RV Educational Institutions ®
RV College of Engineering ®

Autonomous Institution Affiliated to Visvesvaraya Technological University, Belagavi

Approved by AICTE, New Delhi

Go, change the world

BACHELOR OF ENGINEERING (B.E.)
2022 SCHEME

SCHEME & SYLLABUS
SECOND YEAR B.E. PROGRAMS

ELECTRONICS & INSTRUMENTATION ENGINEERING

ACADEMIC YEAR 2023-24

ELECTRONICS & INSTRUMENTATION ENGINEERING

DEPARTMENT VISION

Achieving academic excellence in Instrumentation Technology by adopting interdisciplinary research with a focus on sustainable and inclusive technologies

DEPARTMENT MISSION

1. To create an environment for students to excel in domain areas and get motivated to involve in interdisciplinary research by utilizing state of the art infrastructure.
2. To impart technical knowledge, encourage experiential learning and develop future professional leaders.
3. To establish industry-academia networking and develop industry-ready students and future entrepreneurs, to meet societal & industrial challenges.
4. To motivate lifelong learning and research in sustainable technologies to find improved solutions for the betterment of society.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: Apply Instrumentation, Electronics, Controls and Automation concepts to develop technical solutions for industrial problems.

PEO2: Exhibit competency in adapting to various industrial challenges and work in inter-disciplinary projects with team spirit and professional ethics for achieving Organizational goals.

PEO3: Pursue higher education in technology or management and achieve professional excellence by imbibing leadership qualities and communication skills.

PEO4: Become entrepreneurs with a focus on sustainable technologies and develop innovative solutions to meet industrial and societal needs.

PROGRAM SPECIFIC OUTCOMES

PSO1: Design, analyze and practice the instrumentation, controls and automation concepts and techniques required for industrial and/or research pursuits resulting in product development, publications or patents.

PSO2: Demonstrate the knowledge of basic science, mathematics, electronic system design and programming for real-time applications, towards developing industrial solutions and become technology leaders of future.

LEAD SOCIETY

International Society of Automation (ISA)

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
24.	AEC	Ability Enhancement Courses

INDEX

2022 SCHEME - CREDITS AND COMPONENTS								
III SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**
			L	**T**	**P**	**Total**		
1	MAT231AT	Linear Algebra, Fourier Transforms and Statistics	3	1	0	**4**	MA	Theory
2	CV232AT/ ME232AT/ BT232AT	Environment & Sustainability / Material Science for Engineers / Bio Safety Standards & Ethics	3	0	0	**3**	CV/ME/ BT	Theory
3	EI233AI	Linear Integrated Circuits and Applications (Common to EI, ET)	3	0	1	**4**	EI	Theory + Lab
4	EC234AI	Analysis and Design of Digital Circuits with HDL (Common to EC, EI, ET, EE)	3	0	1	**4**	EC	Theory + Lab
5	EI235AT	Control Engineering	3	1	0	**4**	EI	Theory
6	HS237XL	Ability Enhancement Course	0	0	2	**2**	HS	Lab
7	CS139AT	Bridge Course: C Programming	2(A)	0	0	**AUDIT**	CS	Theory
		Total				**21**		

Sl. No.	Course Code	Course Title	Credit allocation				BoS	Cluster
			L	T	P	Total		
1	MAT231AT	Linear algebra, Fourier Transform and Statistics	3	1	0	4	MA	EC, EE, EI, ET
2	MAT231BT	Statistics, Laplace transform and numerical methods	3	1	0	4	MA	AS, BT, CH, IM, ME
3	MAT231CT	Linear Algebra and Probability Theory	3	1	0	4	MA	CD, CS, CY, IS
4	MAT231DT	Applied Mathematics for Civil Engineering	3	1	0	4	MA	CV
5	MAT231ET	Mathematics for Artificial Intelligence & Machine Learning	3	1	0	4	MA	AI & ML

Ability Enhancement Courses					
Sl. No.	BoS	Course Code	Course Title	Category	Credits
6	HS	HS237AL	National Service Scheme	LAB	2
	HS	HS237BL	National Cadet Corps	LAB	2
	HS	HS237CL	Physical Education: Sports & Athletics	LAB	2
	HS	HS237DL	Music	LAB	2
	HS	HS237EL	Dance	LAB	2
	HS	HS237FL	Theater (Light Camera & Action)	LAB	2
	HS	HS237GL	Art Work & Painting	LAB	2
	HS	HS237HL	Photography & Film Making	LAB	2

IV SEMESTER								
Sl. No.	**Course Code**	**Course Title**	**Credit Allocation**				**BoS**	**Category**
			L	**T**	**P**	**Total**		
1	MAT241T	Probability Theory and Linear Programming	3	0	0	**3**	MA	Theory
2	CV242AT/ ME242AT/ BT242AT	Environment & Sustainability / Material Science for Engineers / Bio Safety Standards & Ethics	3	0	0	**3**	CV/ME/ BT	Theory
3	EI243AI	Microcontroller & Programming (Common to EI, EC, EE, ET)	3	0	1	**4**	EI	Theory + Lab
4	EC244AI	Signals & Systems (Common to EC, EI)	3	0	1	**4**	EC	Theory + Lab
5	EI245AT	Sensors and Actuators	3	0	0	**3**	EI	Theory
6	XX246XT	Professional Elective Courses –Group A	2	0	0	**2**	EI	**NPTEL**
7	EI247DL	Design Thinking Lab	0	0	2	**2**	EI	Lab
8	HS248AT	Universal Human Values	2	0	0	**2**	HS	Theory
9	MAT149AT	Bridge Course: Mathematics	2 (A)	0	0	**AUDIT**	MA	Theory
		Total				**23**		

Professional Elective Courses- Group A					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	IM	IM246AT	Data Science for Engineers	NPTEL	2
	EE	EE246BT	Programming, Data structures and algorithms using Python	NPTEL	2
	EI	EI246CT	Introduction to Machine Learning	NPTEL	2
	EI	EI246DT	Hardware modelling using Verilog	NPTEL	2
	EI	EI246ET	Power Plant Engineering	NPTEL	2

Semester: III						
LINEAR ALGEBRA, FOURIER TRANSFORMS AND STATISTICS **Category: PROFESSIONAL CORE COURSE** **(Common to EC, EE, EI, ET)** **(Theory)**						
Course Code	**:**	MAT231AT		**CIE**	**:**	100 Marks
Credits: L: T: P	**:**	3:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L+30T		**SEE Duration**	**:**	03 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 product, orthogonal matrices, orthogonal and orthonormal bases, Gram-Schmidt process, QR-factorization. Least squares solution. Eigen values and Eigen vectors (recapitulation), diagonalization of a matrix (symmetric matrices) and singular value decomposition. Implementation using MATLAB.	
Unit –III	**09 Hrs**
Fourier Series: Introduction, periodic function, even and odd functions. Dirichlet's conditions, Euler formulae for Fourier series, complex Fourier series, problems on time periodic signals, Fourier sine series, Fourier cosine series. Harmonic analysis. Implementation using MATLAB.	
Unit –IV	**09 Hrs**
Fourier Transforms: Complex Fourier transform from infinite Fourier series, Fourier sine transform, Fourier cosine transform, properties - linearity, scaling, time-shift and modulation. Convolution theorem, Parseval identities. Implementation using MATLAB.	
Unit –V	**09 Hrs**
Statistics: Central moments, mean, variance, coefficients of skewness and kurtosis in terms of moments. Correlation analysis, rank correlation, linear and multivariate regression analysis. Implementation using MATLAB.	

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

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	The Fast Fourier Transform- An Introduction to its Theory and Applications, E. Oran Brigham, 1st Edition, 1973, Prentice Hall, Inc., ISBN: 13-978-0133074963.
4	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 978- 81-933284-9-1.

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						
ENVIRONMENT AND SUSTAINABILITY **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	:	CV232AT		**CIE**	:	100 Marks
Credits: L:T:P	:	03:00:00		**SEE**	:	100 Marks
Total Hours	:	45L		**SEE Duration**	:	03 Hrs

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

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

ENVIRONMENTAL POLLUTION

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollution. Solid, Hazardous and E-Waste management. Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

Unit–II — **09 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 — **09 Hrs**

SUSTAINABILITY AND MANAGEMENT

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

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 — **09 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						
MATERIALS SCIENCE FOR ENGINEERS **Category: Professional Core** **(Theory)**						
Course Code	**:**	ME232AT		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	40L		**SEE Duration**	**:**	**3 Hours**

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

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

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

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

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

Semester: III						
BIO SAFETY STANDARDS AND ETHICS **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	BT232AT		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

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

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	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						
LINEAR INTEGRATED CIRCUITS AND APPLICATIONS **Category: PROFESSIONAL CORE COURSE** **(Common to EI and ET)** **(Theory and Practice)**						
Course Code	**:**	EI233AI		**CIE**	:	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	:	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	:	03 Hrs+03 Hrs

Unit-I	**09 Hrs**
Operational Amplifier Characteristics: Operational Amplifier characteristics, DC performance, characteristics of Op-Amp, AC performance characteristics of Op-Amp, Noise, Open-loop op-amp Configurations, Closed-loop Op-Amp Configurations, Differential Amplifier, General description, Manufacturer's Specifications and Electrical Characteristics of the Op-Amp, Power supply Connections.	
Unit – II	**09 Hrs**
Applications of Operational Amplifiers: Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, Voltage-Controlled Voltage Source, Current Sources, Inverting current Amplifier, Current-Controlled Current Source, Voltage to current converter, Current to Voltage Converter. **Waveform Generator:** Sine-wave Generators, Triangular Wave Generators, Sawtooth Wave Generators, Timer IC 555-Monostable and Astable multivibrators.	
Unit –III	**09 Hrs**
Voltage Regulators: Basics of Voltage Regulator, Linear Voltage Regulators Using Op-amps, IC Voltage Regulators, three terminal Adjustable Voltage Regulator, General Purpose Regulator, Switched Mode Power Supplies, Voltage Controlled Oscillators. **Operational Amplifier-Non-linear Circuits:** Precision Rectifier, Analog Switches, Peak Detectors, Sample and Hold circuits, Applications.	
Unit –IV	**09 Hrs**
Active Filters: Introduction, Comparison Between Passive and Active Networks, Active Network Design, Filter Approximations, General Second Order Filter with Unity Gain and Variable Gain, Design of Low-pass Filters. **Types:** High-pass Filters, Bandpass Filters, Band-reject filters, All-pass Filters, State-variable Filters, Switched Capacitor Filters, Chebyshev Filters, Butterworth Filters.	
Unit –V	**09 Hrs**
D/A and A/D Converters: Analog and Digital Data Conversions, Specifications of D/A Converter, Basic D/A Conversion Techniques, Switches for D/A Converters, Multiplying D/A Converters, Monolithic D/A Converter, Sampling Process, High Speed Sample and Hold Circuit, A/D Converters, Specifications of A/D Converter, Classification of A/D Converter, Over-Sampling A/D Converters. **Special Function Integrated Circuits:** Voltage-to-frequency and Frequency to voltage Converters, Series Voltage-to-frequency and Frequency-to-Voltage Converters.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the basics of operational amplifiers.
CO2	Analyze the performance of OPAMP and build simple circuits using OPAMP.
CO3	Apply the concepts to design various applications of OPAMP.
CO4	Design a system using various ICs for a specific application.

Reference Books	
1.	Linear integrated circuits, S Shalivahanan, V S Kanchana Bhaskaran, Mc.Grawhill Publications, 2018, ISBN: 10:0-07-064818-2.
2.	Electronic Devices and Circuit Theory, Robert L.Boylestad, Louis Nashelsky, 8th Edition, 2010, Prentice-Hall India, ISBN:81-203-2064-6.
3.	Microelectronics circuits Analysis and Design, M.H Rashid,2nd Edition, 2011, Thomson Publication, ISBN:0-534-95174-0.
4.	Microelectronics circuits, Sedra & Smith, 5th Edition, Oxford Publication, ISBN-13: 978-0195338836.
5.	Op-Amps and Linear Integrated Circuits, Ramakanth A Gayakwad, Pearson, 4th Edition, ISBN-13: 978-9353949037.

Laboratory Component

PART B

Practical: Hardware design and simulation of the following to be carried out.

1. Experimental verification of simple applications of OPAMP 741 such as inverting amplifier, non-inverting amplifier, adder/subtractor, integrator and differentiator circuits
2. Design and implementation of peak detector, half wave and full wave precision rectifiers using operational amplifier IC741.
3. Design and implementation of a Schmitt trigger circuit for given UTP & LTP using op-amp.
4. Design and implementation of active 2nd order low pass and high pass filters and to obtain the frequency response of the filters.
5. Design and implementation of astable multivibrator using 555 timer.
6. Design and implementation of RC phase shift oscillator by simulation and experiment.

PART B

Innovative Experiments (IE)

1. Realization of 2-bit flash type ADC.
2. Analysis of function generator using operational amplifier (sine, triangular, and square wave).
3. Analysis of voltage comparator.
4. Design of voltage regulator using IC 7900.
5. Generation of ramp wave for a given frequency using NE 555 timer.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding 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 (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 50 MARKS.	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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	30
3	Viva	10
	TOTAL	**50**

Semester: III

ANALYSIS AND DESIGN OF DIGITAL CIRCUITS WITH HDL
Category: PROFESSIONAL CORE COURSE
(Common to EC, EI, ET, EE)
(Theory & Practice)

Course Code	**:**	EC234AI		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	**:**	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	**:**	03Hrs+03 Hrs

Unit-I — **09 Hrs**

Introduction to Verilog: Design Methodology-An Introduction:
Verilog History, System representation, Number representation and Verilog ports. Verilog Data Types: Net, Register and Constant. Verilog Operators: Logical, Arithmetic, Bitwise, Reduction, Relational, Concatenation and Conditional. Verilog Primitives. Logic Simulation, Design Verification, and Test Methodology: Four-Value Logic and Signal Resolution in Verilog, Test Methodology Signal Generators for Test benches, Event-Driven Simulation, Sized Numbers. Introduction to Modeling Styles: Dataflow modeling, Behavioral modelling, Structural modelling.

Unit – II — **09 Hrs**

Combinational Circuits Design:
Arithmetic circuits, code converters and logic functions implementation using Decoders/ De-Multiplexers and Multiplexers. Design of a Priority encoder, Magnitude comparator, Parallel Adder/Subtractor, Concepts of ripple carry and carry look ahead adders and BCD adder.
Dataflow/Behavioural/Structural Modelling:
Verilog Data flow/Behavioral/Structural Models, Module Ports, Top-Down Design and Nested Modules.

Unit –III — **09 Hrs**

Introduction, Latches and Flip Flops:
Triggering of Flip Flops, Characteristics Equation Flip Flop Excitation Tables, Flip-Flop conversions. Propagation delay, setup and hold time.
Synchronous Sequential Circuits Design:
Introduction to FSM (Mealy and Moore), Analysis of Clocked Sequential Circuits, State table and Reduction, State Diagram, Design of synchronous Counter, Programmable mod-n counter.
Behavioral Modeling:
Latches and Flip Flop Circuits in Verilog, design of synchronous counters using Verilog.

Unit –IV — **09 Hrs**

Asynchronous Sequential Circuit Design:
Design of Ripple/Asynchronous Counter (mod-n counter), Effects of Propagation delay in Ripple Counter, Integrated Circuit Ripple Counter.
Registers:
Registers, Shift Registers and Various Operations, Ring counters, Johnson counters, Serial Adder. Design of Sequence Detector and Sequence Generators (PRBS).
Behavioral Modeling:
Design of synchronous counters and shift registers using Verilog.

Unit –V — **09 Hrs**

ALU Design:
Processor Organization, Design of Arithmetic Unit, Design of Logic unit, Design of Arithmetic and Logic unit, Status Register, Design of Shifter, The Complete Processor unit and op-code generation.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Analyze and design different types of digital circuits for area, delay and power constraints.
CO2	Apply the knowledge of digital circuits to construct sub-systems useful for digital system designs.
CO3	Implement digital circuits for a particular application considering performance parameters.
CO4	Evaluate the performance of different digital systems to apply in real world applications.

Reference Books	
1.	Verilog HDL: A Guide to Digital Design & Synthesis, Samir Palnitkar, SunSoft Press, 1st Edition, 1996, ISBN: 978-81-775-8918-4.
2.	Digital Logic and Computer Design, M. Morris Mano, Pearson Education Inc., 13th Impression, 2011, ISBN: 978-81-7758-409-7.
3.	Fundamentals of Logic Design, Charles H. Roth (Jr.), West publications, 4th Edition, 1992, ISBN-13: 978-0-314-92218-2.
4.	Digital Fundamentals, Thomas Floyd, 11th Edition, Pearson Education India, ISBN 13: 978-1-292-07598-3, 2015.
5.	Digital Principle and Design, Donald D. Givone, Mc Graw-Hill, ISBN: 0-07-119520-3 (ISE), 2003.

Laboratory Component

PART B
Practicals:

1. Truth Table verification of NOT, AND, OR, XOR, XNOR, NAND, NOR gates using IC trainer kit.
2. Realization of Binary Adder and Subtractor IC-7483.
3. Realization of Boolean Function using MUX/DEMUX (IC-74153, IC-74139.)
4. Design of synchronous 3-bit up/down counter using IC-7476/IC-74112 on IC trainer kit.
5. Realization of Binary Adder and Subtractor using Verilog
6. Realization of Multiplexer/Decoders/Encoder in Verilog.
7. Realization of D, T, JK flip flop in Verilog using behavioural modelling on FPGA board.
8. Design of synchronous (up/down/BCD counter in Verilog using behavioural modelling.
9. Design of Shift register, ring counter, Johnson counter using Verilog.
10. Design of Sequence generator and detector.

PART B
Innovative Experiments (IE)

1. Multiplier Designs (Booth, Wallace)
2. Basic Processor Design.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**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,	**40**

	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.**	
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 50 MARKS.	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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	30
3	Viva	10
	TOTAL	**50**

Semester: III						
CONTROL ENGINEERING **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	EI235AT		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	03:01:00		**SEE**	**:**	100 Marks
Total Hours	**:**	45L+15T		**SEE Duration**	**:**	03 Hrs

Unit-I	**09 Hrs**
Introduction: Definitions, Classification of control systems open loop and closed loop, linear and nonlinear, time variant and time invariant, continuous and discrete time systems. Block diagram of a typical closed loop control system showing the basic structure and different terminologies. **Modelling and Representation of Control System:** The transfer function concept, transfer function of simple electrical networks, different forms of transfer functions, transfer function of a closed loop system block diagrams and signal flow graphs. Masons gain formula. Modelling of mechanical translational and rotational systems and their analogies.	
Unit – II	**09 Hrs**
Time Response of Feedback Control Systems: Standard test signals, step response of first and second order systems, time domain specifications. Type and order of the system, Steady state error and static error constants. Effect of feedback on sensitivity. **Stability Analysis:** Concept of stability, types of stability, Routh Hurwitz criterion, relative stability analysis.	
Unit –III	**09 Hrs**
Root Locus: Introduction, concept of magnitude and angle criterion, construction of root loci, root contours. Effect of adding a pole/zero to the system.	
Unit –IV	**09 Hrs**
Introduction to frequency domain: Frequency domain specifications, concept of phase margin and gain margin, correlation between time and frequency response. **Frequency Domain Analysis**: Introduction to frequency domain plots, polar plots, principle of argument, Nyquist plots and Nyquist stability criterion.	
Unit –V	**09 Hrs**
Frequency Domain Analysis: Bode plots**,** stability analysis using Bode diagrams. **Controllers and compensators:** Introduction to basic controllers P, PI, PD and PID and their effect on dynamic and static behaviour of the system. Definition and need for a compensator.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Comprehend the different types of control systems and their building blocks
CO2	Analyse the different systems by means of their transfer function
CO3	Evaluate the performance of systems and assess their stability
CO4	Create a model of the system for the desired performance parameters

Reference Books	
1.	Control System Engineering, J Nagarath and M. Gopal, 6th Edition, 2017, New age International publishers, ISBN: 8122420087.
2.	Control systems: Principles and design, M. Gopal, TMH, 4th Edition, 2012, ISBN: 9780071333269.
3.	Modern Control Engineering, K. Ogata, Pearson education, 5th Edition. 2015, ISBN: 9789332550162.
4.	Automatic Control Systems, Kuo B.C, 9th Edition, 2014, Prentice Hall of India Ltd., New Delhi, ISBN-13: 978-8126552337.

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

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

Semester: IV						
NATIONAL SERVICE SCHEME(NSS) (Practical)						
Course Code	**:**	**HS237AL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**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 withsurveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for implementation methodologies.	**10**	*****
Case Study-based Teaching-Learning	**10**	Implementation strategies of the projectwith report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Semester: IV						
NATIONAL CADET CORPS(NCC) (Practical)						
Course Code	**:**	**HS237BL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**02 Hrs**
Unit-I						**14 Hrs**
Drill: Foot Drill- Drill ki Aam Hidayaten, Word ki Command, Savdhan, Vishram, Aram Se, Murdna, KadvarSizing, 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 throughoutthe 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 projectwith report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Semester: IV						
PHYSICAL EDUCATION (SPORTS & ATHLETICS) (Practical)						
Course Code	**:**	**HS237CL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**00:00:02**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**02 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 (Practical)						
Course Code	**:**	**HS237DL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**SEE Duration**	**:**	**02 Hrs**

Content — **26 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 GlorySt 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 (Practical)						
Course Code	**:**	**HS237EL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**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) (Practical)						
Course Code	**:**	**HS237FL**		**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. Thisis aimed at to make everyone in the room comfortable with each other. This helps everyone get over socialanxiety, 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 thedramatic aspect of it, this unit discusses some tips to help the young actors improve their dialogue deliveryskills:
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 (Practical)						
Course Code	**:**	**HS237GL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**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 stylizationto 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 compulsorilytake 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 presentedart 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 projectwith report
Sector wise study & consolidation	**10**	
Video based seminar (4-5 minutes per student)	**10**	
TOTAL MARKS FOR THE COURSE	**50 MARKS**	**50 MARKS**

Semester: IV						
PHOTOGRAPHY & FILM MAKING (Practical)						
Course Code	**:**	**HS237HL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**26P**		**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 tosubmit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand basics of photography and videography and improve their skills.
CO2	Appreciate the skills acquired from photography.
CO3	Perform and present photos and films in a presentable manner.
CO4	Develop skills like team building and collaboration.

Reference Books	
1.	Read This If You Want to Take Great Photographs – Henry Carroll
2.	The Digital Photography Book: Part 1 – Scott Kelby

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

Semester: 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	**06 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	**06 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	**06 Hrs**
Decision Control and Looping Statements Introduction to decision control, conditional branching statements, iterative statements, Nested loops, Break and continue statements, goto statements **Arrays** Introduction, Declaration of Arrays, Accessing elements of an array, Storing values in arrays, Operations on Arrays- Traversing, Inserting and Deletion of element in an array. Two dimensional arrays- Operations on two dimensional arrays.	
Unit –IV	**06 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	**06 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:-	
CO1	Analyze problems and design solution using program design tools.
CO2	Evaluate the appropriate method/data structure required in C programming to develop solutions by investigating the problem.
CO3	Design a sustainable solution using C programming with societal and environmental concern by engaging in lifelong learning for emerging technology
CO4	Demonstrate programming skills to solve inter-disciplinary problems using modern tools effectively by exhibiting team work through oral presentation and written reports.

Reference Books	
1.	Programming in C, 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.

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 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 up to 50 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 20 MARKS.**	**20**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (10) & Phase II (10) ADDING UPTO 20 MARKS**.	**20**
MAXIMUM MARKS FOR THE CIE THEORY		**50**

Semester: IV						
PROBABILITY THEORY AND LINEAR PROGRAMMING **Category: PROFESSIONAL CORE COURSE** **(Common to AS, CH, CV, EE, EI, ET, ME)** **(Theory)**						
Course Code	**:**	MAT241AT		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	2:1:0		**SEE**	**:**	100 Marks
Total Hours	**:**	30L+26T		**SEE Duration**	**:**	03 Hours

Unit-I	**06 Hrs**
Random Variables: Random variables-discrete and continuous, probability mass function, probability density function, cumulative distributon function, mean and variance. Two or more random variables - Joint probability mass function, joint probability density function, conditional distribution and independence, Covariance and Correlation.	
Unit – II	**06 Hrs**
Probability Distributions: Discrete distributions - Binomial, Poisson and Geometric. Continuous distributions – Exponential, Uniform, Normal and Weibull. Implementation using MATLAB.	
Unit –III	**06 Hrs**
Sampling Distributions and Estimation: Population and sample, Sampling distributions - Simple random sampling (with replacement and without replacement). Standard error, Sampling distributions of means (σ known), Sampling distributions of proportions, Sampling distribution of differences and sums. Estimation-point estimation, interval estimation. Implementation using MATLAB.	
Unit –IV	**06 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). Simulation using MATLAB.	
Unit –V	**06 Hrs**
Linear Programming: Mathematical formulation of linear programming problem. Solving linear programming problem using Graphical, Simplex and Big M methods. Implementation using MATLAB.	

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

Reference Books	
1	Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th Edition, 2016, Pearson Education, ISBN-13: 978-0134115856.
2	Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, 6th Edition, John Wiley & Sons, 2014, ISBN:13 9781118539712, ISBN (BRV):9781118645062.
3	Introduction to Probability and Statistics for Engineers and Scientists, Sheldon Ross, 5th Edition, 2014, Academic Press, ISBN: 13-978-0123948113.
4	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 81-7409-195-5.

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: IV						
ENVIRONMENT AND SUSTAINABILITY **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	CV242AT		**CIE**	:	100 Marks
Credits: L:T:P	**:**	03:00:00		**SEE**	:	100 Marks
Total Hours	**:**	45L		**SEE Duration**	:	03 Hrs

Unit-I	**10 Hrs**
ENVIRONMENT AND BIODIVERSITY Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity. **ENVIRONMENTAL POLLUTION** Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollution. Solid, Hazardous and E-Waste management. Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.	
Unit – II	**09 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	**09 Hrs**
SUSTAINABILITY AND MANAGEMENT Introduction to Environmental Economics, Environmental Audit, Development, GDP, Sustainability - concept, needs and challenges-economic, social and aspects of sustainability - from unsustainability to sustainability- millennium development goals and protocols. 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	**09 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. Conceptof Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management. Relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India. Sustainability Reporting: Flavor of GRI, Dow Jones Sustainability Index, CEPI. Investor interest in Sustainability.	

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

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

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

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

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

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

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

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

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

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

Semester: IV						
BIO SAFETY STANDARDS AND ETHICS **Category: PROFESSIONAL CORE COURSE** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	BT242AT		**CIE**	**:**	100 Marks
Credits: L: T:P	**:**	3:0:0		**SEE**	**:**	100 Marks
Total Hours	**:**	45L		**SEE Duration**	**:**	03 Hrs

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

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

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

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

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO.	**CONTENTS**	**MARKS**
	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						
MICROCONTROLLER & PROGRAMMING **Category: PROFESSIONAL CORE COURSE** **(Common to EI, EC, ET, EE)** **(Theory and Practice)**						
Course Code	**:**	EI243AI		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	**:**	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	**:**	03 Hrs+03 Hrs

Unit-I	**09 Hrs**
Introduction to Processing units: Computer System, Processor, Block diagram, Processor logic unit, Control unit, Instruction format, Assembly language, High level language, Embedded computing applications, Microcontroller, Instruction set architectures (CISC, RISC), Harvard and Von Neumann, Floating and fixed point, Introduction of controller families: 8-bit, 16-bit,32-bit, 64-bit, ARM Processor families, Cortex A, Cortex R and Cortex M, Thumb 2 instruction set.	
Unit – II	**09 Hrs**
Cortex M Architecture: Advantages of Cortex M CPUs, Programmer's model: Operation modes & states, Registers, Special Registers, APSR, Memory System, Low power modes, Instruction Set: Memory access instructions, Arithmetic, Logical, Shift, Program flow control instructions, Programming examples, IDEs, ST-Link debugger.	
Unit –III	**09 Hrs**
Digital and Analog IO: ARM Cortex M4 MCUs, Memory organization, Reset & Clock Control, GPIO, Programming: interfacing LEDs and Push buttons, Analog to digital converters (ADC), Successive Approximation ADC, Programming and interfacing an analog sensor, Digital to Analog Converter (DAC), Programming.	
Unit –IV	**09 Hrs**
Serial Port USART: Basics of serial communication (Synchronous, asynchronous), Framing, Sampling, Baud rate generation, Programming USART for character transmission, Serial Peripheral Interface, Programming SPI for data transfer.	
Unit –V	**09 Hrs**
Interrupts and Timers: Types of interrupts, Nested vector interrupt controller (NVIC) in Cortex-M cores, Interrupt vectors, Priorities, Programming interrupts, Timers, Controlling the operation, Programming with timers, Pulse width modulators, Programming modulators to generate PWM wave for given specifications.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Analyse the architecture, instruction set and memory organization of processing units used to build computers and embedded systems.
CO2	Compile the information of ADCs, DACs, Serial ports and interrupts available on embedded processors to map to real world requirements.
CO3	Apply the knowledge of microcontroller for programming peripherals using registers and APIs generated using auto code generators.
CO4	Formulate and design different applications on embedded processors to solve problems related to society.

Reference Books	
1.	The Definitive Guide to the ARM Cortex-M3& M4 Processors, Joseph Yiu, 3rd Edition, Newnes (Elsevier), 2014, ISBN:978-93-5107-175-4.
2.	STM32 Arm Programming for Embedded Systems, Shujen Chen, Eshragh Ghaemi, Muhammad Ali Mazidi, Microdigitaled, ISBN: 978-0997925944.
3.	Reference manuals: STM32F411, STMcubeMX, SPI
4.	White Paper: Cortex-M for Beginners - An overview of the Arm Cortex-M processor family and comparison.

Practical: Programming in ARM Assembly using Keil

1. Data Transfer Programs: Block Moves & Exchange (With & Without Overlap) with & without String Instructions.
2. Arithmetic Operations: Addition, Multiplication & Division on 32-Bit Data.
3. Search for a Key in an Array of Elements using Linear Search, Binary Search. Programming in Keil using embedded C in STMCubeMx.
4. Program digital IOs control LEDs, seven segment interface, push buttons.
5. Program digital IOs to control stepper and motor drivers for given specifications.
6. Program ADC and show analog to digital conversion. Display digital value on suitable interface.
7. Program ADC and show interfacing of analog sensor for given specifications.
8. Program USART and serial data transfer.
9. Program SPI and show the configuration and data transfer between SPI slave device and master.
10. Program to configure NVIC and writing interrupt service routines.

Innovative Experiments

1. Program SPI and show the configuration and data transfer between SPI slave device and master.
2. Program ADC and show interfacing of analog sensor for given specifications.
3. Data transfer in polling, interrupt and DMA based modes.
4. Real time Audio applications: Flanging effect.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS.	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding 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 (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 50 MARKS.	**50**
MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)		**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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	30
3	Viva	10
	TOTAL	**50**

Semester: IV						
SIGNALS & SYSTEMS **Category: PROFESSIONAL CORE COURSE** **(Common to EC, EI)** **(Theory & Practice)**						
Course Code	**:**	EC244AI		**CIE**	**:**	100+50 Marks
Credits: L:T:P	**:**	03:00:01		**SEE**	**:**	100+50 Marks
Total Hours	**:**	45L+30P		**SEE Duration**	**:**	03 Hrs+03 Hrs

Unit-I	**09 Hrs**
Introduction to Signals and Systems: Definition of Signals, Types and Classification of Signals with examples, Basic Operations on Signals, definition of Systems, Properties of Systems, System Viewed as Interconnection of Operations. Conversion of analog to digital signals.	
Unit – II	**09 Hrs**
Time domain representations of Linear Time Invariant Systems: Convolution Sum, concepts of Convolution Integrals, Interconnections of LTI System, Relations between LTI Systems, Properties of LTI systems, Applications.	
Unit –III	**09 Hrs**
Applications of Fourier Representations: Review of Fourier transform, Concepts of DTFS and DTFT with properties (no derivation), computation of DTFT for basic periodic and non-periodic signals, Applications.	
Unit –IV	**09 Hrs**
The Discrete Fourier transforms - Properties and Applications: Concept of DFT, Properties of DFT, Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs, circular correlation and circular convolution. Linear filtering methods based on the DFT. Filtering of long data sequence. Efficient computation of Radix – 2 FFT Algorithms up to 4-point FFT	
Unit –V	**09 Hrs**
Time and frequency domain features: Time domain features like mean, variance, correlation, skewness, energy, envelop of signal etc., Frequency domain features like dominant frequency, peak value etc, Classification of signals based on feature extraction.	

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Analyze the fundamental concepts of both continuous and discrete signals and systems, representation of both periodic & aperiodic signals in frequency domain.
CO2	Analysis the strong fundamentals in discrete time signal processing.
CO3	Analyze discrete system and validate the functionality of the same using simulation tool.
CO4	Design discrete systems to meet specific requirement for signal processing application.

Reference Books	
1.	Signals and Systems, Simon Haykin and Barry Van Veen, John Wiley & Sons, 2nd Edition,2008. **(Unit 1 and 2)**
2.	Digital Signal Processing, Proakis G & Dimitris G. Manolakis, PHI, 3rd Edition, 2007. **(Unit 3, 4 and 5)**
3.	Signals and Systems, V. Oppenheim, Alan Willsky and A. Hamid Nawab, Pearson Education, Asia/ PHI, 2nd Edition, 2006
4.	Digital Signal Processing a Practical Approach, Emmanuel C. Ifeachar, Barrie E. Jervis,Pearson Education, 2nd Edition, 2003.

Practical's:

1. Generation of the following discrete signals using MATLAB. (i) unit step (ii) unit impulse (iii) unit ramp (iv) Sinc (v) Gaussian .
2. Perform basic operations: time shifting, time scaling and time reversal for the above signals and plot.
3. Write a MATLAB program to FT of basic signals. Also plot its magnitude and phase spectrum.
4. Write a MATLAB program for calculating DFT and IDFT discrete time sequences using analytical calculation and inbuilt function.
5. Write a Python program for linear and circular convolution of two discrete time sequences. Plot all the sequences and verify the result by analytical calculation.
6. Write a Python program for circular correlation of two discrete time sequences. Plot all the sequences and verify the result by analytical calculation.
7. Write a python code to extract features in time domain for any signal.
8. Write a python code to extract features in frequency domain for any signal.
9. Develop a Simulink model to demonstrate Amplitude modulation and Demodulation.
10. Write a python Code to classify two signals using various features.

Innovative Experiment

1. Demonstrate of any real time applications using microcontroller.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY AND PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks. Each quiz is evaluated for 10 marks adding up to 20 MARKS.	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO tests will be conducted**. Each test will be evaluated for **50 Marks**, adding 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 (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 50 MARKS.	**50**
	MAXIMUM MARKS FOR THE CIE (THEORY AND PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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	30
3	Viva	10
	TOTAL	**50**

Semester: IV						
SENSORS AND ACTUATORS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	:	EI245AT		**CIE**	:	100 Marks
Credits: L:T:P	:	03:00:00		**SEE**	:	100 Marks
Total Hours	:	45L		**SEE Duration**	:	03 Hrs

Unit-I	**09 Hrs**
Introduction: Definition of a sensor, Generalized measurement system, Static and dynamic characteristics of Instruments, Classification of sensors, Characteristics of sensors. **Resistive sensors:** Potentiometers: Characteristics, Loading effect, and problems. Strain gauge: Theory, Types, applications and problems. Thermistor, RTD: Theory, applications and problems.	
Unit – II	**09 Hrs**
Thermocouple: Measurement of thermocouple output, compensating circuits, lead compensation, advantages, and disadvantages of thermocouple. **Inductive sensors:** Basic principle, Types of Inductive transducers: LVDT Principle of working and construction, Characteristics, Practical applications of LVDT. **Capacitive sensors:** Capacitive sensors using change in area of plates (Cylindrical), distance between plates (Parallel plate) and change of dielectric constants, Frequency response, Applications of Capacitive sensors and problems.	
Unit –III	**09 Hrs**
Piezo-electric sensors: Principle of operation, expression for output voltage, piezo-electric materials, equivalent circuit, loading effect, Frequency response and problems. **Photo sensors:** Photo resistor, Photodiode, Phototransistor, Photo FET, Charge coupled device. **Chemical sensors:** pH value sensor, dissolved oxygen sensor, oxidation-reduction potential sensor, Zirconium probe Sensors, Chem FET sensors. **Tactile sensors:** Construction and operation, types. **Special Transducers:** Direction sensors, Thin film sensors and smart sensors: Principles and applications.	
Unit –IV	**09 Hrs**
Fabrication Techniques for Thin film Sensors: Photo Lithography; Types of photoresists, application of photoresists on substrate. **LIGA process**; General Description, Material for Substrate and Photoresists and Electroplating. **Humidity Sensors and Moisture Sensors:** Concept of humidity, Electrical Conductivity Sensors, Thermal Conductivity Sensors, Optical Hygrometer, Oscillating Hygrometer. **IR Sensors:** Golay cells, Thermopile, Pyroelectric sensor, Bolometers, Active Far-Infrared Sensors, Gas flame detectors.	
Unit –V	**09 Hrs**
Actuators: Introduction to Actuators, Types of Actuators: Thermal Actuators, Electromagnetic actuators, Hydraulic and Pneumatic Actuators, Smart Material Actuators.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Comprehend the basic principles of different sensors and actuators.
CO2	Apply the knowledge of sensors and actuators to comprehend digital instrumentation systems.
CO3	Analyse and evaluate the performance characteristics of different sensors for various applications.
CO4	Create a system using appropriate sensors for a particular application.

Reference Books	
1.	Handbook of Modern Sensors: Physics, Designs, and Applications, Jacob Fraden, Springer, 2016 Edition, ISBN: 3319307673
2.	Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co. (P) Limited, 8th Edition, January 2015, ISBN: 8177001000.
3.	Sensors and Actuators: Control systems Instrumentation, Clarence W.de Silva, CRC Press, 2015 Edition, ISBN: 978-1-4200-4483-6.
4.	Sensors and Actuators: Francisco Alegria, World Scientific Publishing, 2022 Edition, ISBN: 978-981-124-250-2.

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

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

Semester: IV						
DATA SCIENCE FOR ENGINEERS **Category: PROFESSIONAL ELECTIVE COURSE(GROUP-A)** **(Theory)**						
Course Code	**:**	IM246AT		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	02:00:00		**SEE**	**:**	50 Marks
Total Hours	**:**	30L		**SEE Duration**	**:**	02 Hrs

Unit-I	**10 Hrs**
Course philosophy and introduction to R,Linear algebra for data science Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse) Geometric view - vectors, distance, projections, eigenvalue decomposition Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)	
Unit – II	**10 Hrs**
Optimization, Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.	
Unit –III	**10 Hrs**
Classification using logistic regression, Classification using kNN and k-means clustering.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental principles of data science and the role of R as a tool for data analysis.
CO2	Acquire knowledge and skills in optimization techniques, which are essential for solving data science problems efficiently.
CO3	Apply logistic regression for classification problems, using it to make informed decisions based on data.
CO4	Demonstrate competence in k-nearest neighbours (kNN) classification and k-means clustering as additional tools for solving classification and clustering tasks.

Reference Books	
1.	Introduction to Linear Algebra, Gilbert Strang, Wellesley Publishers, 2016, ISBN: 9780980232776, 0980232775.
2.	Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, Wiley Publishers, 2014, ISBN: 9788126562947, 8126562943.

Semester: IV						
PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON **Category: PROFESSIONAL ELECTIVE COURSE (GROUP-A)** **(Theory)**						
Course Code	**:**	EE246BT		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	02:00:00		**SEE**	**:**	50 Marks
Total Hours	**:**	30L		**SEE Duration**	**:**	02 Hrs

Unit-I	**10 Hrs**
Informal introduction to programming, algorithms and data structures via gcd, Downloading and installing Python. **gcd in Python:** variables, operations, control flow - assignments, conditionals, loops, functions. **Python:** types, expressions, strings, lists, tuples. **Python memory model:** names, mutable and immutable values. **List operations:** slices etc, Binary search. **Inductive function denitions:** numerical and structural induction, Elementary inductive sorting: selection and insertion sort, In-place sorting. **Basic algorithmic analysis:** input size, asymptotic complexity, O () notation, Arrays vs lists, Merge sort, Quick sort, Stable sorting	
Unit – II	**10 Hrs**
Dictionaries More on Python functions: optional arguments, default values, Passing functions as arguments. **Higher order functions on lists:** map, lter, list comprehension, Exception handling, Basic input/output Handling files, String processing. **Backtracking:** N Queens, recording all solutions. **Scope in Python:** local, global, nonlocal names, Nested functions. **Data structures:** stack, queue, Heaps.	
Unit –III	**10 Hrs**
Abstract datatypes, Classes and objects in Python. **Linked List:** find, insert, delete. **Binary search trees:** find, insert, delete, Height-balanced binary search trees. **Efficient evaluation of recursive definitions:** memorization, Dynamic programming: examples **Other programming languages:** C and manual memory management. **Other programming paradigms:** functional programming	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand data structures and algorithms in programming perspectives.
CO2	Apply data structures and algorithms to solve real world problem.
CO3	Analyse existing data structures and algorithms found in python's libraries.
CO4	Develop an application using python programming.

Reference Books	
1.	Michael T. Goodrich, Roberto Tamassia and Michael H. Goldwasser, "Data Structures and Algorithms in Python", Wiley Publications, ISBN-13:9781118290279.
2.	Kenneth A. Lambert, "Fundamentals of Python Data Structures", Cengage Learning PTR Publications, ISBN-13: 978-1-285-75200-6.

Semester: IV						
INTRODUCTION TO MACHINE LEARNING **Category: PROFESSIONAL ELECTIVE COURSE (GROUP-A)** **(Theory)**						
Course Code	**:**	EI246CT		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	02:00:00		**SEE**	**:**	50 Marks
Total Hours	**:**	30L		**SEE Duration**	**:**	02 Hrs
Unit-I						**10 Hrs**
Introduction: Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation Linear regression, Decision trees, overfitting. Instance based learning, Feature reduction, Collaborative filtering based recommendation						
Unit – II						**10 Hrs**
Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network						
Unit –III						**10 Hrs**
Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the basic concept of machine learning
CO2	Apply machine-learning algorithms including decision trees, naïve Bayes, and logistic regression
CO3	Analyze the application scenarios for different supervised classification algorithms discussed above
CO4	Develop machine-learning concepts such as regularization, overfitting, and Laplace smoothing to design efficient machine learning models

Reference Books	
1.	Machine Learning, Tom Mitchell, 1st Edition, McGraw- Hill, 2017, ISBN: 978-1259096952
2.	Introduction to Machine Learning, Ethem Alpaydin, 2nd Edition, MIT Press , 2010, ISBN: 978-0262012430

Semester: IV						
HARDWARE MODELING USING VERILOG **Category: PROFESSIONAL ELECTIVE COURSE (GROUP-A)** **(Theory)**						
Course Code	**:**	EI246DT		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	02:00:00		**SEE**	**:**	50 Marks
Total Hours	**:**	30L		**SEE Duration**	**:**	02 Hrs
Unit-I						**10 Hrs**
Introduction to digital circuit design flow, Verilog variables, operators and language construct, Modelling: combinational circuits using Verilog.						
Unit – II						**10 Hrs**
Modeling sequential circuits using Verilog, Verilog test benches and design simulation, Behavioural versus structural design modelling.						
Unit –III						**10 Hrs**
Miscellaneous modeling issues: pipelining, memory, etc, Processor design using Verilog.						

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the digital circuit design flow.
CO2	Familiarity with Verilog variables, operators, and language constructs.
CO3	Model combinational circuits and sequential circuits using Verilog.
CO4	Address miscellaneous modelling issues like pipelining and memory.

Reference Books	
1.	"Verilog HDL: A Guide to Digital Design and Synthesis", Samir Palnitkar., SunSoft Press, 2003, ISBN:0-13-044911-3
2.	"Verilog Digital System Design: With Examples and Explanations", Zainalabedin Navabi, McGraw Hill LLC, 2005, ISBN: 9780071588928, 0071588922.

Semester: IV						
POWER PLANT ENGINEERING **Category: PROFESSIONAL ELECTIVE COURSE (GROUP-A)** **(Theory)**						
Course Code	**:**	EI246ET		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	50 Marks
Total Hours	**:**	30L		**SEE Duration**	**:**	02 Hrs

Unit-I	**10 Hrs**
The energy scenario, steam power plants, fuel handling, ash handling, chimney draught. Fossil fuel steam generators, high pressure boilers, performance of boilers, fuels and combustion, steam turbines. Impulse turbines, reaction turbines, feed water treatment, steam condensers, problem solving.	
Unit – II	**10 Hrs**
Condensate feed water system, circulating water system, gas turbine cycles, combined cycles, hydro-electric, power plants. Classification of hydro-plants, hydraulic turbines, hydro plant controls, problem solving. Principles of nuclear energy, thermal fission reactors and Power Plants, Fast breeder reactors, solar energy, solar thermal energy.	
Unit –III	**10 Hrs**
Solar thermal energy, direct energy conversion, wind energy, geothermal energy, energy from oceans. Energy storage, economics of power generation, economics of power generation, environmental aspect of power generation, problem solving.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
CO2	Apply the concepts to define the working principle of diesel power plant
CO3	Analyze the working and layout of different power plants
CO4	Apply the mathematical and working principles of different power plants for the generation of power.

Reference Books	
1.	Power plant Engineering, Black & Veatch, 1st Edition, CBS Publisher, 2005, ISBN: 978-8123919461
2.	Power plant Technology, El-Wakil, M.M.,1st Edition, McGraw-Hill Book Co, 2017, ISBN: 978-0070702448

Semester: IV						
DESIGN THINKING LAB **Category: PROFESSIONAL CORE COURSE** **(Practice)**						
Course Code	**:**	EI247DL		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	0:00:02		**SEE**	**:**	50 Marks
Total Hours	**:**	26P		**SEE Duration**	**:**	02 Hrs
						26 Hrs

Guidelines for Design Thinking Lab (DTL):

1. 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 must select a theme that will provide solutions to the challenges of societal concern. Normally three to four themes would be identified by the department.
4. Each group should follow the stages of Empathy, Design, Ideate, prototype and Test for completion of DTL.
5. After every stage of DTL, the committee constituted by the department along with the coordinators would evaluate for CIE. The committee shall consist of respective coordinator & two senior faculty members as examiners. The evaluation will be done for each student separately.
6. The team should prepare a Digital Poster and a report should be submitted after incorporation of any modifications suggested by the evaluation committee.

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 must 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.
9. 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	Interpret the process of Design Thinking to solve real world problems from the end user viewpoint.
CO2	Apply design thinking tools to make decisions and attain a feasible solution.
CO3	Identify and solve a Capstone project with sustainable goals using Design Thinking.
CO4	Develop a prototype and optimize it further through demonstrations.

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION		
#	**COMPONENTS**	**MARKS**
1.	Empathy, Ideate evaluation	**10**
2.	Design evaluation	**20**
3.	Prototype evaluation, Digital Poster presentation and report submission	**20**
MAXIMUM MARKS FOR THE CIE		**50**

RUBRIC FOR SEMESTER END EXAMINATION(LAB)		
Q.NO.	**CONTENTS**	**MARKS**
1	Write Up	10
2	Demonstration of the project	30
3	Viva	10
	TOTAL	**50**

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

Unit-I	**10 Hrs**

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration '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 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	Understand human relationships and human nature in mind so that they will have better critical ability.
CO3	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	Apply what they have learnt to their own self in different day-to-day settings in real life.

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

RUBRICS FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 5 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**10**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 25 Marks, adding up to 50 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 20 MARKS.**	**20**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (10) & Phase II (10) ADDING UPTO 20 MARKS**.	**20**
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

RUBRICS FOR SEMESTER END EXAMINATION (THEORY)		
Q.NO.	**CONTENTS**	**MARKS**
	PART A	
1	Objective type questions covering entire syllabus	**10**
	PART B (Maximum of THREE Sub-divisions only)	
2	Unit 1: (Compulsory)	**08**
3 & 4	Unit 2: Question 3 or 4	**08**
5 & 6	Unit 3: Question 5 or 6	**08**
7 & 8	Unit 4: Question 7 or 8	**08**
9 &10	Unit 5: Question 9 or 10	**08**
	TOTAL	**50**

Semester: IV						
Bridge Course: MATHEMATICS (Mandatory Audit Course) (AS, BT, CH, CV, EC, EE, EI, ET, IM, ME)						
Course Code	**:**	MAT149AT		**CIE**	**:**	50 Marks
Credits: L: T: P	**:**	2:0:0		**SEE**	**:**	**NO SEE** (AUDIT COURSE)
Total Hours	**:**	30L				

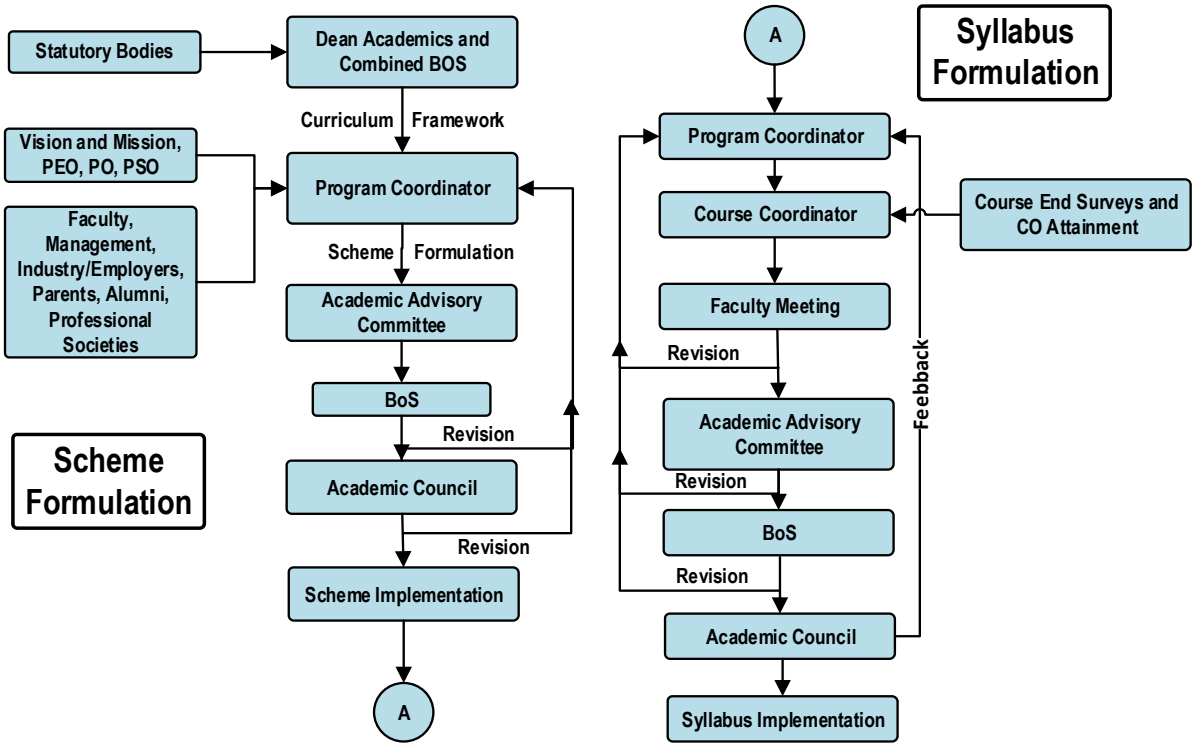
Unit-I	**10 Hrs**
Multivariable Calculus: **Partial Differentiation:** Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems. **Vector Differentiation:** Introduction, velocity and acceleration, gradient, divergence – solenoidal vector function, curl – irrotational vector function and Laplacian, simple problems.	
Unit – II	**10 Hrs**
Differential Equations: Higher order linear differential equations with constant coefficients, solution of homogeneous equations - Complementary functions. Non-homogeneous equations – Inverse differential operator method of finding particular integral based on input function (force function).	
Unit –III	**10 Hrs**
Numerical Methods: Solution of algebraic and transcendental equations – Intermediate value property, Newton-Raphson method. Solution of first order ordinary differential equations – Taylor series and 4th order Runge-Kutta methods. Numerical integration – Simpson's 1/3rd, 3/8th 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.

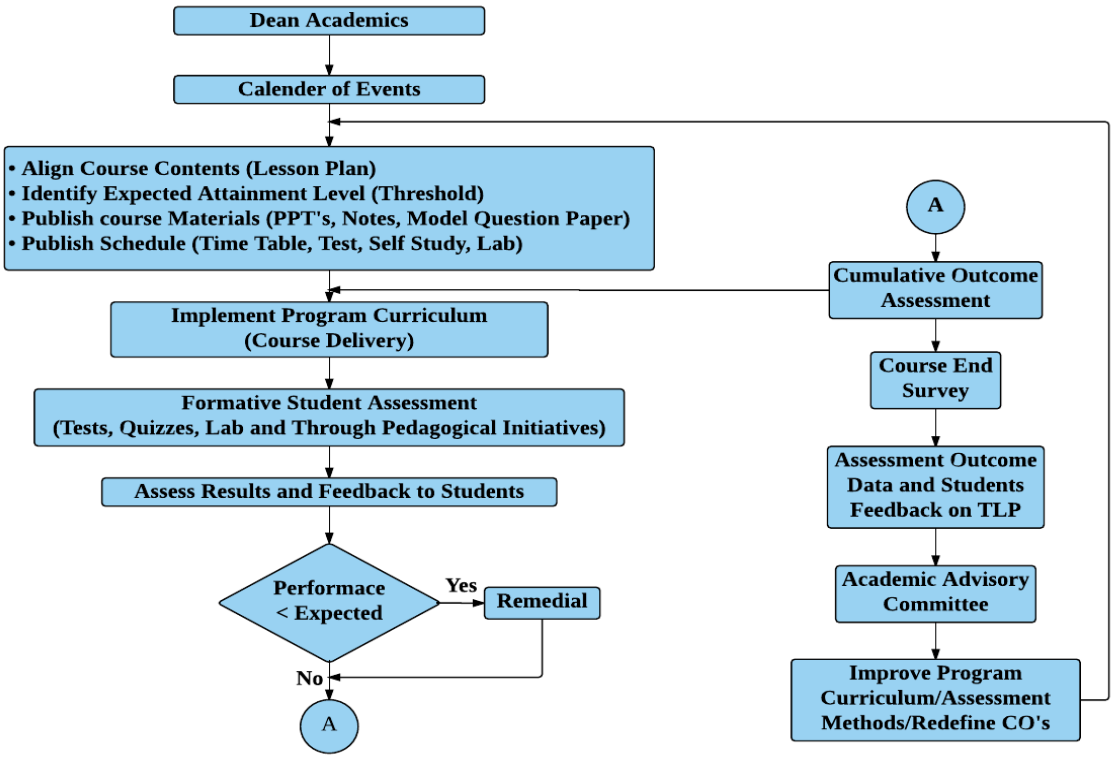
Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44th Edition, 2015, Khanna Publishers, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11th Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	A Textbook of Engineering Mathematics, N.P. Bali & Manish Goyal,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

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

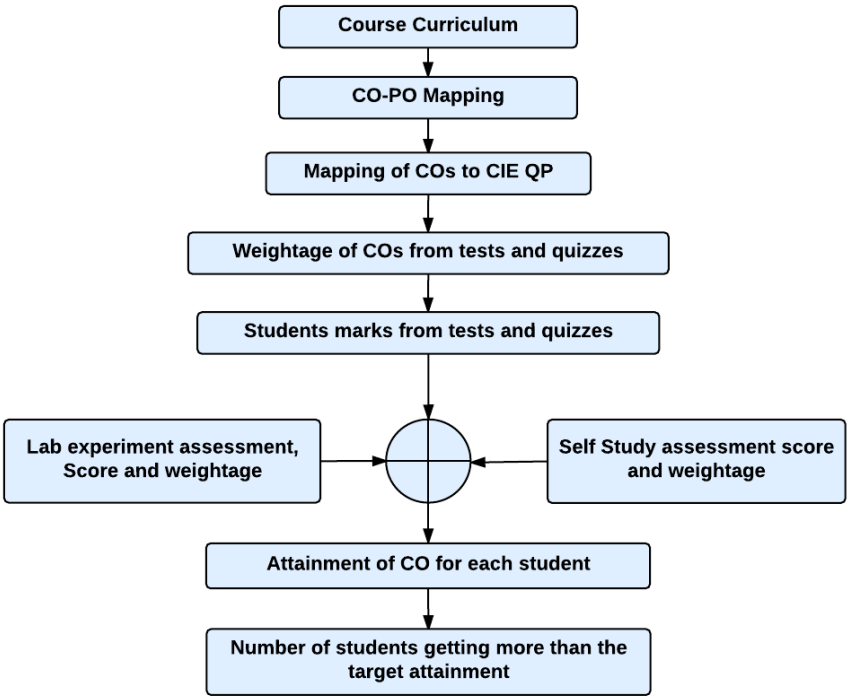
Curriculum Design Process



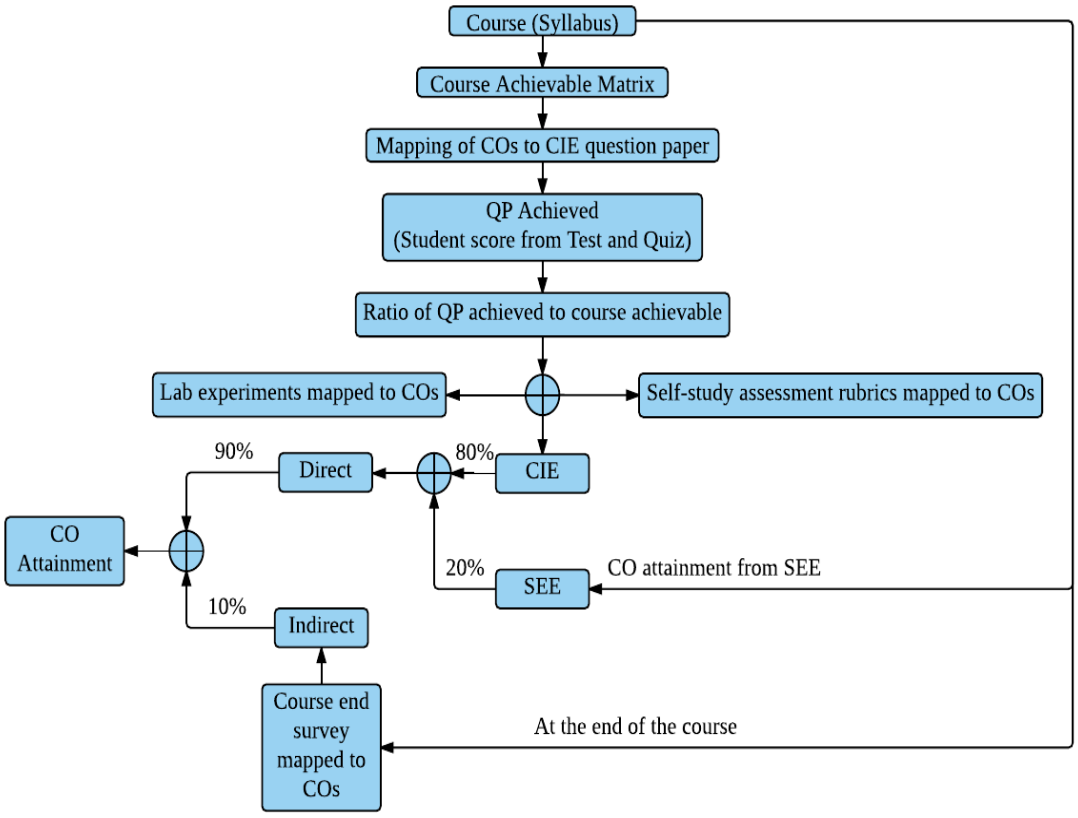
Academic Planning and Implementation



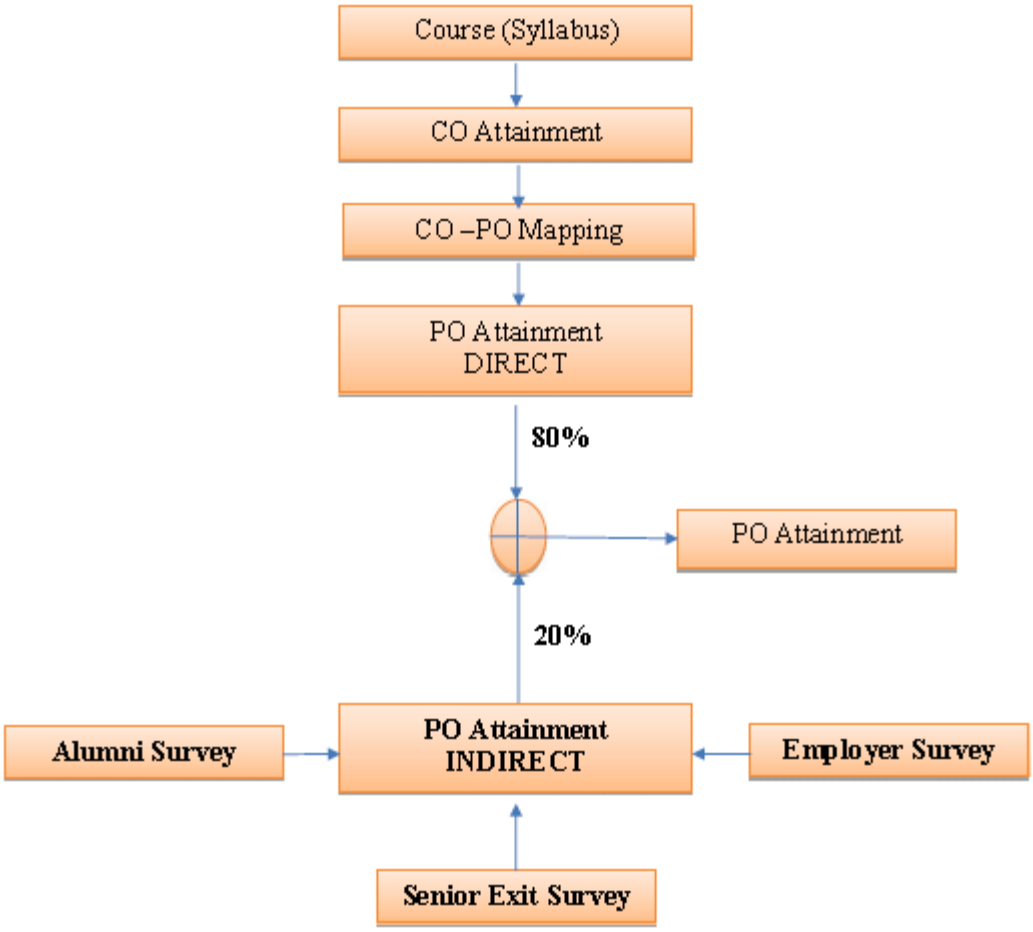
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



PROGRAM OUTCOMES (POs)

1) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
2) **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3) **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4) **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6) **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7) **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9) **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with th e society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11) **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12) **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.