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

MECHANICAL ENGINEERING

ACADEMIC YEAR 2023-24

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation

MECHANICAL ENGINEERING

DEPARTMENT VISION

Quality Education in Design, Materials, Thermal and Manufacturing with emphasis on Research, Sustainable technologies, and Entrepreneurship for Societal Symbiosis

DEPARTMENT MISSION

- Imparting knowledge in basic and applied areas of Mechanical Engineering
- Providing state-of-art laboratories and infrastructure for academics and research
- Facilitating faculty development through continuous improvement programs
- Promoting research, education and training in frontier areas of nanotechnology, advanced composites, surface technologies, MEMS and sustainable technology
- Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy
- Imbibing social and ethical values in students, staff and faculty through personality development programs

PROGRAM EDUCATIONAL OBJECTIVES

PEO1 Successful professional careers with sound fundamental knowledge in Mathematics, Physical Sciences and Mechanical Engineering leading to leadership, entrepreneurship or pursuing higher education.

PEO2 Expertise in specialized areas of Mechanical Engineering such as Materials, Design, Manufacturing and Thermal Engineering with a focus on research and innovation.

PEO3 Ability of problem solving by adopting analytical, numerical and experimental skills with awareness of societal impact.

PEO4 Sound communication skills, team working ability, professional ethics and zeal for life-long learning.

PROGRAM SPECIFIC OUTCOMES

PSO1 Project Innovation: Competency, creativity and innovativeness in Mechanical Engineering with Multidisciplinary approach.

PSO2 Research Innovation: Analytical, research and communication skills for placement in industries, research organizations and for pursuing higher education.

PSO3 Special Labs: Knowledge in cutting edge technologies and skills in modern simulation tools.

LEAD SOCIETY

American Society of Mechanical Engineers – ASME

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

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Bachelor of Engineering in

MECHANICAL ENGINEERING

III SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	MAT231BT	Statistics, Laplace Transform and Numerical Methods	3	1	0	4	MA	Theory	1.5	**100**	****	**3**	**100**	****
2	XX232AT	Basket courses (Group A)	3	0	0	3	BT/ CV/ ME	Theory	1.5	**100**	****	**3**	**100**	****
3	ME233AI	Solid Mechanics	3	0	1	4	ME	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	ME234AI	Engineering Thermodynamics	3	0	1	4	ME	Theory + Lab	1.5	**100**	**50**	**3**	**100**	**50**
5	ME235AI	Metrology and Machine Drawing	3	0	1	4	ME	Theory	1.5	**100**	**50**	**3**	**100**	**50**
6	HS237XL	Ability Enhancement Courses (Group C)	0	0	2	2	HSS	Lab	****	****	**50**	**2**	****	**50**
7	CS139DT	Bridge Course: C Programming	2	0	0	Ad	MA	Theory	1	**50**	****	****	****	****
						21								

IV SEMESTER

Sl. No.	Course Code	Course Title	Credit Allocation				BoS	Category	CIE Duration (H)	Max Marks CIE		SEE Duration (H)	Max Marks SEE	
			L	T	P	Total				Theory	Lab		Theory	Lab
1	MAT241AT	Probability Theory and Linear Programming	2	1	0	3	MA	Theory	1.5	100	****	3	100	****
2	XX242AT	Basket courses (Group A)	3	0	0	3	BT/ CV/ ME	Theory	1.5	100	****	3	100	****
3	ME243AT	Theory of Machines	3	0	0	3	ME	Theory	1.5	100	****	3	100	****
4	ME244AI	Fluid Mechanics	3	0	1	4	ME	Theory + Lab	1.5	100	50	3	100	50
5	ME245AI	Manufacturing Technology	3	0	1	4	ME	Theory + Lab	1.5	100	50	3	100	50
6	XX246XT	Professional Core Courses 3 - Group B	2	0	0	2	ME	NPTEL	****	****	****	3	100	****
7	ME247DL	Design Thinking Lab	0	0	2	2	ME	Lab	2	****	50	3	****	50
8	HS248XT	Universal Human Values	2	0		2	HSS	Theory	1	50	****	2		
9	MAT149DT	Bridge Course: Mathematics	2	0	0	Ad	CS	Theory	1	50	****	****	****	****
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Basket courses (Group A)

***Ability Enhancement Courses (Group C)**

INDEX

Basket Courses (Group A)

Professional Core Courses 3 - Group B

Semester: III						
STATISTICS, LAPLACE TRANSFORM AND NUMERICAL METHODS (Theory) (AS, BT, CH, IM, ME)						
Course Code	**:**	MAT231BT		**CIE**	**:**	**100 Marks**
Credits: L: T: P	**:**	3:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L+30T		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Statistics: Central moments, mean, variance, coefficients of skewness and kurtosis in terms of moments. Correlation analysis, rank correlation, curve fitting, linear and multivariate regression analysis. Implementation using MATLAB.	
Unit – II	**09 Hrs**
Complex Analysis: Complex function, analytic function, Cauchy-Riemann equations, harmonic functions. Construction of analytic function– Milne -Thomson method. Taylor, Maclaurin, Laurent series. Zeros and poles, Residue theorem. Implementation using MATLAB.	
Unit –III	**09 Hrs**
Laplace Transform: Existence and uniqueness of Laplace transform, transform of elementary functions, region of convergence. Properties - linearity, scaling, s - domain shift, differentiation in the s - domain, division by t, differentiation and integration in the time domain. Laplace transform of time domain periodic functions, Heaviside unit step function, unit impulse function, t - shift property. Implementation using MATLAB.	
Unit –IV	**09 Hrs**
Inverse Laplace Transform: Definition, properties, evaluation using different methods. Convolution theorem. Application to solve ordinary linear differential equations. Implementation using MATLAB.	
Unit –V	**09 Hrs**
Numerical Methods for Partial Differential Equations: Numerical solutions to partial differential equations – Finite difference approximation to derivatives, solution of Laplace equation in two-dimension, heat and wave equations in one dimension (explicit methods). Implementation using MATLAB.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Illustrate the fundamental concepts of statistics, complex analysis, Laplace & inverse Laplace transform and numerical methods.
CO2:	Apply the acquired knowledge of statistics, complex analysis, Laplace transform and numerical methods for partial differential equations to solve the problems of engineering applications.
CO3:	Analyze the solution of the problems obtained from appropriate techniques of statistics, complex analysis, Laplace transform and numerical methods to the real - world problems.
CO4:	Interpret the overall knowledge of statistics, complex analysis, Laplace transform and numerical methods to solve partial differential equations arising in many practical situations.

Reference Books	
1	Advanced Engineering Mathematics, Dennis G. Zill, Warren S. Wright, 7th Edition, 2020, Jones and Bartlett publishers, ISBN: 13-978-1284105902.
2	Numerical Methods for Scientific and Engineering Computation, M.K. Jain, S.R.K. Iyenger and R.K. Jain, 6th Edition, 2012, New Age International Publishers, ISBN: 9788122433234, 8122433235.
3	Advanced Engineering Mathematics, Erwin Kreyszig, 9th Edition, 2007, John Wiley & Sons, ISBN: 978-81-265-3135-6.
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 (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**	**:**	**3 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 o Genetic manipulation), GEAC (Genetic Engg Approval Committee) for GMO applications in food and agriculture. Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	
Unit –III	**10 Hrs**
Food Safety Standards: FSSAI (Food Safety and Standards Authority of India), Functions, License, types of FSSAI Licences and compliance rules. **Food Hygiene:** General principles of food microbiology and overview of 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	Comprehensive knowledge of Biohazards and bio safety levels
CO2	Understanding the biosafety guidelines and their importance to the society
CO3	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	IPR Biosafety and Bioethics,_Deepa Goel, Shomini Parashar,1st Edition, Pearson; 2013, ISBN: 978-8131774700.
2	The Food Safety, Cynthia A Roberts, Oryx Press, 1st Edition, 2001, ISBN: 1–57356–305–6.
3	Food Safety Management Systems, Hal King, Springer Cham, 2020, ISBN: 978-3-030-44734-2.
4	Bioethics: The Basics, Routledge, Alastair V. Campbell, 2nd Edition, 2017, ISBN: 978-0415790314.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
4.	**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**
5.	**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**
6.	**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)	
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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
(Common to all Programs)
(Theory)

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

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

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

ENVIRONMENTAL POLLUTION

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

Unit – II — **08 Hrs**

RENEWABLE SOURCES OF ENERGY

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

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

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

Unit –III — **08 Hrs**

UNIT IV SUSTAINABILITY AND MANAGEMENT

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

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

Unit –IV — **08 Hrs**

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

SUSTAINABILITY PRACTICES

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

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

Unit –V — **08 Hrs**

Corporate Social Responsibility (CSR) - Meaning & Definition of CSR, History & evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management. Relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India.

Sustainability Reporting: Flavour of GRI, Dow Jones Sustainability Index, CEPI. Investor interest in Sustainability.

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

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.

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)		
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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**
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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						
SOLID MECHANICS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	ME233AI		**CIE**	**:**	100 + 50 Marks
Credits: L:T:P	**:**	3:0:1		**SEE**	**:**	100 + 50 Marks
Total Hours	**:**	46 Hrs T+ 39 Hrs P		**SEE Duration**	**:**	3 + 3 Hours

Part – A

Unit – I	**06 Hrs**
Stress and Strains: Stresses in Compound Bars and Composite bars, Thermal Stresses in Compound and Composite structures. Introduction to stress-strain tensors, invariants, Principal stresses (3D stresses)	
Unit -II	**10 Hrs**
Bending moment and shear force in beams: Introduction, Types of beams, Loads and Reactions, Shear forces and bending moments, Rate of loading, Sign conventions, Relationship between shear force and bending moments, Shear force and bending moment diagrams subjected to concentrated loads, uniform distributed load (UDL) for different types of beams. (UVL not included) **Bending stress in beams:** Introduction, Assumptions in simple bending theory, Derivation of Bernoulli's equation, Modulus of rupture, Section modulus, Flexural rigidity, Bending stress distribution in beams of various sections.	
Unit –III	**10 Hrs**
Shear stresses in beams: Expression for horizontal shear stress distribution in beam, Shear stress diagram for simple rectangular and I section and T sections only. Numericals. **Deflection of determinate Beams:** Introduction, Definitions of slope, Deflection, Elastic curve, Derivation of differential equation of flexure, Sign convention, Double integration method, Slope and deflection using Macaulay's method for prismatic beams and overhanging beams subjected to point loads, UDL and couple. Numerical problems.	
Unit –IV	**10 Hrs**
Torsion of shafts: Assumptions in theory of pure torsion, Torsion equations, Torsional rigidity and modulus of rupture, Power transmitted, Comparison of solid and hollow circular shafts. Numericals. **Analysis of columns and struts**: Introduction, Euler's theory on columns, Effective length, Slenderness ratio, short and long columns, Radius of gyration, Problems on Euler's Buckling load and Rankine's theory (no derivation), Limitations of Euler's theory.	
Unit - V	**10 Hrs**
Thick and thin cylinders: Stresses in thin cylinders, Changes in dimensions of cylinder (diameter, length and volume), Thick cylinders subjected to internal and external pressures (Lame's equation), (Compound cylinders not included). **Theories of Failures:** Maximum Principal stress theory, Maximum shear stress theory; Maximum strain theory, Maximum Strain energy theory, Maximum Distortion Energy Theory, Numericals	

PART – B		
Solid Mechanics Laboratory		
Section – I (Destructive testing)		**30 Hrs**
1.	Preparation of specimens as per ASTM Standards	
2.	Microstructural studies of MS, Al and Cu structural materials using optical microscope	
3.	Mechanical Characterization of MS and CI (Hardness, Tensile, Compression, Double shear, Impact - Charpy, Izod and Drop weight, Torsion and Wear)	
4.	Study of fracture and worn-out surfaces using SEM	
Section – II (Non-destructive testing)		**09 Hrs**
1.	Magnetic Particle Test	
2.	Ultrasonic Test	
3.	Dye Penetrant Test	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Apply material properties and behaviour under different types of loading conditions.
CO2:	Compute the stresses, strains, moments, deflections and derive the expressions used from the fundamentals.
CO3:	Design geometrical shape & size for various applications such as beams, shafts, pressure vessels and columns using failure theories
CO4:	Determine mechanical properties by destructive and non-destructive methods

Reference Books	
1.	**Strength of Materials**, S Ramamrutham, R Narayanan, 2020, Dhanpatrai Publishing Company, 20th Edition, ISBN: 9788187433545
2.	**Elements of Strength of Materials**, Timoshenko, 2022, Affiliated East-West Press, ISBN: 9788176710190
3.	**Strength of Materials**, S S Bhavikatti, 2021, S Chand & Company, New Delhi, 5th Edition, ISBN: 978-9354531972,
4.	**Mechanics of Materials**, F.P. Beer and R. Johnson, McGraw-Hill Publishers, ISBN: 9780073529387, 2006
5.	**https://onlinecourses.nptel.ac.in/**

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

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

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

Semester: III						
ENGINEERING THERMODYNAMICS **Category: Professional Core Course** **(Theory and Practice)**						
Course	**:**	ME234AI		**CIE Marks:**	**:**	100 + 50 Marks
Credits:	**:**	3:0:1		**SEE Marks:**	**:**	100 + 50 Marks
Hours:	**:**	46 hrs + 39 hrs		**SEE Duration:**	**:**	3 hrs + 3 hrs

Part – A

Unit - I	**06 Hrs**
First Law of Thermodynamics: Concept of pure substances, PMM-I, Enthalpy, Applications of first law of thermodynamics to steady flow processes, Steady State Steady Flow Energy Equation and its applications. **Second Law of Thermodynamics:** Thermal energy reservoirs, heat engines, refrigerators and heat pumps, Efficiency and COP. Statements of second law of thermodynamics, Equivalence of Kelvin-Planck and Clausius statements, PMM-II	
Unit – II	**10 Hrs**
Irreversibility: Irreversibility and factors of irreversibility, Carnot cycle, Carnot theorems. **Entropy:** Clausius theorem and Inequality, Entropy- property of a system, Principle of increase of entropy, Change of entropy for different processes, Exergy and Anergy.	
Unit – III	**10 Hrs**
Gas Power Cycles: Efficiency of air standard cycles – Otto and Diesel cycles; mean effective pressure, Comparison of Otto, Diesel and Dual cycles. **Gas Turbines:** Brayton cycle, Working of Closed and Open cycles, Thermal efficiency of ideal, actual and modified Brayton cycle, Isentropic efficiency, Regeneration, Reheating, Intercooling.	
Unit – IV	**10 Hrs**
Reciprocating air compressors: Classification, Work input with and without clearance, Volumetric efficiency, Adiabatic, Isothermal and Mechanical efficiency, Maximum work input in multi-stage compression with intercooling, Intermediate pressure for minimum work input. **Vapor Power Cycles:** Ideal and Actual Rankine cycle, Thermal efficiency of Rankine cycle, Modification of Rankine cycle – Regenerative cycle, Reheat cycle.	
UNIT-V	**10 Hrs**
Refrigeration Cycles: Vapour Compression refrigeration system, Effect of condenser and evaporator pressure on COP, Properties of refrigerants, VCR and air refrigeration cycles for industrial applications, Vapour Absorption refrigeration system. **Psychometrics:** Atmospheric air and Psychrometric properties, DBT, WBT, Partial pressures, RH and Specific humidity, Dew point temperature, degree of saturation, Adiabatic saturation temperature, Psychrometric processes, Use of Psychrometric chart.	

Engineering Thermodynamics Lab	
Section – I	**09 Hrs**
1. Determination of fuel and lubricating oil properties. (Flash point, Fire point, Viscosity, and Calorific Value)	
2. Valve timing diagram of a 4 stroke IC Engine.	
3. COP of Vapor Compression Refrigeration system	
Section – II	**30 Hrs**
1. Performance tests on IC Engines – Petrol and Diesel Engine	
2. Performance test on two stage reciprocating air compressor	
3. Experiments on automotive mechatronic systems	
a. Study of fuse box configuration b. Inspection of fuse and relay condition c. Study of sensors in automotive systems d. Use of multi-meter for automotive diagnosis e. Study of starter motor f. Analysis and diagnosis of faults on various sub-systems of passenger vehicles.	
4. Demonstration of OBD kit for a four-wheeler	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain basic concepts and Laws of thermodynamics
CO2:	Analyse the performance of thermodynamic cycles with different processes
CO3:	Apply the knowledge to solve problems associated with thermodynamic applications
CO4:	Determination of fuel properties and fault detection in automotive systems

Reference Books	
1	Basic & Applied Thermodynamics, P K Nag, 2nd Edition, 2017, McGraw Hill Education, ISBN 10-0070151318, 13-978-0070151314
2	Thermodynamics - An Engineering Approach, Yunus A. Cengel, Michael A. Boles, Mehmet Kanoglu, 9th Edition, 2019, McGraw Hill Education, ISBN 10-9353165741, 13-978-9353165741
3	Principles of Engineering Thermodynamics, Moran, Shapiro, Boettner, Bailey, 8th Edition, 2015, Wiley Publications, ISBN 10-8126556722, 13-978-8126556724
4	Thermal Engineering, R.K. Rajput, 10th Edition, 2020, Laxmi Publications, ISBN 10-8131808041, 13-978-8131808047
5	www.nptel.ac.in
6	www.matlab.in

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

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

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

Semester III						
METROLOGY AND MACHINE DRAWING **Category: Professional Core Course** **(Theory and Practice)**						
Course Code	**:**	ME235AI		**CIE Marks**	**:**	100 + 50 Marks
Credits: L: T: P	**:**	3:0:1		**SEE Marks**	**:**	100 + 50 Marks
Total Duration	**:**	40 Hrs + 39 Hrs		**SEE Duration**	**:**	03 + 03 Hours

PART – A

Unit – 1	**06 hrs**
Concepts of Measurements: Methods of measurements, errors in measurements, accuracy and precision, repeatability, standards and their roles, wavelength standard, modern metre, Hierarchical classification of standards, Line and End measurements, calibration of end bars. Fundamentals of measurement systems, generalized measurement system, Transducers-Characteristics transfer efficiency, primary and secondary transducers, mechanical transducers.	
Unit - 2	**09 hrs**
Comparators: Mechanical- Reed, Mikrokator, sigma comparator. Electrical type- LVDT. Optical- Zeiss ultra-optimeter, Angular measurements- Sine bar, optical bevel protractor. Slip gauges and classification. **Limits, fits and tolerances**: Definition of tolerance, Principle of interchangeability and selective assembly, Indian standards, concept of limits of size and tolerances, definition of fits, types of fits, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges.	
Unit - 3	**10 hrs**
Advances in Metrology: Precision instruments based on laser-Principles- laser interferometer- Michelson interferometer and machine tool metrology. Coordinate measuring machine (CMM)- Constructional features – types, applications. **Measurement of Torque, Force & Temperature:** Force- Equal arm, unequal arm, load cell, proving ring. Torque- Torsion bar dynamometer, Prony brake dynamometer. Temperature- thermocouple, RTD, bimetallic strip, pressure thermometers, optical pyrometer, Infrared thermometers.	
Unit - 4	**08 hrs**
Machine Drawing Concepts: Conventional Representations of Interrupted views, Machining symbols, surface roughness symbols. GD &T symbols, form tolerance- flatness, cylindricity, straightness, circularity, orientation- tolerances-perpendicularity, parallelism and angularity. **Screw thread profiles**: Terminology, Standard forms of V-threads, Standard Square threads, modified forms of square threads. Types of Welded Joints, Representation of welds, symbols and its conventions.	
Unit-5	**07 hrs**
Digital Metrology: Metrology and Digitalization, Implementation Strategy, Data Acquisition, Setup Fundamentals for Measurement and Data Acquisition, Length Measurement in Open Loop, Thermal Measurement and Data-Acquisition Considerations, Data Transfer to Cloud, Internet of Things (IoT) Metrology, Closed-Loop Data Analysis- (In-Process Inspection), Digital Twin Metrology Inspection. **Advanced MEMS Inspection:** ACES Methodology, Computational Solution, Experimental Solution Based on Optoelectronic Methodology, The OELIM System, MEMS Samples Used, Deformations of a Micro-gyroscope, Functional Operation of a Micro-accelerometer, Thermomechanical Deformations of a Cantilever Microcontact.	

Part – B	
Metrology and Machine Drawing Lab	**39 Hrs**
1. Assembly drawing – Universal Coupling, Screw Jack, Plummer block, Connecting rod, Crane Hook. 2. CAM profile – Radial, offset of knife edge, roller and flat followers type CAM profiles. 3. Demonstration of slip gauge, LVDT, Profile Projector, Tool Makers Microscope, Strain Gauges, Thermocouples, Surface profilometer	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the principle of linear and angular measurements and its use in Digital metrology.
CO2:	Illustrate the principle of MEMS, CMM, torque, force and temperature measuring devices.
CO3:	Apply the principle of GD&T to assemblies in machine drawing
CO4:	Create 3D model of machine components and indicate the drawing conventions.

Reference Books	
1	Engineering Metrology and Measurements, NV Raghavendra, L Krishna murthy, 2013, Oxford publishers. ISBN: 978-0198085492.
2	Geometric Dimensioning and Tolerancing for Mechanical Design, Gene Cogorno, 2006, McGraw-Hill, ISBN-13:978-0071772129
3	Metrology and Instrumentation, Samir Mekid, Ryszard J. Pryputniewicz, 2022, Wiley-ASME Press Series, ISBN: 9781119721734
4	Optical Imaging and Metrology, John Wiley and Sons, ISBN: 9783527648474
5	Fundamentals of Machine Drawing, Sadhu Singh, 2013, Prentice Hall India Learning publications. ISBN: 9788120346796
6	https://nptel.ac.in/courses/112104250 - Engineering Metrology

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

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

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

Semester: III						
NATIONAL SERVICE SCHEME(NSS) (Practical)						
Course Code	**:**	**HS237AL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**

Prerequisites:

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

Content	**13 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 belowmentioned 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 forimplementation.
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, SwachhBharat, 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 thesame.
CO3	Evaluate the existing system and to propose practical solutions for the same for sustainabledevelopment.

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						
NATIONAL CADET CORPS (NCC) (Practical)						
Course Code	**:**	**HS237BL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**15P**		**SEE Duration**	**:**	**02 Hrs**
Unit-I						**07 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						**03 Hrs**
Weapon Training (WT): Introduction & Characteristics of 7.62 Self Loading rifle, Identification of rifle parts						
Unit –III						**03 Hrs**
Adventure activities: Trekking and obstacle course						
Unit –IV						**02 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 ofaccidents 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 socialservice 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 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: III						
PHYSICAL EDUCATION (SPORTS & ATHLETICS) (Practical)						
Course Code	**:**	**HS237CL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.5 Hrs**
Content						**30 Hrs**

Topics for Viva:

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

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand the basic principles and practices of Physical Education and Sports.
CO2	Instruct the Physical Activities and Sports practices for Healthy Living.
CO3	To develop professionalism among students to conduct, organize & Officiate Physical Education andSports 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 Kinetics'.
Note: Skills of Sports and Games (Game Specific books) may be referred	

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour withsurveyed data.	**10**	*****
EXPERIENTIAL LEARNING Presentation 2 (phase 2) Content development, strategies for 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: III						
MUSIC (Practical)						
Course Code	:	**HS237DL**		**CIE**	:	**50 Marks**
Credits: L: T: P	:	**0:0:1**		**SEE**	:	**50 Marks**
Total Hours	:	**13P**		**SEE Duration**	:	**02 Hrs**
Content						**13 Hrs**

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

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

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

Course Outcomes: After completing the course, the students will be able to: -

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

Reference Books

1.	Music Cognition: The Basics by Henkjan Honing.
2.	Basic Rudiments Answer Book - Ultimate Music Theory: Basic Music Theory Answer Book by 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 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 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: III						
DANCE (Practical)						
Course Code	**:**	**HS237EL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**13 Hrs**

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

Course Outcomes: After 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 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: III						
Theater (Light Camera & Action) (Practical)						
Course Code	**:**	**HS237FL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**13 Hrs**

1. Break the ICE
2. Introduction to freedom Talk to each and every single person for a period of 5 complete minutes. 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: III						
ART WORK & PAINTING (Practical)						
Course Code	**:**	**HS237GL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**

Contents **13 Hrs**

1. Use points, line and curves to create various shapes and forms
2. Use of shapes and forms to create various objects and structures
3. Recognizing distinctions in objects when viewed from various perspectives and grasping basic notions of perspective
4. Students will be introduced to the significance of color in art, as well as the principles of color theory and application.
5. Applied the concepts of unity, harmony, balance, rhythm, emphasis and proportion, abstraction and 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 implementationmethodologies.	**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: III						
PHOTOGRAPHY & FILM MAKING (Practical)						
Course Code	**:**	**HS237HL**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:1**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Contents						**13 Hrs**

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

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

CIE will be evaluated based on their presentation, approach and implementation strategies. Students need 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 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: III						
BRIDGE COURSE: C PROGRAMMING (Common to all Programs)						
Course Code	**:**	**CS139DT**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0(Audit)**		**SEE**	**:**	**--**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**--**

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

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

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

PRACTICE PROGRAMS

Implement the following programs using cc/gcc compiler

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

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

Semester: IV						
PROBABILITY THEORY AND LINEAR PROGRAMMING (Theory) (AS, CH, CV, EE, EI, ET, ME)						
Course Code	**:**	MA241AT		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	2:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	30L+13T		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Random Variables: Random variables-discrete and continuous, probability mass function, probability density function, cumulative distribution function, mean and variance. Two or more random variables - Joint probability mass function, joint probability density function, conditional distribution and independence, Covariance and Correlation. Simulation using MATLAB.	
Unit – II	**06 Hrs**
Probability Distributions: Discrete distributions - Binomial, Poisson and Geometric. Continuous distributions – Exponential, Uniform, Normal and Weibull. Simulation using MATLAB.	
Unit –III	**06 Hrs**
Sampling and Estimation: Population and sample, Simple random sampling (with replacement and without replacement). Sampling distributions of means (σ known), Sampling distributions of mean (σ unknown): t - distribution, Sampling distributions of variance: Chi - squared distribution. Estimation - Maximum Likelihood Estimation.	
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).	
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.	

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	Sheldon Ross, Introduction to Probability and Statistics for Engineers and Scietists, Sheldon Ross, 5th Edition, 2014, Academic Press, ISBN: 13-978-0123948113.
4	Fundamentals of Applied Probability and Random Processes, Oliver C Ibe, 2nd Edition, 2014, Academic Press Inc, ISBN: 13-978-0128008522.
5	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 (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**	**:**	**3 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 o Genetic manipulation), GEAC (Genetic Engg Approval Committee) for GMO applications in food and agriculture. Overview of National Regulations and relevant International Agreements including Cartagena Protocol.	
Unit –III	**10 Hrs**
Food Safety Standards: FSSAI (Food Safety and Standards Authority of India), Functions, License, types of FSSAI Licences and compliance rules. **Food Hygiene:** General principles of food microbiology and overview of 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	Comprehensive knowledge of Biohazards and bio safety levels
CO2	Understanding the biosafety guidelines and their importance to the society
CO3	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	IPR Biosafety and Bioethics,_Deepa Goel, Shomini Parashar,1st Edition, Pearson; 2013, ISBN: 978-8131774700.
2	The Food Safety, Cynthia A Roberts, Oryx Press, 1st Edition, 2001, ISBN: 1–57356–305–6.
3	Food Safety Management Systems, Hal King, Springer Cham, 2020, ISBN: 978-3-030-44734-2.
4	Bioethics: The Basics, Routledge, Alastair V. Campbell, 2nd Edition, 2017, ISBN: 978-0415790314.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
7.	**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**
8.	**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**
9.	**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

ENVIRONMENT AND SUSTAINABILITY
(Common to all Programs)
(Theory)

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

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

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

ENVIRONMENTAL POLLUTION

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

Unit – II — **08 Hrs**

RENEWABLE SOURCES OF ENERGY

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

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

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

Unit –III — **08 Hrs**

SUSTAINABILITY AND MANAGEMENT

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

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

Unit –IV — **08 Hrs**

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

SUSTAINABILITY PRACTICES

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

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

Unit –V — **08 Hrs**

Corporate Social Responsibility (CSR) - Meaning & Definition of CSR, History & evolution of CSR. Concept of Charity, Corporate philanthropy, Corporate Citizenship, CSR-an overlapping concept. Concept of sustainability & Stakeholder Management. Relation between CSR and Corporate governance; environmental aspect of CSR; Chronological evolution of CSR in India.

Sustainability Reporting: Flavour of GRI, Dow Jones Sustainability Index, CEPI. Investor interest in Sustainability.

Reference Books	
2.	'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

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.

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 characterization 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						
THEORY OF MACHINES **Category: Professional Core Course** **(Theory)**						
Course Code	:	ME243AT		**CIE**	:	100 Marks
Credits: L:T:P	:	3:0:0		**SEE**	:	100 Marks
Total Hours	:	42 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**06 Hrs**
Mechanisms: Definition of link, pair, kinematic chain, mechanism, machine, inversion, structure, Types of motion: constrained, unconstrained and successfully constrained. Grashof's criterion, Gruebler's criterion for mobility of mechanisms, Numericals. Inversions of four bar chain, single slider crank chain and double slider crank chain. Straight line motion mechanisms - Peaucellier and Hart mechanisms. Intermittent motion mechanisms - Ratchet and pawl, Geneva wheel. Steering gear mechanism - Davis and Ackermann. Toggle mechanism, Pantograph, Hooke's joint. (No derivations)	
Unit - II	**08 Hrs**
Velocity and Acceleration (Graphical Method): Relative Velocity Method: Velocity and acceleration of simple mechanisms, Coriolis component of acceleration. Instantaneous centre Method: Centrodes – Kennedy's theorem – linear and angular velocity of simple mechanisms. Klein's Construction Method - single slider crank mechanism. **Force Analysis:** Static Force Analysis: Static equilibrium, equilibrium of two and three force members; members with two forces and torque, free body diagram, static force analysis of four bar mechanism and slider crank mechanism without friction. Simple numerical problems. (No derivations). Dynamic Force Analysis -four bar mechanism and slider crank mechanism. Dynamically equivalent system. (No numerical problems)	
Unit – III	**10 Hrs**
Balancing of Rotating Masses: Static and Dynamic balancing, balancing of single rotating mass, balancing in same plane and in different plane, balancing of several rotating masses rotating at different planes. Numerical problems. (No derivations) (Graphical Method only) **Balancing of Reciprocating Masses:** Inertia effect of crank and connecting rod of single cylinder engine, partial balancing of multi-cylinder engine (Primary and Secondary forces and couples), Balancing of V engine, Direct and Reverse crank method. Numerical problems. (No derivations) (Graphical Method only)	
Unit - IV	**10 Hrs**
Controlling Devices: Governors – Mechanical and Electronic: Types of governors - Centrifugal and Inertia, Porter Governor and Hartnell Governor, electronic governor. Definitions - Speed of Governor, Sensitiveness, Stability, Isochronism, Hunting, Controlling force curves. **Flywheels and Gyroscope**: Types of flywheels, Energy stored in flywheels, applications. Numericals, Mechanical and Electronic gyroscope, Vectorial representation of angular motion. Definitions. Gyroscopic couple. Applications – Automobile (Two and Four Wheelers), Aeroplane and Ship. (Only theory concepts)	

Unit - V	08 Hrs
Power Transmission Systems: **Epicyclic gear Trains**: Numerical problems on epicyclic gear trains – Tabular column method only. Bevel gear Differential of an automobile. **Belt & Rope Drives**: Types – Flat, V and Circular, Open belt and Cross belt drives. Velocity ratio, Slip and Creep. Ratio of belt tensions. Initial tension, centrifugal tension. Power transmitted by belt drive. Condition for maximum power transmission. Rope drive: Ratio of tensions, Initial tension and centrifugal tension. Power transmitted. Condition for maximum power transmission. Numerical problems on flat belt drives. (No derivations).	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Define basic terminologies of kinematics & Construct diagrams to estimate velocity and acceleration for mechanism.
CO2:	Apply the fundamental principles of statics and dynamics for balancing of rotating and reciprocating masses
CO3:	Illustrate the principles of governors, flywheels & gyroscope on stabilization of vehicles
CO4:	Design basic power transmission systems such as gear trains, belt & rope drives for various applications.
References Books:	
1.	**Theory of Machines,** Thomas Bevan, 2009, 3rd Edition, Pearson Publishers, ISBN-9788123908748,
2.	**Theory of Machines and Mechanisms**, John J. Uicker, 2017, Gordon R. Pennock & Joseph E. Shigley, 5th Edition, Oxford University Press, ISBN: 9780190264482
3.	**Theory of Machines** Sadhu Singh,2013, 2nd Edition, Pearson Education Publications, ISBN: 978813179989,
4.	**Theory of Machines,** Rattan S.S, 2019, 5th Edition, Tata McGraw Hill Publications, ISBN: 9789353166281,
5.	https://mechanicalbasics.com/theory-of-machines

Semester: IV						
FLUID MECHANICS **Category: Professional Core Course** **(Theory and Practice)**						
Course Code:	**:**	ME244AI		**CIE Marks**	**:**	100+50 Marks
Credits: L:T: P	**:**	3:0:1		**SEE Marks**	**:**	100+50 Marks
Total Duration:	**:**	46 Hrs + 32		**SEE Duration**	**:**	03 + 03 Hrs

Part – A	
UNIT-I	**06 Hrs**
Introduction to fluids and Fluid Statics: Important properties of fluids, Newton's Law of Viscosity, Pressure at a point; Pressure variation with depth; Manometer and other pressure measuring devices; Hydrostatic forces and determination of centre of pressure on submerged plane and curved surfaces, Problems	
UNIT-II	**10 Hrs**
Buoyancy and Stability: Concept of buoyancy, Stability of floating bodies, Meta centre and Metacentric height; analytical determination of meta centric height; stability of submerged bodies, Problems **Fluid Kinematics:** Types of fluid flows, Lagrangian and Eulerian descriptions; parameters of flow visualization; velocity and total acceleration of a fluid particle, Stream function, Potential function, Problems	
UNIT-III	**10 Hrs**
Fluid Dynamics: General continuity equation in Cartesian coordinates; Euler's equation; Bernoulli's equation and their applications - Venturimeter, Orifice Meter, Pitot tube, Problems. **Flow over notches:** Flow over V notch, Rectangular notch, Trapezoidal notch. Problems Momentum principle, Reynold's transport theorem (only theory)	
UNIT-IV	**10 Hrs**
Viscous flow through pipes: Reynolds Number, Laminar and turbulent flows, Steady laminar flow through a smooth pipe - Hagen-Poiseuille equation, Problems **Turbulent flow in Pipes:** Major losses; Darcy Weisbach equation and Minor Losses due to various pipe fittings, Problems, Moody's chart.	
UNIT-V	**10 Hrs**
Boundary Layer Theory: Flow over a flat plate: Displacement, Momentum and Energy thickness, Flow separation concept, Problems **Dimensional and Model Analysis:** Similitude; Geometric, Kinematic and Dynamic similarities; Buckingham pi theorem and its application to fluid mechanics problems; Dimensionless numbers; Model studies, Problems	

Part – B	
Fluid Mechanics Lab	**32 Hrs**
Calibration of Venturimeter, Orifice meter, Notches	
Fluid flow in pipes – Major and Minor losses	
Impact of jet on vanes	
Flow Visualization experiments	
Demonstration of IoT based flow measuring devices	
Wind tunnel experiments	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explain and understand properties of fluids
CO2:	Analyse the effect of forces for static and dynamic conditions of fluid flow
CO3:	Apply desirable fluid parameters for real time problems
CO4:	Adopt hydrostatic and dynamic concepts of fluids for engineering applications
Reference Books	
1	A Textbook of Fluid Mechanics, R K Bansal, 8th Edition, 2020, Laxmi Publications, ISBN 10-9788131802946, 13-978-8131802946
2	Fluid Mechanics: Fundamentals and Applications, John. M. Cimbala Yunus A. Cengel, 4th Edition, 2019, McGraw-Hill Publications, ISBN 10-9353166217, 13-978-9353166212
3	Hydraulics and Fluid Mechanics, Dr. P.N. MODI, S.M. SETH, 22nd Edition, 2019, Rajsons Publications Pvt. Ltd., ISBN 10-8189401262, 13-9788189401269
4	Introduction to Fluid Mechanics and Fluid Machines, S K Som, Gautam Biswas, S Chakraborty, 3rd Edition, 2017, ISBN 10-0071329196, 13-978-0071329194
5	www.nptel.ac.in, www.matlab.in

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

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

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

Semester IV						
MANUFACTURING TECHNOLOGY **Category: Professional Core Course** **(Theory and Practice)**						
Course Code:	**:**	ME245AI		**CIE Marks**	**:**	100 + 50 marks
Credits: L:T:P	**:**	3:0:1		**SEE Marks**	**:**	100 + 50 marks
Hours /Week:	**:**	40 Hrs + 30 Hrs		**SEE Duration**	**:**	3 + 3 Hours

Part – A

Unit – 1	**07 Hrs**
Casting – Patterns: Types & allowances. Moulding sand: Properties, types of moulds, Moulding machines**,** Cores: types & functions, Special Casting Processes: CO_2, Shell, Investment and Hot & cold chamber die casting, Centrifugal and Continuous casting. Gating and Riser Design: Elements of gating system, Types of gates and gating systems. Pouring time calculations: Top & bottom gating and condition to avoid aspiration effect (derivations and Problems), Risers, Solidification Time: Chvorinov's rule and Caine's method (Problems). Casting Defects: Types, causes and remedies.	
Unit - 2	**09 Hrs**
Bulk deformation processes - Forging: Operations, Lubrication, Extrusion: Types & defects, Drawing: Wire, Rod and Tube drawing, Rolling Mills: Types & defects. Flat Rolling Terminology: Draft, Forward and backward slip, Roll strip contact length, Bite angle, Ragging, Neutral plane and Angle of nip, Problems. **Sheet Metal Forming**: Press tool operations, Punch and die clearances, Sheet Metal Drawing: Drawing, cupping and deep drawing, Draw Die Design: Factors considered for designing a draw die & defects, Sheet Metal Dies: Progressive, Compound and Combination dies, Bending and bending allowance, Rubber forming, Problems.	
Unit -3	**09 Hrs**
Metal Cutting: Mechanics of chip formation, Types of chips, Orthogonal and oblique cutting, Merchant's thin shear plane model: Force Calculations, Shear angle, Chip thickness ratio, Velocity relationships, Strain rate, Work done in shear, Friction and total work done, Cutting tool geometry & significance of various tool angles, Cutting tool materials, Problems. **Tool Wear,** Taylor's tool life equation, Machinability, Machinability index. Surface finish: Ideal surface finish in turning, Thermal aspects in metal cutting, Tool work thermocouple method for measuring chip-tool interface temperature, Cutting Fluids: Functions & types, Economics of Machining –Minimisation of the machining cost, Maximising the production rate, Problems.	
Unit -4	**09 Hrs**
Milling: Plain milling cutter nomenclature, Milling Time: Slab and face milling, Indexing: Direct, simple, compound, differential and angular indexing, Drilling: Twist drill geometry, Drilling time, Torque and thrust, Problems **Grinding:** Types of abrasives, bonding processes, Creep feed grinding, Designation and selection of grinding wheel, wheel balancing, dressing and truing, Surface Finishing Processes: Lapping, Honing, Super finishing, Polishing and Buffing.	

Unit -5	06 Hrs
Non-Conventional machining: Need and classification. EDM, ECM – Material removal rate (MRR) and Gap resistance, Electrochemical discharge machining (ECDM), CHM, USM, LBM, Problems. **Welding**: Emission and ionisation of arc, arc structure, characteristics (constant-current and constant voltage) and power, Modes of metal transfer; TIG, MIG welding, Submerged arc welding (SAW), Welding defects. Friction stir welding, Resistance welding: Principle and types of resistance welding.	

Part – B - Manufacturing Technology Lab	
Section – I (Machine Shop)	**18 Hrs**
Lathe operations: 1. Step, Taper Turning and Knurling 2. External and Internal Thread Cutting 3. Eccentric Turning **Milling Operations:** 1. Cutting of spur gear teeth using Horizontal Milling Machine 2. Making rectangular slot using Vertical Milling Machine	
Section – II (Foundry Practice)	**12 Hrs**
1. Preparation of sand mould with and without pattern. 2. Clay and Moisture content test on moulding sand 3. Compression, Shear and Permeability test on the moulding sand specimen 4. Grain fineness test	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the terminology related to primary and secondary operations.
CO2:	Select appropriate manufacturing process for machine components
CO3:	Apply principles of casting, forming, welding, and metal cutting for manufacturing process
CO4:	Develop engineering components using primary and secondary operations

Reference Books	
1	Manufacturing Technology, Vol. 1 – Foundry, Forming, and Welding, P N Rao, 5th Edition, 2019, Mc Graw Hill Education (India) Private Limited, ISBN-13: 978-93-5316-050-0.
2	Manufacturing Technology, Vol. 2 – Metal Cutting and Machine Tools, P N Rao, 4th Edition, 2019, McGraw Hill Education (India) Pvt. Limited, ISBN-13: 978-93-5316-052-4.
3	Manufacturing Science, Amitabha Ghosh and Ashok Kumar Mallik, 2nd Edition, 2010, East-West Press Limited, ISBN: 978-81-7671-063-3.
4	Introduction to Micromachining, V.K. Jain, 2nd Edition, 2006, Narosa Publishers, ISBN-13: 978-8184873610.
5	https://nptel.ac.in/courses/112107219 - Fundamentals of Manufacturing Processes

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

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

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

Semester IV						
Product Engineering & Design Thinking **Category: Professional Core Elective** **Stream: Mechanical Engineering** **(NPTEL Course)**						
Course Code	**:**	ME246AT		**CIE Marks**	:	****
Credits: L:T:P	**:**	2:0:0		**SEE Marks**	:	100 Marks
Total Hours	**:**	30 Hrs		**SEE Duration**	:	3 Hours
Unit – I						**10 Hrs**
Introduction to Product design, product engineering, and design thinking; Product Design Specification and Planning. Integrating the Fuzzy Front End of complex product development aligned to Design Thinking Models. Design Thinking for need identification and product specification; Conceptual design stemmed from Idea generation, tools, and techniques.						
Unit – II						**10 Hrs**
Concept Generation, evaluation, selection, and testing methods Embodiment design, product architecture, configuration design; Eco-design Design for Manufacturing and Prototyping Engineering (Digital and Rapid); Product Innovation in Design Thinking Paradigm with affordability engineering complying with quality, robustness, and reliability with illustrations						
Unit – III						**10 Hrs**
Design challenge themes in complex value-sensitive product development, such as mechatronic devices; Design Thinking steps, tools, and methodologies; Application of Design Thinking in product engineering and Frugal Innovation. Design Entrepreneurship and user experience study methods in Industrial Design.						

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand approaches for product design specification & planning
CO2:	Apply design Thinking for need identification and product specification
CO3:	Recognize the concept Generation, evaluation, selection, and testing methods
CO4:	Analyze the design challenge themes in complex value-sensitive product development

References Books:	
1	Engineering Design: A Systematic Approach by Gerhard Pahl, W. Beitz, JörgFeldhusen, Karl-Heinrich Grote. ISBN 978-1-84628-318-5, 3rd edition, Springer Verlag London Limited, 2007
2	Product Design and Development by Ulrich, Karl T. Eppinger, Steve D and Yang, Maria C.,7th ed. 2020, McGraw-Hill Education. ISBN13: 9781260043655
3	Product Engineering and Design Thinking Lecture Notes by Pranab K Dan and Prabir Sarkar, NPTEL

Semester IV						
Steam and gas power systems **Category: Professional Core Elective** **Stream: Mechanical Engineering** **(NPTEL Course)**						
Course Code	**:**	ME246BT		**CIE Marks**	:	****
Credits: L:T:P	**:**	2:0:0		**SEE Marks**	:	100 Marks
Total Hours	**:**	30 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**10 Hrs**
Review of thermodynamics, Rankine cycle, performance, binary vapour cycle and co-generation, numerical. Steam generators, fire tube and water tube boilers, boiler mountings and accessories, high pressure boilers, drought, performance of boiler.	
Unit - II	**10 Hrs**
combustion of fuel, boiler trial, nozzle and diffusers, momentum and continuity equations, efficiency and critical pressure, general relationships and supersaturated flow, Numericals, steam turbine, compounding, impulse steam turbine, performance, reaction steam turbine, performance, energy loss.	
Unit - III	**10 Hrs**
Condensors, gas turbine cycle, performance evaluations, modifications, problem solving, centrifugal compressors, characteristics, axial flow compressors, characteristics, jet propulsion, Numericals.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the working of steam and gas power systems
CO2:	Perform analysis of vapour power cycle, steam generators and their accessories
CO3:	Evaluate the performance of Boilers and combustion of fuel, high pressure boilers and flow through steam and gas nozzles
CO4:	Illustrate The gas turbine cycle, working of gas turbines, centrifugal compressors, axial compressors and combustion chamber of gas turbines.

References Books:	
1	Basic Engineering Thermodynamics, Rayner Joel, Longman; 5th edition, ISBN-13 : 978-0582256293
2	Gas Turbine Theory, HIH Saravanamuttoo, GFC Rogers, H Cohen, PV Straznicky, AC Nix, Pearson; 7th edition, ISBN-13 : 978-1292093093
3	https://www.youtube.com/playlist?list=PL6Qggk0O9yRItYPKm51jEnZoM-mSOM4XA

Semester IV						
Fundamentals of welding science & technology **Category: Professional Core Elective** **Stream: Mechanical Engineering** **(NPTEL Course)**						
Course Code	**:**	ME246CT		**CIE Marks**	:	****
Credits: L:T:P	**:**	2:0:0		**SEE Marks**	:	100 Marks
Total Hours	**:**	30 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**10 Hrs**
Introduction and classification of welding Nomenclature and symbol of welding joints Power source of welding	
Unit - II	**10 Hrs**
Physics and principle of arc welding Different types of welding methods and their details	
Unit - III	**10 Hrs**
Special methods of welding methods their details Welding defects and inspection	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the physics and various classification of welding processes
CO2:	Apply the special methods of welding for specific applications.
CO3:	Analyse defects in welding and suggest remedies.
CO4:	Develop special methods for inspection of weldments.

References Books:	
1	V. M. Radhakrishnan, Welding Technology and Design, New age. 2002.
2	J. A. Goldak, Computational Welding Mechanics, Springer 2005.
3	L-E Lindgren, Computational Welding Mechanics, Woodhead Publishing Limited,2007.

Semester IV						
Manufacturing guidelines for Product design **Category: Professional Core Elective** **Stream: Mechanical Engineering** **(NPTEL Course)**						
Course Code	**:**	ME246DT		**CIE Marks**	:	****
Credits: L:T:P	**:**	2:0:0		**SEE Marks**	:	100 Marks
Total Hours	**:**	30 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**10 Hrs**
Product Design: Basics, Introduction of Manufacturing Processes, Manufacturing Processes : Advantages and Limitations-I, Manufacturing Processes : Advantages and Limitations-II, Process Capabilities: Basics. Engineering Materials, Properties of Materials, Selection of Materials – I, Selection of Materials – II, Applications of Engineering Material.	
Unit - II	**10 Hrs**
Selection of Processes-I, Selection of Processes-II, Process Capabilities, Design Guidelines for Sand Casting, Design Guidelines for Die Casting Process. Product Design Guidelines: Compression Molding and Extrusion, Design Guidelines for Extrusion and Injection Molding, Design Guidelines for Sheet Metal Working, Design Guidelines for Machining, Design Guidelines for Powder Metal Processing. Assembly Processes: Introduction, Adhesive Joining: Guidelines, Design Guidelines for Mechanical Fasteners, Design Guidelines for Welding, Design Guidelines: Brazing and Soldering.	
Unit - III	**10 Hrs**
Induction Welding: Plastics, Ultrasonic Welding: Plastics, Vibration and Spin Welding: Plastics, Microwave Joining, Hole Making: Guidelines. Design for Environment, Design for Environment: Steps, Product Architecture, Rapid Prototyping, Product Design: Manufacturing Perspective.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basics of selection of engineering materials and manufacturing processes
CO2:	Apply the principles of DMFA and ergonomics in product design.
CO3:	Analyse the design guidelines for different manufacturing processes.
CO4:	Develop innovative ideas for design from environment perspective.

References Books:	
1	Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. Knight, Marcel Dekker, University of Rhode Island Kingston, New York, USA.
2	Manufacturing Processes: Casting, Forming and Welding: H. S. Shan, Cambridge University Press.

Semester IV						
Solar photovoltaics, Principles, Technologies & Materials **Category: Professional Core Elective** **Stream: Mechanical Engineering** **(NPTEL Course)**						
Course Code	**:**	ME246ET		**CIE Marks**	:	****
Credits: L:T:P	**:**	2:0:0		**SEE Marks**	:	100 Marks
Total Hours	**:**	30 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**10 Hrs**
Introduction and Solar radiation fundamentals Basic physics of semiconductors Carrier transport, generation and recombination in semiconductors	
Unit - II	**10 Hrs**
Semiconductor junctions Essential characteristics of solar photovoltaic devices First Generation Solar Cells	
Unit - III	**10 Hrs**
Second Generation Solar Cells Third Generation Solar Cells	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understand the basic physics of semiconductors
CO2:	Analyse the essential characteristics of solar photovoltaic devices
CO3:	Apply the various solar photovoltaic technologies and the fabrication aspects of the devices.
CO4:	Analyse the materials and technologies issues as well as device measurement techniques.

References Books:	
1	Handbook of Photovoltaic Science and Engineering. Eds. A. Luque and S. Hegedus, Wiley
2	The Physics of Solar Cells, Jenny Nelson, Imperial College Press
3	Photovoltaics Materials by R.H. Bube

Semester IV						
DESIGN THINKING LAB **Category: Professional Core Course** **(Practice)**						
Course Code	:	ME247DL		**CIE Marks**	:	50 Marks
Credits: L:T:P	:	0:0:2		**SEE Marks**	:	50 Marks
Total Hours	:	39 Hrs		**SEE Duration**	:	3 Hours

Unit - I	**10 Hrs**
Understanding Design thinking: Design Thinking Methodology: The 5 Stages of the Design Thinking Process-Empathise, Define (the problem), Ideate, Prototype, and Test. Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – Multivarible product or Prototyping, Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design	
Unit - II	**15 Hrs**
DT For strategic innovations Growth: Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.	
Unit - III	**14 Hrs**
Design Thinking Workshop: The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing- Documentation and the Pitching: 10 hours design thinking workshop from the expect and then presentation by the students on the learning from the workshop,	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Understanding various design process procedure
CO2:	Explore reverse engineering to understand products
CO3:	Develop technical drawing/prototype for design ideas
CO4:	Create design ideas through different techniques

References Books:	
1	Kilion Langenfeld, Design Thinking for Beginners, Personal Growth Hackers, ISBN: 13-9783967160628
2	Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, Routeldge Taylor & Francis Grovel, 1st Edition, 2018, ISBN: 13-978-1-315-56193-6
3	Walter Brenner, Falk Uebernickel, Design Thinking for Innovation Research and Practice, Springer, 1st Edition, 2016, ISBN: 13-9783319260983
4	Emrah Yayici, Design Thinking Methodology Book, ArtBiz Tech Publishers, 1st Edition, 2016, ISBN:10- 6058603757, 13-9786058603752

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (LAB)		
#	**COMPONENTS**	**MARKS**
1.	Conduction of laboratory exercises, lab report, observation, and analysis	20
2.	Experiential Learning	20
3.	Lab test	10
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

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

Semester: IV						
Universal Human Values and Professional Ethics (Theory)						
Course Code	**:**	**HS248XT**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**28L+0+0**		**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.	

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.

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.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 05 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	10
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO** tests will be conducted. Each test will be evaluated for 25 Marks, adding upto 50 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 20 MARKS.**	20
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10**). Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome).THE SUM OF ALL WILL BE THE FINAL MARKS OF 20.**	20
	MAXIMUM MARKS FOR THE CIE THEORY	**50**

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

Semester: IV						
Bridge Course: MATHEMATICS (Mandatory Audit Course) (AS, BT, CH, CV, EC, EE, EI, ET, IM, ME)						
Course Code	**:**	MAT149BT		**CIE**	**:**	50 Marks
Credits: L: T: P	**:**	2:0:0		**SEE**	**:**	**NO SEE** (AUDIT COURSE)
Total Hours	**:**	30L				

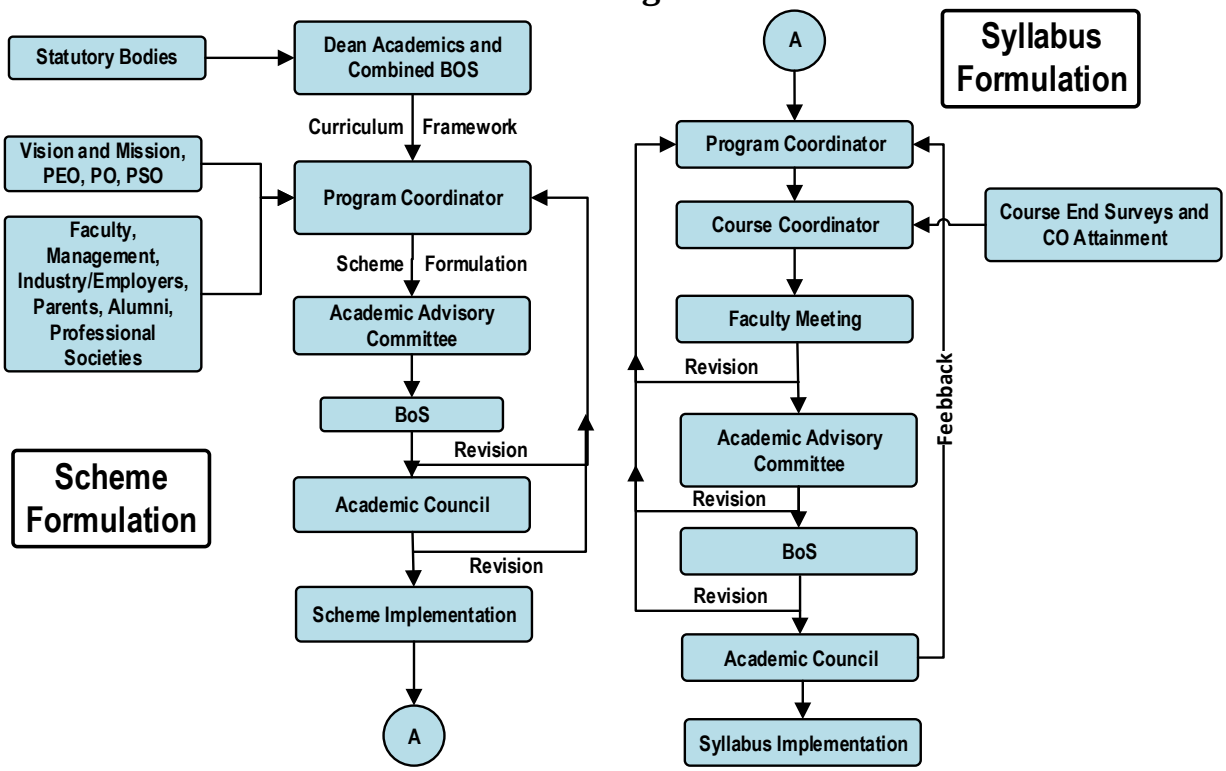
Unit-I	**10 Hrs**
Multivariable Calculus: **Partial Differentiation:** Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems. **Vector Differentiation:** Introduction, velocity and acceleration, gradient, divergence – solenoidal vector function, curl – irrotational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

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

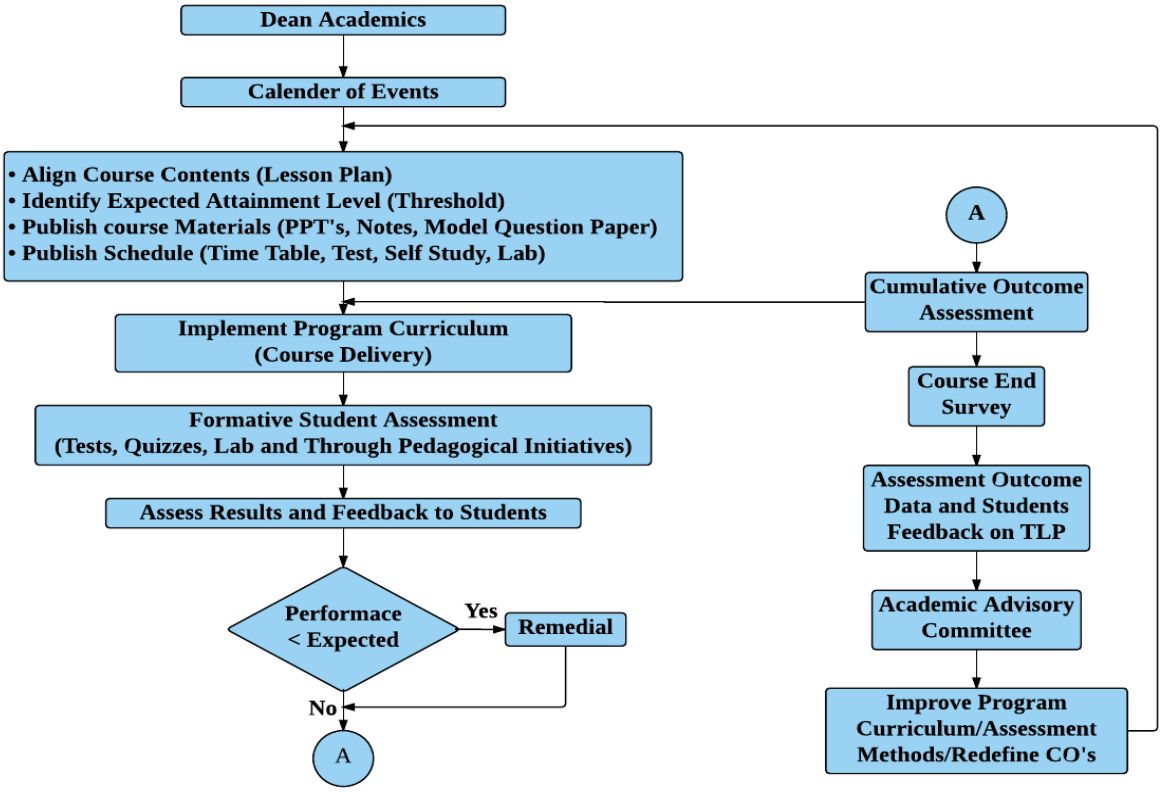
Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44^{th} Edition, 2015, Khanna Publishers, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11^{th} Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	A Textbook of Engineering Mathematics, N.P. Bali & Manish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

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

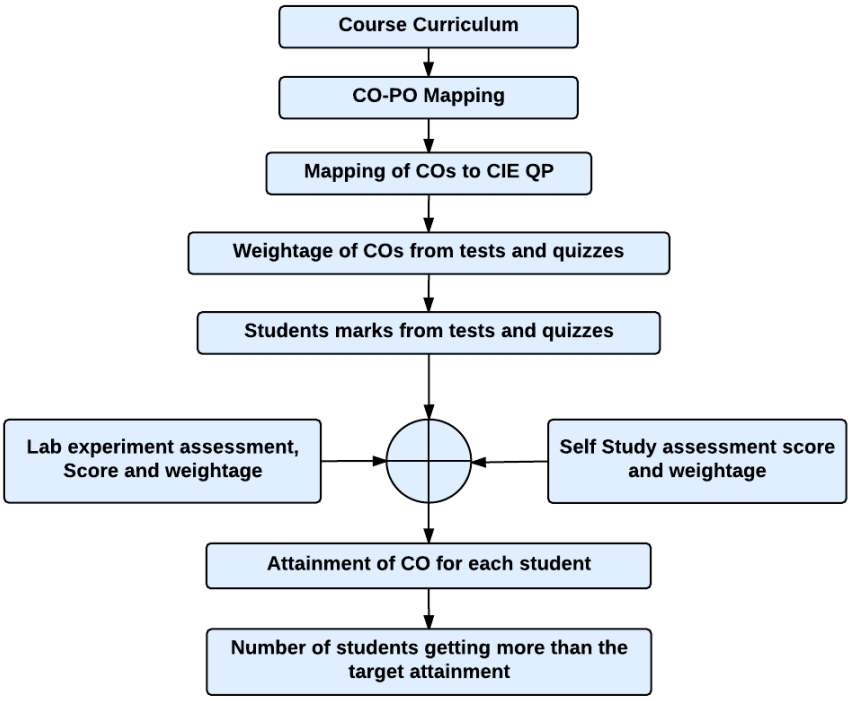
Curriculum Design Process



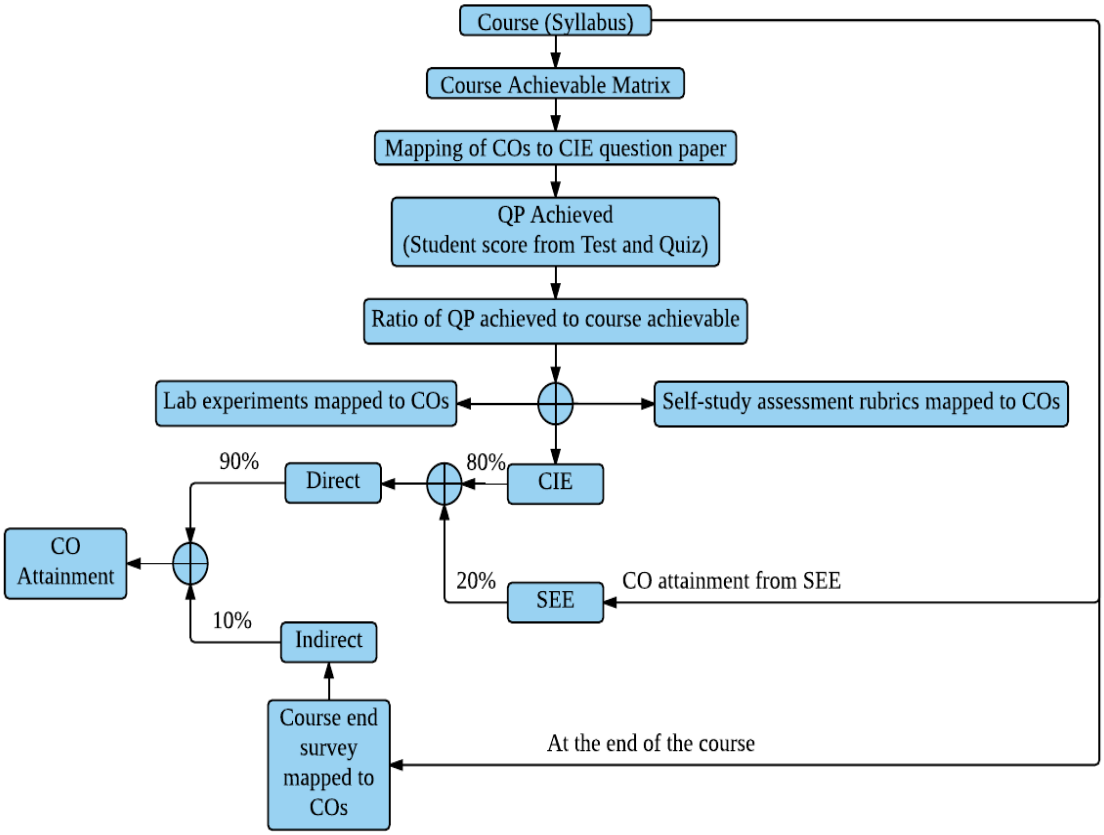
Academic Planning and Implementation



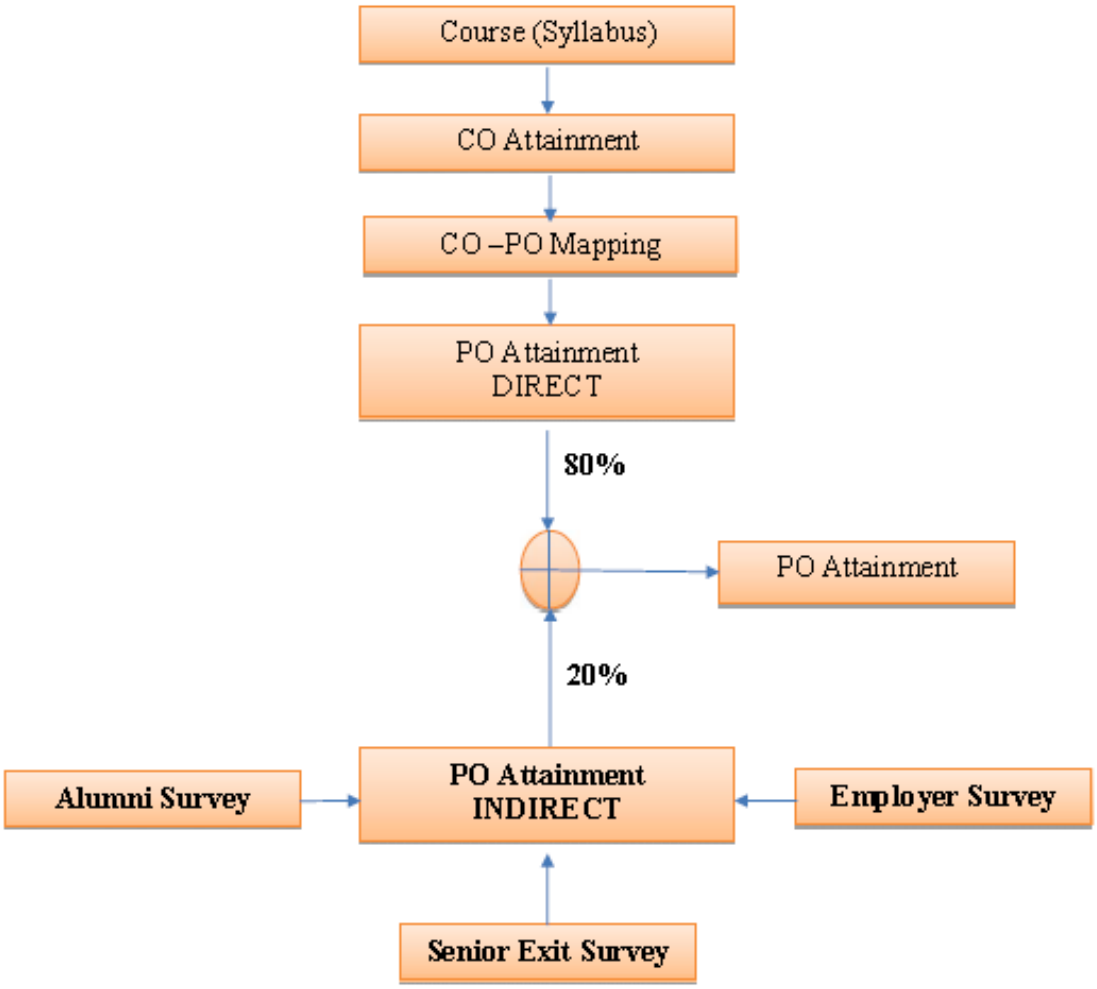
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



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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 teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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