COMPONENT

PART- A: Experiments

Conduction of laboratory exercises using digital trainer kit/FPGA/Appropriate simulator

Ex. No.	Description	
1	Realization of Excess-3 Code converter with Parallel Adder and Subtractor using 4-bit adder, using the IC – 7483.	
2.	Realization of Full Adder and Full Subtract or using Multiplexers, using IC 74153.	
3	Design and realization One Bit and Two-Bit Magnitude Comparator using logic Gates.	
4	a)	Realization of Binary to Gray Code Converter using decoders, using the IC 74139.
	b)	Realization of single digit Seven segment display using the BCD to seven segment decoders, using the IC–7447 and Realization of Priority Encoder using IC–74147.
5.	Design and Realization of Master-Slave JK Flip Flop using only NAND Gates.	
6	a)	Realization of Synchronous Up-Down programmable counter using IC 74192.
	b)	Realization of Asynchronous decade counter and its variations using IC 7490
7	a)	Design and realization of sequence generator using IC 7495.
	b)	Realization of Ring counter and Johnson counter using IC 7495.
8	Design of Mod-N Synchronous Up counters using IC 74112 / 7476 / Simulation	

PART- B: Innovative Experiments (IE) / Open Ended Experiments

Design a 4/8-bit CPU using the LOGISIM simulator, for the following specifications.

1) Program Counter (Assume 256 locations of program/code memory)
2) Instruction Register (Assume instruction size as 16 bit)
3) General Purpose Registers (RISC type-R0-R7): Use Harvard & Multiple Bus Architecture
4) ALU (to support 4-bit integer arithmetic operations & 4-bit logical operations)
5) Memory – 1024 locations of ROM (to store instructions of size 16 bit) and 256 RAM (to store 4-bit data)
6) Implement the following instructions namely: MOV, ADD, SUB, LOAD, STORE, AND, XOR, NOT, BRANCH, BRANCH ON CONDITION.
7) Result to be displayed on 7-segment displays / reg tab of LOGISIM

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREESub-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						
OPERATING SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to CS, IS, CD & CY)**						
Course Code	**:**	**CS235AI**		**CIE**	**:**	**100 + 50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 + 50 Marks**
Total Hours	**:**	**45L + 30P**		**SEE Duration**	**:**	**3 + 3 Hours**

Unit-I	**10 Hrs.**
Introduction- Perspectives Business domain: Virtualization and Cloud Computing Application: Traditional computing, Mobile computing, Distributed systems **Introduction** Operating System introduction, Operating System structure, Operating system Operations. **System Structures** Operating system services, System Calls, Types of System calls **Process Management** Process concept, Process scheduling, Operations on processes	
Unit – II	**08 Hrs.**
Multithreaded programming Overview, Multicore programming, Multithreading models, Thread libraries - pthreads **CPU scheduling and Process Synchronization** Basic concepts, scheduling criteria, scheduling algorithms-FCFS, SJF, RR, priority, Real-time CPU scheduling	
Unit –III	**09 Hrs.**
Process Synchronization Background, The Critical section problem, Peterson's Solution **Process Synchronization** Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization **Case study:** Implementation of classic synchronization problem using semaphores	
Unit –IV	**08 Hrs.**
Main Memory Management Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of page table. **Virtual memory** Background, Demand Paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing	
Unit –V	**10 Hrs.**
File Systems File Naming, File Structure, File Types, File Access, File Attributes, File Operations, An example program using File-System calls, File-System Layout, Implementing Files. **The Virtual File System:** The role of the Virtual File System (VFS), VFS data structure, Filesystem Types, Filesystem handling, Pathname lookup, Implementation of VFS System calls, File Locking.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Demonstrate the fundamental concepts of operating system like process management, file management, memory management and issues of synchronization.
CO 2	Analyze and interpret operating system concepts to acquire a detailed understanding of the course.
CO 3	Apply the operating systems concepts to address related new problems in computer science Domain.
CO 4	Design or develop solutions using modern tools to solve applicable problems in operating systems domain.
CO5	Extend the theoretical knowledge acquired through the course to demonstrate skills like investigation, effective communication, working in team/Individual, following ethical practices by implementing operating system concepts/applications and engage in lifelong learning.

Reference Books	
1.	Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin , Greg Gagne, 9th Edition, Incorporated, 2018, John Wiley & Sons, ISBN 978-1-265-5427-0
2.	Modern operating systems, Tanenbaum, Andrew, 4th Edition, Pearson Education, Inc 2009. ISBN 013359162X, 978-0133591620
3.	UNIX System Programming Using C++, Terrence Chan, 2011, Prentice Hall India, ISBN: 9788120314689 978-8120314689.
4.	Operating systems - A concept based Approach, D.M Dhamdhere, 3rd Edition, 2017, Tata McGraw-Hill, ISBN: 1259005585, 978-1259005589
5.	"xv6: a simple, Unix-like teaching operating system", https://pdos.csail.mit.edu/6.828/2014/xv6/book-rev8.pdf
6.	Understanding the LINUX Kernal, Daniel P Bovet and Marco Cesati, 3rd Edition, 17 November 2005, O'Reilly Publication, 9780596554910, 0596554915. (For Virtual File System of fifth unit)

Laboratory Component
PART A 1. Implementation of basic UNIX commands using file APIs- Write a program to implementcommandsls(-l option), cp, rm and mv using UNIX file APIs. 2. Apply the concepts of Process control system calls to build applications to demonstrate use of fork, execve, wait, getpid, exit system calls 3. Apply the pthread library to build Applications to demonstrate use of pthread library functions to create and manage threads. 4. Apply the concepts of Process/Thread synchronization to build Applications to demonstrate process/thread synchronization using semaphores and mutex. Implement Dining philosophers problem, reader-writer and producer-consumer. 5. Apply the concepts of Process/Thread synchronization for file access to build applications to demonstrate process/thread synchronization using file locks. 6. Apply the concepts of Static and Shared libraries to write a program to create and use static and shared libraries. Demonstrate the advantage of shared libraries over static libraries in terms of memory usage.

PART B
Open Ended Project

The students are expected to implement a mini project using operating system concepts andAPIs/system calls. They are required to form a team with constraint of maximum 3 persons in a team, select a problem/application of their choice to implement and to take confirmation from faculty incharge before starting the project. The objectives of project implementation are:

- Explore and understand underlying architecture, kernel structure and associated components for implementation of the project.
- Design and implement the solution using appropriate tools and platform.
- Documentation and submission of report

Sample projects can be kernel implementation from scratch, compiler implementation, assembler implementation, iOS system level programs, Android OS system level programs, Embedded OS system level programs, Raspberry Pi OS implementation, File System implementation and similar such projects.

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 (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRATICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type of questions covering entire syllabus	20
	PART B (Maximum of THREESub-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						
DESIGN THINKING LAB **Category: PROFESSIONAL CORE COURSE** **(Practical)**						
Course Code	**:**	**CS237DL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**56P**		**SEE Duration**	**:**	**2 Hours**

Guidelines for Design Thinking Lab:

1. The Design Thinking Lab (DTL) is to be carried out by a team of two-three students.
2. Each student in a team must contribute equally in the tasks mentioned below.
3. Each group has to select a theme that will provide solutions to the challenges of societal concern. Normally three to four themes would be identified by the 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.

The Design Thinking lab tasks would involve:

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

The students are required to submit the Poster and the report in the prescribed format provided by the department.

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

Scheme of Evaluation for CIE Marks:

Evaluation will be carried out in three phases:

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

Scheme of Evaluation for SEE Marks:

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

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, Nestedloops, Break and continue statements, goto statements **Arrays** Introduction, Declaration of Arrays, Accessing elements of an array, Storing values in arrays, Operations on Arrays- Traversing, Inserting and Deletion of element in an array. Two dimensional arrays- Operations on two dimensional arrays.	
Unit –IV	**6 Hrs**
Strings Introduction, Operations on strings- finding length of a string, converting characters of a string into uppercase and lowercase, Concatenating two strings, appending a string to another string, comparing two string, reversing a string. String and character Built in functions. **Functions** Introduction, Using functions, Function declaration/function prototype, Function definition, Function call, Return statement.	
Unit-V	**6 Hrs**
Functions Passing parameters to a function, Built-in functions. Passing arrays to functions. Recursion. **Structures and Pointers** Introduction: Structure Declaration, Typedef declaration, initialization of structures, accessing members of a structures, Introduction to pointers, declaring pointer variables.	

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Analyse problems and design solution using program design tools.
CO 2	Evaluate the appropriate method/data structure required in C programming to develop solutions by investigating the problem.
CO 3	Design a sustainable solution using C programming with societal and environmental concern by engaging in lifelong learning for emerging technology
CO 4	Demonstrate programming skills to solve inter-disciplinary problems using modern tools effectively by exhibiting team work through oral presentation and written reports.

Reference Books	
1.	Programming in C, Reema Thareja, 2018, Oxford University Press. ISBN: 9780199492282.
2.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2015, 2nd Edition, Prentice Hall, ISBN (13): 9780131103627.
3.	Turbo C: The Complete Reference, H. Schildt, 2000, 4th Edition, Mcgraw Hill Education, ISBN-13: 9780070411838.
4.	Algorithmic Problem Solving, Roland Backhouse, 2011, Wiley, ISBN: 978-0-470-68453-5

PRACTICE PROGRAMS

Implement the following programs using cc/gcc compiler

1. Familiarization with programming environment: Concept of creating, naming and saving the program file in gedit/vi editor, Concept of compilation and execution, Concept of debugging in GDB environment.
2. Implementation and execution of simple programs to understand working of
   - Formatted input and output functions- printf() and scanf().
   - Escape sequences in C.
   - Using formula in a C program for specific computation: For example: computing area of circle, converting Celsius to Fahrenheit, area of a triangle, converting distance in centimeters to inches, etc.
   - Preprocessor directives (#include, #define).
3. Execution of erroneous C programs to understand debugging and correcting the errors like:
   - Syntax / compiler errors.
   - Run-time errors.
   - Linker errors.
   - Logical errors.
   - Semantical errors.
4. Implementation and execution of simple programs to understand working of operators like:
   - Unary.
   - Arithmetic.
   - Logical.
   - Relational.
   - Conditional.
   - Bitwise.
5. Develop a C program to compute the roots of the equation ax2 + bx + c = 0.
6. Develop a C program that reads N integer numbers and arrange them in ascending or descending order using selection sort and bubble sort technique.
7. Develop a C program for Matrix multiplication.
8. Develop a C program to search an element using Binary search and linear search techniques.
9. Using functions develop a C program to perform the following tasks by parameter passing to read a string from the user and print appropriate message for palindrome or not palindrome.
10. Develop a C program to compute average marks of 'n' students (Name, Roll_No, Test Marks) and search a particular record based on 'Roll_No'.
11. Develop a C program using pointers to function to find given two strings are equal or not.
12. Develop a C program using recursion, to determine GCD , LCM of two numbers and to perform binary to decimal conversion.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**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**

Computer Science & Engineering [DATA SCIENCE]

FOURTH SEMESTER									Max Marks CIE		SEE Duration (H)	Max Marks SEE	
Slo. No.	**BoS**	**Course Code**	**Course Title**	**L**	**T**	**P**	**Credits**	**Category**	**Theory**	**Lab**	**Hours**	**Theory**	**Lab**
1	CS	CS241AT	Discrete Mathematical Structures and Combinatorics (Common to AI, CS, IS, CD & CY)	3	0	0	3	Theory	**100**	****	**3**	**100**	***
2	BT/CV/ME	XX232TX	Basket Courses - **Group A**	3	0	0	3	Thoery	**100**	****	**3**	**100**	***
3	CD	CD343AI	Design and Analysis of Algorithms (Common to AI, CS, IS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
4	CS	CS344AI	IoT and Embedded Computing (Common to CS, CD & CY)	3	0	1	4	Theory &Practice	**100**	**50**	**3**	**100**	**50**
5	CY	CY245AT	Computer Networks (Common to AI, CS, IS, CD & CY)	3	0	0	3	Theory	**100**	****	**3**	**100**	***
6	CS	CS246TX	Professional Elective Courses - **Group B**	2	0	0	2	NPTEL	**50**	****	**3**	**50**	***
7	HS	HS247LX	Ability Enhancement Course - **Group C**	0	0	2	2	Practice	****	**50**	**2**	****	**50**
8	HS	HS248AT	Universal Human Values	2	0	0	2	Theory	**50**	****	**2**	**50**	***
9	**MAT**	MAT149AT	**Bridge Course: Mathematics**	**2**	**0**	**0**	**Audit**	**Audit Course**	**50**	***	***	***	***
			Total				**23**						

Group A: Basket Courses (Students can select any ONE COURSE out of THREE COURSES in ODD Sem & ONE COURSE out of remaining courses in EVEN Sem)								
2	CV	CV242TA	Environment & Sustainability	3	0	0	3	Theory
	ME	ME242TB	Material Science for Engineers	3	0	0	3	Theory
	BT	BT242TC	Bio Safety Standards and Ethics	3	0	0	3	Theory

Group B: NPTEL COURSES (Professional Elective Courses)					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	CD	CD246TA	Machine Learning For Earth System Sciences (Common to CS, **CD**& CY)	NPTEL	2
	AI	AI246TB	Modern Algebra (Common to CS, IS, CD, **AI** & CY)	NPTEL	2
	CY	CY246TC	Distributed Systems (Common to CS, IS, CD &**CY**)	NPTEL	2
	IS	IS246TD	Introduction To Haskell Programming (Common to CS, **IS**, CD & CY)	NPTEL	2
	CS	CS246TE	Google Cloud Computing Foundations (Common to **CS**, IS, CD & CY)	NPTEL	2
	CS	CS246TF	Introduction to Graph Algorithm	NPTEL	2
	CS	CS246TG	Data Science for Engineers	NPTEL	2
	CS	CS246TH	Design Technology and Innovation	NPTEL	2

Group C: Ability Enhancement Courses During III Sem: AS, CH, CV, EC, EE, EI, ET, IM & ME. During IV Sem: AI, BT, CD, CS, CY & IS.					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
7	HS	HS247LA	National Service Scheme	LAB	2
	HS	HS247LB	National Cadet Corps	LAB	2
	HS	HS247LC	Physical Education : Sports & Athletics	LAB	2
	HS	HS247LD	Music	LAB	2
	HS	HS247LE	Dance	LAB	2
	HS	HS247LF	Theater (Light Camera & Action)	LAB	2
	HS	HS247LG	Art Work & Painting	LAB	2
	HS	HS247LH	Photography & Film Making	LAB	2

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

Unit-I	**9 Hrs**
Fundamental Principles of Counting and Combinatorics The Rule of Sum and Product, Permutations, Combinations, Principle of Inclusion and Exclusion, Derangements, The Binomial Theorem, Combinations with repetition. **Recursive Definitions, Recurrence Relations** Recursive definition, First order linear recurrence relation- Formulation problems and examples, Second order linear recurrence relations with constant coefficients- Homogeneous and Non homogeneous, Generating functions.	
Unit – II	**9 Hrs**
Fundamentals of Logic Basic Connectives and Truth Tables, Tautologies, Logical Equivalence: The laws of logic, Logical Implications, Rules of inference. Open Statement, Quantifiers, Definition and the use of Quantifiers, Definitions, and the proofs of theorems.	
Unit –III	**9 Hrs**
Relations Properties of relations, Composition of Relations, Partial Orders, Hasse Diagrams, Equivalence Relations, and Partitions. **Functions** Functions-plain, One-to-one, onto functions, Stirling numbers of the second kind, Function composition and Inverse function, Growth of function.	
Unit –IV	**9 Hrs**
Groups theory Definition, Examples and Elementary properties, Abelian groups, Homomorphism isomorphism, cyclic groups, cosets and Lagrange's theorem. **Coding Theory:** Elementary coding theory, the hamming metric, the parity-Check and Generator Matrices	
Unit-V	**9 Hrs**
Introduction to Graph Theory: Graphs and their basic properties - degree, path, cycle, complement, subgraphs, isomorphism, Computer representations of graphs. Eulerian and Hamiltonian graphs, Graph coloring, Planar graphs. **Trees:** Definitions, Properties, and Examples, Routed Trees, Trees and Sorting, Spanning trees.	

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Apply the concepts of discrete mathematical structures for effective computation and relating problems in the computer science domain.
CO 2:	Analyze the concepts of discrete mathematics to various fields of computer science.
CO 3:	Design solutions for complex problems using different concepts of discrete mathematical structure as a logical predictable system.
CO 4:	Explore/Develop new innovative ideas to solve some open problems in theoretical computer science.
CO 5:	Effectively communicate, work in groups in order to accomplish a task and engage in continuing professional development.

Reference Books:	
1.	Ralph P. Grimaldi and B V Ramana, Discrete and Combinatorial Mathematics- An Applied Introduction, Pearson Education, Asia, 5th Edition – 2017, ISBN 978-0321385024
2.	J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata – McGraw Hill, 1st Edition 2017, ISBN 13:978-0074631133
3.	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata – McGraw Hill, 6th Edition, 7 edition 2017, ISBN-(13): 978-0070681880

EXPERIENTIAL LEARNING

Based on the concepts learnt in this course like relations, functions- problems on graph theory such as graph coloring, scheduling problems could be given for Experiential learning.

Also using the concepts of logical reasoning and group theory some of the NLP problems could also be given for Experiential learning.

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

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

Semester: III/ IV						
ENVIRONMENT & SUSTAINABILITY **Category: BASKET COURSES - GROUP A** **(Theory)** **(Common to all Programs)**						
Course Code	**:**	**CV242TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
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 Pollutions. Solid, Hazardous and E-Waste management. Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.	
Unit – II	**08 Hrs**
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-Socioeconomical and technological change. Applications of - Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.	
Unit –III	**08 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. 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 –IV	**08 Hrs**
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. **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.	

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

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

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

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

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

Semester: III / IV						
MATERIALS SCIENCE FOR ENGINEERS **Category: BASKET COURSES - GROUP A** **(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 behavior: 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: fiber-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. Characterization 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	Analyze the effect of different heat treatment processes.
CO4	Recognize different types of nanomaterials, synthesis methods and characterisation techniques.

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

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

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

Semester: III / IV						
BIO SAFETY STANDARDS AND ETHICS **Category: BASKET COURSES - GROUP A** **(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 o 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 food borne pathogens, sources of microorganisms in the food chain (raw materials, water, air, equipment, etc.) Quality of foods, Microbial food spoilage and Food borne 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 Food borne 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: IV						
DESIGN AND ANALYSIS OF ALGORITHMS **Category: PROFESSIONAL CORE COURSE** **(Theory and Practice)** **(Common to CS, IS, CD, AI & 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 +3 Hours**

Unit-I	**8Hrs**
Introduction- Perspectives **Business domain:** Banking, Finance services, IT, Manufacturing, e-Commerce, Online services and marketing, Logistics and Supply Chain Management, Telecommunication. **Applications:** Communication & Networking, Search engines, Machine learning, Database management, Software tools development, Data organization, GPS navigation systems **Introduction:** Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithmic Efficiency: Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non-recursive and Recursive Algorithms. **Brute Force:** Selection Sort and Bubble Sort.	
Unit – II	**10Hrs**
Divide and Conquer: Merge sort, Quicksort, Multiplication of Long Integers, Strassen's Matrix Multiplication. **Decrease and Conquer:** Insertion Sort, Depth First Search, Breadth First Search, Topological Sorting, Application of DFS and BFS.	
Unit –III	**10Hrs**
Transform and Conquer: Presorting, Heapsort, Problem reduction. **Space and Time Tradeoffs:** Sorting by Counting, Naive String Matching, Input Enhancement in String Matching: Horspool's and Boyer-Moore algorithm.	
Unit –IV	**10Hrs**
Dynamic Programming: Computing a Binomial Coefficient, Warshall's and Floyd's Algorithms, 0/1 Knapsack Problem and Memory Functions. **Greedy Technique:** Prim's Algorithm, Dijkstra's Algorithm, Huffman Trees and codes, Fractional Knapsack Problem.	
Unit-V	**7 Hrs**
Backtracking: N-Queen's Problem, Sum of Subset Problem. **Branch-and-Bound:** Travelling Salesperson Problem, Assignment Problem **Decision Trees:** Decision Trees for Sorting **NP and NP-Complete Problems:** Basic Concepts, Non- Deterministic Algorithms, P, NP, NP Complete, and NP-Hard classes	

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

Reference Books	
1.	Introduction to the Design and Analysis of Algorithms, Anany Levitin, University, 3rd Edition, 2012, Pearson, ISBN 13: 978-0-13-231681-1.
2.	Introduction to Algorithms, Cormen T.H., Leiserson C.E., Rivest R.L., Stein C., 3rd Edition, 2010, PHI, ISBN:9780262033848.
3.	Computer Algorithms, Horowitz E., Sahani S., Rajasekharan S., 2nd Edition, 2006, Galgotia Publications, ISBN:9780716783169.

Laboratory Component

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

Practice Programs:

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

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

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

3. Apply transform and conquer strategy
    - Heapsort
    - Checking element uniqueness after presorting
4. Apply input enhancement strategy to solve string-matching problem
    - Horspool's algorithm
    - Boyer – Moore's algorithm
5. Apply dynamic programming strategy to solve optimization problem
    - Warshall - Floyd's Algorithms,
    - Knapsack problem solution using memory function.

6. Apply greedy strategy to solve graph problem
    - Dijkstra's algorithm
    - Prim's algorithm
7. Apply backtracking strategy to solve combinatorial problem
    - N- Queen's problem
    - Subset – sum problem
8. Apply branch and bound strategy to solve combinatorial problem
    - Travelling salesperson problem
    - Assignment problem

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION		
#	**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 (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRATICE)	**150**

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

IOT AND EMBEDDED COMPUTING

Category: PROFESSIONAL CORE COURSE

(Theory and Practice)

(Common to CS, CD & CY)

Course Code	**:**	**CS344AI**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L+30P**		**SEE Duration**	**:**	**3+3 Hours**

Unit – I **9 Hrs**

Introduction to Embedded Systems and Applications

Embedded Systems: Definition, Desirable Features & General Characteristics. Embedded Systems Vs General Computing Systems, Model of an Embedded System, Classification of Embedded Systems, Examples of Embedded Systems.

ARM Processor/Controllers**:** History of the ARM Processor, the ARM Core, features of ARM Processors, ARM Processor families - Cortex A, Cortex R and Cortex M.

Interfacing and Application Development Using ARM Microcontroller: LPC 2148 ARM Microcontroller-Features of the LPC 214X Family, Internal Block Diagram of LPC 2148. Block Diagram of MCB 2140 compatible board / RV-ARM-Board, Keil IDE features for embedded application development

Unit – II **9 Hrs**

Embedded System Design using ARM Micro-controllerLPC 2148

Digital Interfacing: LPC 2148 GPIO, Interfacing and Programming with LEDs, Switches, seven segment displays, LCD, Matrix Keypad, Stepper motor, DC Motor, Relay, Opto-isolators.

Analog Interfacing:Analog Interfacing using LPC 2148 ADC Channels, Interfacing with LDR and Temperature sensors. Using DAC for Waveform Generations. (Programs using embedded C)

Unit-III **9 Hrs**

Timers, PWM, Interrupts & Embedded Serial protocols

PWM, Timers and Interrupts: Timers – working of the Timer unit, Programming Timers and Writing Delay programs. Interrupts – Types, Nested Vectored Interrupt Controller, priorities and programming Timers with Interrupts. PWM – working of The Pulse Width Modulation Unit and Programming Using PWM Channels. (Programs using embedded C)

Embedded Serial Protocols: Working & Programming of LPC 2148 UART – Registers, Baud rate calculation, Interface to PC and program development for data transmission.I2C, SPI: Working and Applications of serial protocols I2C and SPI Buses. (No programs)

Unit – IV **9 Hrs**

Internet Of Things – Introduction, Concepts and Use-Cases

Introduction and Concepts:Definition& Characteristics of IOT, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, Levels of IOT deployment.
Use-Cases:Use cases of IOT pertaining to different domains.(Chapters 1,2 from the Reference book 2)

Unit – V **9 Hrs**

Design and Deployment of Internet of Things (IOT)Applications

IOT physical devices and End points: NodeMCU/ESP32(RV-IOT-Board),RaspberryPi: Block diagram, Features and Interfaces.
IOT Physical Servers & Cloud Offerings: Xively /Thing Speak, AWS IOT : Features, Usage and Deployment.
Case Studies: Case studies illustrating IOT design – Home automation, Smart Cities, Agriculture.
(Chapters 5,7,8,9 from Reference book 2)

Course Outcomes: After completing the course, the students will be able to:-	
CO 1	Apply Embedded System and IoT fundamentals and formulate sustainable societal relevant cost-effective solutions.
CO 2	Demonstrate the development of software programs using Embedded C, using Microcontrollers and different sensors and peripherals to build embedded system applications.
CO3	Design smart systems using various I/O peripherals, Sensors, embedded protocols like UART,I2C,SPI using modern tools like Keil IDE software for various domains like Healthcare, automation, agriculture, smart cities and others.
CO 4	Indulge in developing Novel multi-disciplinary IoT projects using prototype boards, with effective oral & written communication skills and working in teams.
CO 5	Engage in Lifelong Learning by investigating and executing real world societal problems using engineering tools – Cross compilers, debuggers and simulators, emerging processor and controller-based hardware platforms, IOT cloud infrastructure & protocols.

Reference Books	
1.	Embedded Systems – An integrated approach, Lyla B. Das, 2013, Pearson Education, ISBN- 978-81-317-8766-3.
2.	Internet of Things – A Hands on approach, Arshdeep Bahga, Vijay Madisetti, 2016, Universities Press, ISBN – 978-81-7371-954-7.
3.	Embedded Systems, Architecture, Programming and Design, Raj Kamal, 2nd Edition-Reprint 2011, Tata McGraw-Hill, ISBN-978-0-07-066764-8.
4.	Interfacing Digital & Analog Peripherals using ARM LPC 2148 based RV-ARM-Board Handbook
5.	Internet of Things, V.K.Jain, Khanna Publications, 2021, ISBN No: 978-81-952075-2-7

Laboratory Component
Laboratory Experiments comprises of, 1. Part A – Embedded Systems Programs Using RV-AllInOne-ARM Board with Embedded C (Keil IDE) 2. Part B – IOT Projects, Using RV-IOT-Kit / RasberrPie, ThingSpeak / AWS Cloud, Web/MobileApp **3.** Prototype the New idea (Productathon, a hackathon style product development competition)

PART A:

Laboratory Experiments using RV-ARM-Board (LPC 2148 ARM Microcontroller) comprises of,

1B) Simulator Elevator Interface using switches and LEDs.

2B) Seven Segment Display Interface: Write a C program to display messages "FIRE" & "HELP" on 4-digit seven segment display alternately with a suitable delay. Extend the program to implement moving display and displaying the numbers.

3B) Stepper Motor Interface: Write an Embedded C program to rotate stepper motor in clockwise direction for "M" steps, anti-clock wise direction for "N" steps. Extend the program to link the movement with the keys and realize the required RPM.

4B) DAC Interface: Write an Embedded C program to generate sine, full rectified, triangular, sawtooth and square waveforms using DAC module.

5B) Matrix Keyboard Interface: Write an Embedded C program to interface 4 X 4 matrix keyboard using lookup table and display the key pressed on the Terminal. Extend the program to read multi digit number.

6B) DC Motor Interface: Write an Embedded C program to generate PWM wave to control speed of DC motor. Control the duty cycle by analog input. Extend the program to link the speed with LDR/Temperature sensors.

7B) Character/Graphics LCD Interface: Write an Embedded C program to display text messages on the display.

PART-B

Design &Develop IOT based Solutions, using (RV-IOT-Board / Raspberry Pi, Use ThingSpeak /AWS cloud services, Use Web Application Frameworks like Django/Mobile App using C/C++/ Phython coding and relevant libraries/APIs

1b. Smart Lighting

2b. Intrusion Detection System

3b. Smart Parking

4b. Weather Monitoring System

5b. Weather Reporting Bot

6b. Forest Fire Detection

7b. Smart Irrigation

Prototype the New idea (Productathon)

Then students are given specific time (a Day or Two) to build their idea into a prototype using the previous Lab Programs carried out. Then an academic & industry panel of judges will evaluate their works and the best three prototypes will be awarded. All the students are required to submit the report, consisting of Hardware circuits, software codes and screenshots of the prototype.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50Marks**, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (10) Designing & Modeling (10)**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 (20 Marks), lab test (10 Marks) and Innovative Experiment/ Concept Design and Implementation (20 Marks) adding up to 50 Marks. THE FINAL MARKS WILL BE 50MARKS	**50**
MAXIMUM MARKS FOR THE CIE THEORY (THEORY AND PRATICE)		**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 THREESub-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 CS, IS, CD, AI & CY)**						
Course Code	**:**	**CY245AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**10Hrs**
Introduction-Perspectives **Business Domains:** Networks. **Applications**: Resource Sharing, Client Server programming, e-commerce and digital communications. Introduction: Networks, Network types. Network Models: TCP / IP protocol suite, Addressing, The OSI Model. Transmission Modes: Parallel Transmission and Serial Transmission. Link Layer: Data Link Control(DLC): DLC Services, Data Link Layer Protocols, High Level Data Link Control (HDLC), Point-to-Point Protocol (PPP): Framing, Transition phases. Media Access Control (MAC): Random Access: CSMA/CD,CSMA/CA.	
Unit – II	**09Hrs**
Network layer design issues: Store and Forward packet Switching, Services Provided to the Transport Layer Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram Subnets; Routing algorithms: Shortest Path Routing, Flooding, Distance Vector Routing, Link state Routing, Hierarchical Routing Broadcast Routing, and Multicast Routing.	
Unit –III	**08 Hrs**
Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies, Congestion Control in Virtual-Circuit Subnets, Congestion Control in Datagram Subnets, Load Shedding, Jitter Control; Quality Of Service: Requirements, Techniques for Achieving Good Quality of Service, Integrated Services Differentiated Services.	
Unit –IV	**09 Hrs**
Internetworking: How networks differ, How networks can be connected, Connectionless Internetworking, Tunnelling, Internetwork Routing, Fragmentation. **The Network Layer in the Internet**: The IP Protocol, IP Addresses, Internet Control Protocols, OSPF-Interior Gateway Routing Protocol, BGP- Exterior Gateway Routing Protocol, IPv6.	
Unit-V	**09Hrs**
The Internet Transport Protocols: Introduction to UDP, Introduction to TCP. The TCP Service Model. **The TCP Protocol:** TCP protocol, TCP Segment Header, TCP Connection Establishment, TCP Connection Release. TCP Transmission Policy, TCP Congestion Control, TCP Timer Management. **Application Layer:** World Wide web and HTTP, Telnet.	

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

Reference Books	
1.	Data Communications and Networking, Behrouz A Forouzan, 5th Edition, 2013, Tata McGraw-Hill, ISBN –9781259064753.
2.	Computer Networks, Andrew S Tanenbaum, 5th Edition, 2014, Pearson Education; ISBN– 978-81-7758-165-2.
3.	Computer Networking, A Top-Down Approach, James Kurose and Keith Ross, 6th Edition, 2013, ISBN-13: 978-0-13-285620-1.
4.	Data and Computer Communications, William Stallings, 8th Edition, 2009, Pearson Education, ISBN-13: 978-0131392052.

EXPERIENTIAL LEARNING

To work on Problems similar to following aspects of Networks: Modern Networking tools usage to solve problems in Networking (Path Characterization & Bandwidth Estimation, Analysing Real-time information about the global routing system, Measure latency and packet loss reason in wired and wireless network). Online data Privacy, Host/Network Intrusion detection, Detection of potential DDoS attacks, Network analysis to monitor Ethernet and WLAN traffic in real time, IP Spoofing, TCP Off path attacks, Privacy Preserving network log data, wireless Security).

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. 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						
NATIONAL SERVICE SCHEME(NSS) **Category: ABILITY ENHANCEMENT COURSE - GROUP C** **(Practical)**						
Course Code	:	**HS247LA**		**CIE**	:	**50 Marks**
Credits: L: T: P	:	**0:0:2**		**SEE**	:	**50 Marks**
Total Hours	:	**13P**		**SEE Duration**	:	**02 Hrs**

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	**26 Hrs**

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

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

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

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the importance of his/her responsibilities towards society.
CO2	Analyze the environmental and societal problems/ issues and will be able to design solutions for the same.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainable development.

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

Semester: IV						
NATIONAL CADET CORPS(NCC) **Category: ABILITY ENHANCEMENT COURSE - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LB**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**15P**		**SEE Duration**	**:**	**02 Hrs**
Unit-I						**10 Hrs**
Drill: 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						**06 Hrs**
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts						
Unit –III						**06 Hrs**
Adventure activities: Trekking and obstacle course						
Unit –IV						**04 Hrs**
Social Service and Community Development (SSCD): Students will participate in various activities throughout the semester e.g., Blood donation Camp, Swachhata Abhiyan, Constitution Day, All National Festival						

Course Outcomes: After 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 & ATHLETICS) Category: ABILITY ENHANCEMENT COURSE - GROUP C (Practical)						
Course Code	**:**	**HS247LC**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.5 Hrs**
Content						**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 - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LD**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Content						**13 Hrs**

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

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

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

Course Outcomes: After 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 - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LE**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**26 Hrs**

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

Course Outcomes: After 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, Jacqueline M. Smith

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 - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LF**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**26 Hrs**

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

Course Outcomes: After 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 informed 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 - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LG**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**

Contents — **26 Hrs**

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

AND

ONE EDUCATIONAL VISIT TO AN ART MUSEUM / INSTITUTE / GALLERY

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

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Use lines, shapes, and colors to depict the various sentiments and moods of life and nature.
CO2	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	Develop the ability to properly use drawing and painting materials (surfaces, tools and equipment, and so on).
CO4	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 & FILM MAKING **Category: ABILITY ENHANCEMENT COURSE - GROUP C** **(Practical)**						
Course Code	**:**	**HS247LH**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**26 Hrs**

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

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

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

Course Outcomes: After 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 (Theory) (Common to all Programs)						
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	**10 Hrs**
Course Introduction-Need, Basic Guidelines,Content and Process for Value Education: PurposeandmotivationforthecourserecapitulationfromUniversalHumanValues-I,Self-Exploration'Natural Acceptance' and Experiential Validation Continuous Happiness and Prosperity- Human Aspirations, Right understanding, Relationship and Physical Facility, Understanding Happiness and Prosperity correctly. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility. **Understanding Harmony in the Human Being-Harmony in Myself!**: Understanding human being as a co- existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' Understanding the Body as an instrument of Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life.	
Unit – II	**10 Hrs**
Understanding Harmony in the Family and Society-Harmony in Human Relationship: Understanding values in human-human relationship; meaning of Justice and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	
Unit –III	**08 Hrs**
Understanding Harmony in the Nature and Existence –Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness, and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence. Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	

Course Outcomes: After completion of 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 so that they will 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 ableto 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, NewAge Intl.Publishers, NewDelhi, 2004
3	The Story of Stuff(Book).
4	The Story of My Experiments with Truth-by Mohandas Karamchand Gandhi
5	Small is Beautiful-E.F Schumacher.
6	Slow is Beautiful-Cecile Andrews.

RUBRICFOR THE CONTINUOUS INTERNAL EVALUATION (LAB)		
#	**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**

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)	12
3 & 4	Unit 2 : Question 3 or 4	14
5 & 6	Unit 3 : Question 5 or 6	14
	TOTAL	**50**

Semester: IV						
Bridge Course: MATHEMATICS (Mandatory Audit Course) (Common to all Programs)						
Course Code	**:**	MAT149AT		**CIE**	**:**	50 Marks
Credits: L: T:P	**:**	2:0:0		**SEE**	**:**	**NO SEE**(AUDIT COURSE)
Total Hours	**:**	30L				

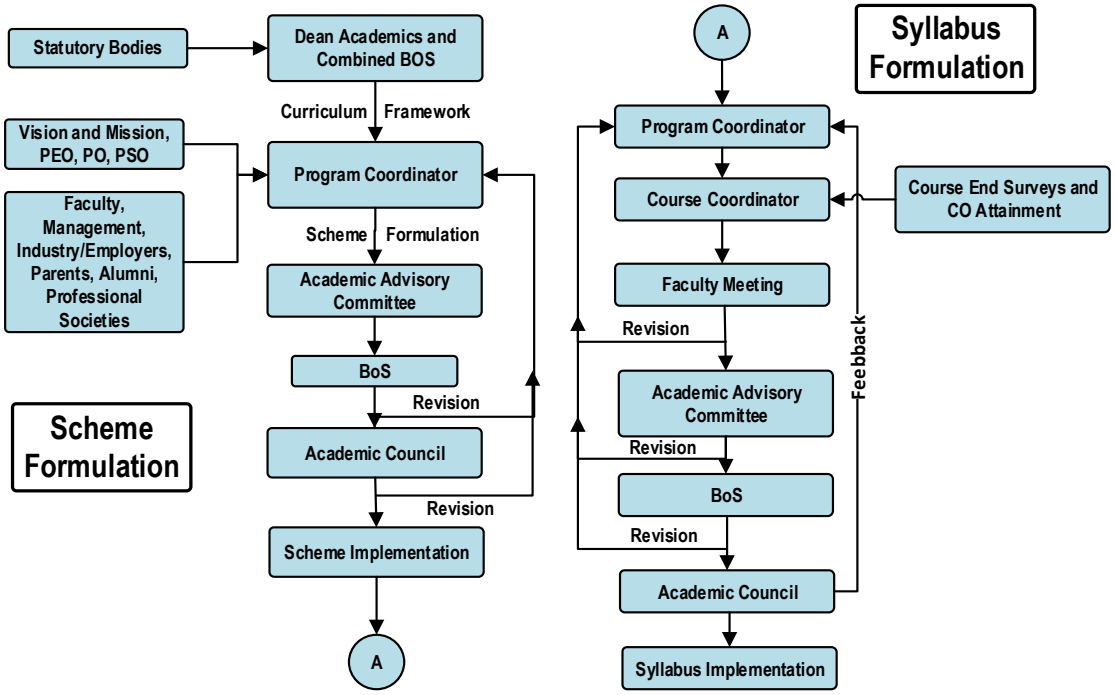
Unit-I	**10Hrs**
Multivariable Calculus: **Partial Differentiation:** Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems. **Vector Differentiation:** Introduction, velocity and acceleration, gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.	
Unit – II	**10Hrs**
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	**10Hrs**
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.

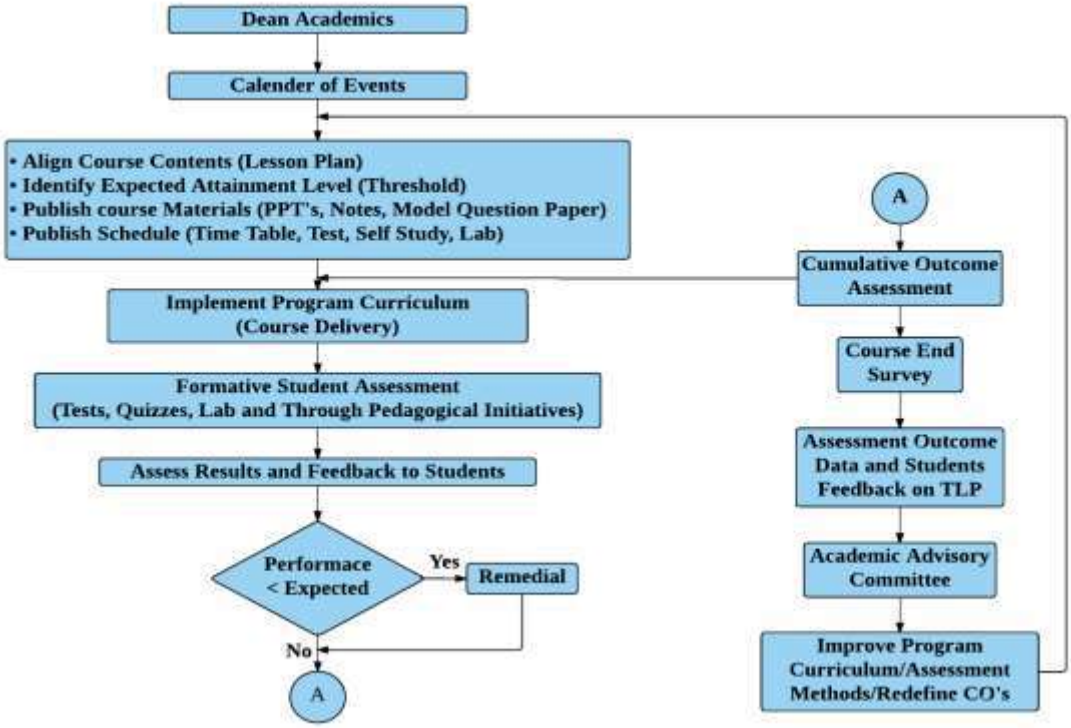
Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44^{th} Edition, 2015, Khanna Publishers, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11^{th} Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	A Textbook of Engineering Mathematics, N.P. Bali & Manish 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). TWOTESTS will be conducted. Each test will be evaluated for 30 Marks, adding upto60 Marks. **FINAL TEST MARKS WILL BE AVERAGE OF TWO TESTS.**	**30**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

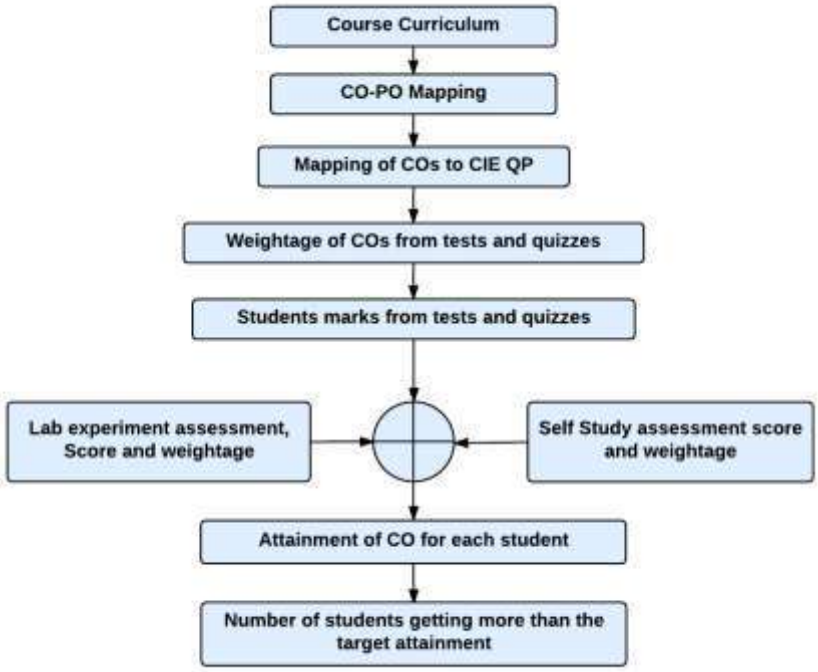
Curriculum Design Process



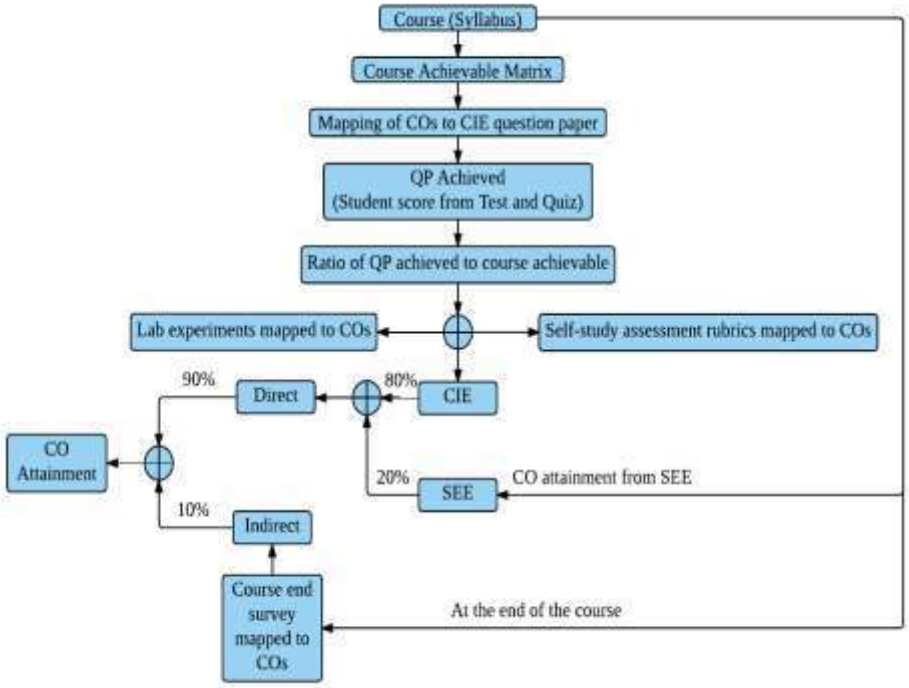
Academic Planning And Implementation



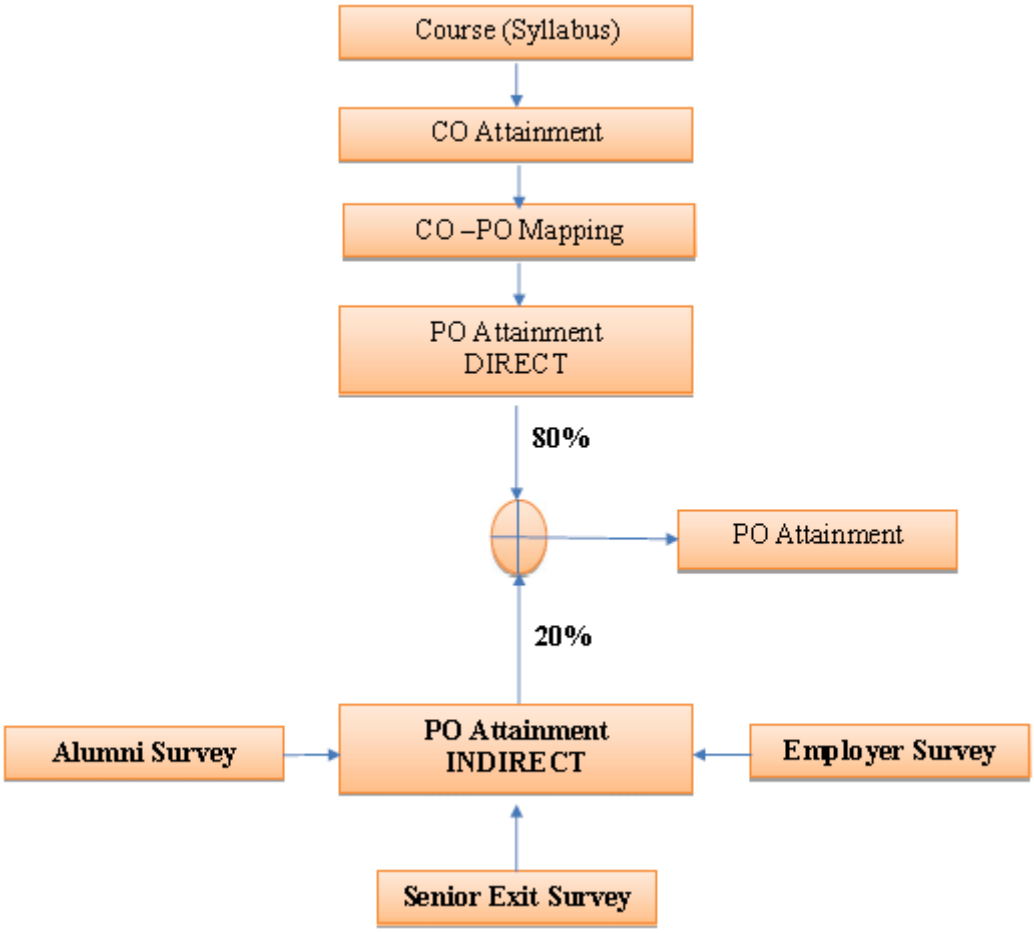
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome 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.

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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 experientiallearning 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