RV College of Engineering®

Aerospace Engineering

Bachelor of Engineering (B.E)

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

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

2024

99TH
NIRF RANKING IN ENGINEERING (2024)

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

EDUFUTURE EXCELLENCE AWARD
BEST PRIVATE ENGINEERING UNIVERSITY (SOUTH)
BY ZEE DIGITAL

1001+
SUBJECT RANKING (ENGINEERING)

801+
SUBJECT RANKING (COMPUTER SCIENCE)

IIRF 2023
ENGINEERING RANKING INDIA
NATIONAL RANK-10
STATE RANK - 2
ZONE RANK - 5

QS-IGUAGE DIAMOND UNIVERSITY RATING (2021-2024)

CURRICULUM STRUCTURE

61 CREDITS PROFESSIONAL CORES (PC)

23 CREDITS BASIC SCIENCE

22 CREDITS ENGINEERING SCIENCE

18 CREDITS PROJECT WORK / INTERNSHIP

12 CREDITS* OTHER ELECTIVES & AEC

12 CREDITS PROFESSIONAL ELECTIVES

12 CREDITS HUMANITIES & SOCIAL SCIENCE

160 CREDITS TOTAL

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

17
Centers of Excellence

11
Centers of Competence

212
Publications On Web Of Science

669
Publications Scopus (2023 - 24)

1093
Citations

70
Patents Filed

39
Patents Granted

61
Published Patents

11
Skill Based Laboratories Across Four Semesters

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

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

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2024

AEROSPACE ENGINEERING

DEPARTMENT VISION

Emerge as a centre of excellence in Aerospace Engineering, Imparting Quality Technical Education, Interdisciplinary Research & Innovation with a focus on Societal empowerment through Sustainable & Inclusive Technologies.

DEPARTMENT MISSION

- Imparting Quality Technical Knowledge in Basic & Applied areas of Aerospace Engineering incorporating the principles of Outcome Based Education.
- Provide state-of-the art laboratories and infrastructure facilities, conducive to motivate Interdisciplinary Research and Innovation in Aerospace Engineering.
- Develop self-motivated engineers with a blend of Discipline, Integrity, Engineering Ethics and Social Responsibility.
- Strengthening collaboration with industries, research organizations and institutes for Internships, Joint Research and Consultancy.
- Focus towards Integrating Sustainable and Inclusive Technologies for Societal Symbiosis.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To provide opportunities for successful professional career with a sound fundamental knowledge in Mathematics, Physical Science & Aerospace Engineering.

PEO2: Motivate innovative research in specialized areas of Aerospace Engineering viz Aerospace structural design, Aerodynamics, Aerospace Propulsion and Guidance & Control systems.

PEO3: Promoting development of problem solving abilities by adopting analytical, numerical and experimental skills with awareness on societal impact.

PEO4: Imbibing sound communication skills, team working ability, professional ethics and zeal for lifelong learning.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO	Description
PSO1	Utilization of the fundamental knowledge and skills of Aerospace Engineering to develop pragmatic solutions for complex Aerospace Engineering problems.
PSO2	Apply Professional Engineering practices and strategies in the development of systems and subsystems for Aerospace Applications.
PSO3	Exhibit Effective Communication skills and a Zeal to function with multi-disciplinary teams
PSO4	Demonstrate Professional Ethics and Responsibilities in Engineering practices towards the achievement of societal symbiosis.

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	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

INDEX

Bachelor of Engineering in

AEROSPACE 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	MA231TB	Statistics, Laplace Transform and Numerical Methods	3	1	0	**4**	MA	Theory	1.5	**100**	****	**3**	**100**	****
2	XX232TX	Basket Courses - **Group A**	3	0	0	**3**	XX	Theory	1.5	**100**	****	**3**	**100**	****
3	AS233AI	Thermodynamics	3	0	1	**4**	AS	Theory & Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	AS234AI	Mechanics of Fluids	3	0	1	**4**	AS	Theory & Lab	1.5	**100**	**50**	**3**	**100**	**50**
5	AS235AT	Structural Mechanics	3	1	0	**4**	AS	Theory	1.5	**100**	****	**3**	**100**	****
6	HS237LX	Ability Enhancement Course: **Group C**	0	0	2	**2**	HS	LAB	1	****	**50**	**2**	****	**50**
7	CS139AT	Bridge Course: C Programming	2	0	0	**AUDIT**	CS	Audit Course	1	**50**	****	****	****	****
						21								

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Slo. No.	BoS	Course Code	Course Title	Common to	Credits
1	MA	MA231TA	Linear algebra, Fourier transforms and statistics	EC,EE, EI, ET	4
		MA231TB	Statistics, Laplace transform and numerical methods	AS, BT, CH, IM, ME	4
		MA231TC	Linear algebra and probability theory	CD,CS,CY,IS	4
		MA231TD	Applied mathematics for civil engineering	CV	4
		MA231TE	Mathematics for artificial intelligence & machine learning	AI & ML	4

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

Sl. No.	BoS	Course Code	Course Title	Category	Credits
2	CV	CV232TA	Environment & Sustainability	Theory	3
	ME	ME232TB	Material Science for Engineers	Theory	3
	BT	BT232TC	Bio Safety Standards and Ethics	Theory	3

Group C: Ability Enhancement Courses
During III Sem: AS, CH, CV, EC, EE, EI, ET, IM & ME.
During IV Sem: AI, BT, CD, CS, CY & IS.

Sl. No.	BoS	Course Code	Course Title	Category	Credits
7	HS	HS237LA	National Service Scheme	LAB	2
	HS	HS237LB	National Cadet Corps	LAB	2
	HS	HS237LC	Physical Education: Sports & Athletics	LAB	2
	HS	HS237LD	Music	LAB	2
	HS	HS237LE	Dance	LAB	2
	HS	HS237LF	Theatre (Light Camera & Action)	LAB	2
	HS	HS237LG	Art Work & Painting	LAB	2
	HS	HS237LH	Photography & Film Making	LAB	2

Bachelor of Engineering in
AEROSPACE ENGINEERING

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	MA241TA	Probability theory and Linear Programming	2	1	0	**3**	MA	Theory	1.5	**100**	****	**3**	**100**	****
2	XX242TX	Basket Courses – **Group A**	3	0	0	**3**	XX	Theory	1.5	**100**	****	**3**	**100**	****
3	AS343AI	Aerospace Propulsion	3	0	1	**4**	AS	Theory & Lab	1.5	**100**	**50**	**3**	**100**	**50**
4	AS244AI	Aerospace Structures	3	0	1	**4**	AS	Theory & Lab	1.5	**100**	**50**	**3**	**100**	**50**
5	AS345AT	Fundamentals of Avionics	3	0	0	**3**	AS	Theory	1.5	**100**	****	**3**	**100**	****
6	XX246TX	Professional Core Courses - **Group B**	2	0	0	**2**	AS	**NPTEL**	****	****	****	**3**	**100**	****
7	AS247DL	Design Thinking Lab	0	0	2	**2**	AS	LAB	2	****	**50**	**2**	****	**50**
8	HS248AT	Universal Human Values	2	0	0	**2**	HS	Theory	1	**50**	****	**2**	**50**	****
9	MAT149AT	Bridge Course: Mathematics	2	0	0	**AUDIT**	MA	Audit Course	1	**50**	****	****	****	****
						23								

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

Group B: NPTEL COURSES (Professional Elective Courses)					
Sl. No.	**BoS**	**Course Code**	**Course Title**	**Category**	**Credits**
6	AS	AS246TA	Introduction to Airplane Performance	NPTEL	2
	AS	AS246TB	Design of fixed wing aircrafts	NPTEL	2
	AS	AS246TC	Principles of Metal Forming Technology	NPTEL	2
	AS	AS246TD	Innovation, Business Models And Entrepreneurship	NPTEL	2
	AS	AS246TE	Project Management : Planning, Execution, Evaluation And Control	NPTEL	2
	AS	AS246TF	Aerospace Structural Analysis	NPTEL	2
	AS	AS246TG	Introduction to Machining and Machining Fluids	NPTEL	2
	AS	AS246TH	Mechanical Measurement Systems	NPTEL	2
	AS	AS246TJ	Nature and Properties of Materials	NPTEL	2
	AS	AS246TK	Wheeled Mobile Robots	NPTEL	2

Semester: III						
STATISTICS, LAPLACE TRANSFORM AND NUMERICAL METHODS **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(AS, BT, CH, IM, ME)**						
Course Code	**:**	**MA231TB**		**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:	Analyse 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: 8174091955

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). THREE tests will be conducted **(**Two regular tests & One optional Improvement test**).** Each test will be evaluated for 50 Marks, adding upto 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (05), Program specific requirements (05), Video based seminar/presentation/demonstration (10), MATLAB (20). **ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE (THEORY)	**100**

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

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	2
CO2	3	2	2	1	1	-	-	-	1	1	-	2
CO3	3	3	2	2	1	-	-	-	1	2	-	2
CO4	3	3	3	2	-	-	-	-	1	1	-	3

High-3: Medium-2: Low-1

Semester: III						
ENVIRONMENT AND SUSTAINABILITY **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**CV232TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

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

ENVIRONMENTAL POLLUTION

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

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

Unit – II — **08 Hrs**

RENEWABLE SOURCES OF ENERGY

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

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

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

Unit –III — **08 Hrs**

SUSTAINABILITY AND MANAGEMENT

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

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

Unit –IV — **08 Hrs**

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

SUSTAINABILITY PRACTICES

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

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

Unit –V — **08 Hrs**

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

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

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

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

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

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

Semester: III						
MATERIALS SCIENCE FOR ENGINEERS **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**ME232TB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3 Hours**

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

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

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

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

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

Semester: III						
BIO SAFETY STANDARDS AND ETHICS **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**BT232TC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Biohazards, Bio safety levels and cabinets: Introduction to Biohazards, Biological Safety levels, Bio safety Cabinets, Study of various types of Bio safety cabinets. Various parameters for design of Biosafety cabinets (Materials used for fabrication, sensors, filters, pumps, compressors)	
Unit – II	**08 Hrs**
Biosafety Guidelines: Biosafety guidelines of Government of India, GMOs & LMOs, Roles of Institutional Biosafety Committee, RCGM (Review committee 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	Have a comprehensive knowledge of Biohazards and bio safety levels
CO2	Understand the biosafety guidelines and their importance to the society
CO3	Acquire knowledge with respect to the Food standards, Hygiene, food processing and packing
CO4	Appreciate the food safety, Ethics, biosafety and bio ethics

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

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

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

Semester: III						
THERMODYNAMICS **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	**AS233AI**		**CIE**	**:**	**100+50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100+50 Marks**
Total Hours	**:**	**45L+28P**		**SEE Duration**	**:**	**3.00 +3.00 Hours**

Unit-I	**11 Hrs**
First Law of thermodynamics: Steady flow energy equation and Steady flow engineering devices**,** PMMK1, Unsteady flow process- Charging and discharging process **Properties of Pure Substances:** Property diagrams for phase-change processes, Property tables, Ideal-gas equation of state, Compressibility factor, use of compressibility charts, Other equation of state- Vander Waal's Equation of State.	
Unit – II	**08 Hrs**
Second law of Thermodynamics: Limitations of First Law of thermodynamics, Heat engine, Heat pump, Clausius and Kelvin Planck statement, Carnot's principle, Carnot cycle and its specialties, PMMK2 **Introduction to Entropy**: Increase of entropy principle, Isentropic process, T-ds relations,	
Unit –III	**08 Hrs**
Entropy: Entropy change of liquids and solids, Entropy change of ideal gases, Isentropic efficiencies of steady flow devices, Entropy balance. **Gas Mixtures:** Mass fraction, Mole fraction, volume fraction, Ideal gas mixture and Real gas mixtures; Dalton's laws of partial pressures, Amagat's law of additive volumes,	
Unit –IV	**07 Hrs**
Gas Cycles: Efficiency of air-Standard cycles-Carnot cycle, Otto, Diesel, Dual and Brayton cycle, Mean effective pressure, Representation of cycles on P-V and T-s diagrams. **Performance of I.C. Engines:** Air and Fuel measurement, Calculation of IP BP & FP, and Heat Balance sheet calculations.	
Unit –V	**11 Hrs**
Psychrometry: Properties of atmospheric air, Construction and use of psychrometric chart, Analysis of various processes, heating, cooling, dehumidifying and humidifying, Adiabatic mixing of moist air, Analysis of various Air conditioning processes.	

LABORATORY EXPERIMENTS

1. Determination of flash point and fire point of the given fuels/lubricating oils using Abel Pensky and Pensky Martin's apparatus
2. Determination of Calorific Value of Solid & Liquid Fuels using Bomb calorimeter
3. Determination of Calorific Value of gaseous fuel using Junker gas calorimeter
4. Determination of viscosity of various lubricating oils using Redwood, Saybolts Viscometers
5. Determination of viscosity of various lubricating oils using Brookfield Viscometer
6. Study of characteristics and performance of a 4 stroke Diesel Piston engine under various conditions
7. Study of characteristics and performance of a 4 stroke Petrol Piston engine under various conditions
8. Determination of Friction power using Morse test
9. Determination of effectiveness of a parallel and counter flow heat exchangers
10. Determination of constituents of a gas mixture using Orsat apparatus
11. Study the performance of vapor compression air conditioning system
12. Study the performance of vapor compression refrigeration

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Understand the concepts and definitions of thermodynamics
CO2:	Differentiate thermodynamic work and heat and apply I law and II law of thermodynamics to different processes
CO3:	Comprehend and utilize the principles of Refrigeration and air conditioning
CO4:	Design and Analyze the functioning of various Thermodynamic cycles

Reference Books	
1	Thermodynamics: An Engineering Approach, Yunus A.Cengal and Michael A.Boles, 8th Edition, 2016, Tata McGraw Hill publications, ISBN: 9780070495036.
2	Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, 2nd Edition, 1986, John Wiley and Sons, ISBN: 978-0471812029.
3	Fundamentals of Classical Thermodynamics, G.J.Van Wylen and R.E.Sonntag, 3rd Edition, 1986, Wiley Eastern, ISBN-13: 978-0-471-61075-5.
4	Basic and Applied Thermodynamics P.K.Nag, 2nd Edition., 2002, Tata McGraw Hill Pub, ISBN-13: 978-0070151314.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY & PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
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 & PRACTICE)	**150**

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

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

Semester: III						
MECHANICS OF FLUIDS **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	**AS234AI**		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	**45L+28P**		**SEE Duration**	**:**	**3.00 +3.00 Hours**

Unit-I	**09 Hrs**
Fluid Statics: Pascal's law, Pressure variation with depth, manometers, hydrostatic thrust on submerged plane and curved surfaces, centre of pressure, Buoyancy, Stability of submerged and floating bodies, Metacenter and Meta centric height. **Fluid Kinematics:** Introduction, Lagrangian & Eulerian Description of Fluids, Types of Fluid Flows, Stream line, streak line and path line, circulation and vorticity, stream function and velocity potential function, continuity equation in Integral form and 3D Cartesian coordinates.	
Unit – II	**09 Hrs**
Potential Flows: Laplace Equation, Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink, Doublet flow, Non-lifting flow over a circular cylinder, Vortex flow, Lifting flow over a circular cylinder, Kutta-Joukowski theorem and generation of Lift, D'Alembert's paradox.	
Unit -III	**11 Hrs**
Fluid Dynamics: Basic governing equations of fluid flows**,** Reynold's Transport theorem, Mass conservation, Momentum Conservation and Energy conservation equations, and Introduction to Navier –Stokes Equations. **Incompressible Inviscid Flow:** Euler's equation of fluid motion (from first principles), Bernoulli's equation, Bernoulli's equation for real fluid flows. **Application of Bernoulli's equation:** Flow measurement: Orifice plate, Venturimeter, Notches: rectangular and V-notch, Pitot and Pitot static tube.	
Unit -IV	**08 Hrs**
Incompressible Viscous flow: Boundary layer concept, Boundary layer thickness, displacement thickness and momentum thickness; flow separation, couette flow, poiseuille flow, kinetic Energy correction factor. **Turbulent Flows:** Mechanism of Transition from Laminar to Turbulent Flows, magnitude, Intensity and scale of Turbulence, Measurement of Turbulence using Hot Wire Anemometer, Velocity distribution in a Turbulent Flow, Head Loss in Pipe due to Friction (Darcy's Equation).	
Unit -V	**08 Hrs**
Dimensional Analysis & Model Studies: Units and Dimensions, Dimensional Homogeneity, Dimensional Analysis-Rayleigh's Method, Buckingham's π-Theorem, Dimensionless numbers. Model Analysis, Types of Similarities and Similitude, Similarity Laws. **Introduction to Compressible Flows:** Stagnation Properties, One-Dimensional Isentropic Flow, Mach number, Mach Cone.	

LABORATORY EXPERIMENTS	
1.	Determination of major losses in fluids flowing through pipes.
2.	Determination of minor losses in fluids flowing through pipes
3.	Determination of Co-efficient of discharge over a V-notch
4.	Determination of force generated by the impact of water jet on the vanes
5.	Determination of Co-efficient of discharge through Venturimeter
6.	Determination of Co-efficient of discharge through Orifice meter
7.	Determination of type of flow for different Reynolds Number using Reynolds apparatus
8.	Study of performance characteristics of a single stage centrifugal pump
9.	Study of performance characteristics of a multi-stage centrifugal pump
10.	Study of performance characteristics of a Francis turbine
11.	Study of performance characteristics of a Pelton wheel
12.	Determination of metacentric height of floating bodies
13.	Flow Visualization studies using water tunnel

Course Outcomes: After completing the course, the students will be able to	
CO 1:	Identify the properties of fluid which influence flow characteristics
CO 2:	Distinguish fluid flows and evaluate the properties associated with the flow
CO 3:	Apply Dimensional analysis and similarity laws for conducting model tests
CO 4:	Evaluate and comment on the flow using flow measuring devices

Reference Books	
1	Fluid Mechanics, Frank M White, 7th Edition, 2012, McGraw Hill, ISBN 9780073529349
2	Fluid Mechanics and Applications, Yunus A. Cengel & John M Cimbala, 12th Edition, 2009, Tata McGraw- Hill Publishers,. ISBN: 9780070700345
3	Fluid Mechanics, Streeter. V. L., and Wylie, E.B., 9th Edition, 2017, McGraw Hill, 1983 ISBN: 0071156003
4	Mechanics of Fluids, B S Massey, 7th Edition, 1998, ELBS Edition. ISBN-10: 0748740430
5	Fluid Mechanics, Hydraulics and Fluid Machines, Ramamritham. S, 9th Edition, 2014, Dhanpat Rai& Sons, Delhi, 1988.ISBN: 978-93-84378-27-1

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY & PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
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 & PRACTICE)	**150**

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

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

Semester: III						
STRUCTURAL MECHANICS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	**AS235AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**11 Hrs**
Basic equations of linear elasticity: Stress and Strain, True stress and Engineering Stress, Hooke's Law, Generalized Hooks law, Relationship between Elastic Constants, Thermal Stresses, Compound bars, Principle of Superposition. **Principal Stresses and Strain:** State of Stress, Stress and Strain at a point, Plane Stress and Plane Strain approximations.	
Unit – II	**09 Hrs**
Bending Moment and Shear Force Diagram: Sign Convention, Procedure for drawing BMD and SFD, Different types of Loading and their S.F & B.M Diagram, Point of Contra flexure, General expression.	
Unit –III	**09 Hrs**
Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions, Implications of the Euler-Bernoulli assumptions. **Deflection of Beams:** Equation of Elastic curve, Deflection of Beams.	
Unit –IV	**07 Hrs**
Torsion: Torsion of circular shafts, polar moment of inertia and polar section modulus, Comparison of solid and hollow shaft, Torsion combined with axial force and bending moments, Power transmission.	
Unit –V	**09 Hrs**
Failure Theories: Maximum Principal Stress Theory, Maximum Shear Stress, Strain Energy Theory, Shear strain Energy theory, Maximum principal strain theory. **Shells:** Thin cylindrical shell of circular cross section, Thin spherical shell, Cylindrical shell with hemispherical ends, Bending stresses in thin-walled circular cylinders.	

Course Outcomes: At the end of this course the student will be able to :	
CO 1:	Understand the nature of different types of loads
CO 2:	Describe the behaviour of structures under various loads
CO 3:	Apply various principles to ascertain the character of materials under different loads
CO 4:	Evaluate the stability of various structures under different loading environments

Reference Books	
1	Timoshenko and Young "Elements of Strength of Mateials', East-West Press, 1976. ISBN: 978-93-84378
2	Beer.F.P. and Johnston.R, 'Mechanics of Materials', McGraw Hill Publishers, 2006. ISBN: 978-0073398
3	Structural Mechanics, Bao Shihua, Gong Yaoqing, Wuhan University of Technology Press, 2005.
4	Aircraft structural Analysis, T.H.G Megson, Butterworth-Heinemann Publications, 2007. ISBN: 978-1-85617-932-4
5	S.Ramamrutham, R Narayanan, "Strength of Materials', Dhanapath Rai Publishing Company, New Delhi, 2012. ISBN: 978-93-84378-26-4

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

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

Semester: III						
NATIONAL SERVICE SCHEME (NSS) (Practical)						
Course Code	**:**	**HS237LA**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**

Prerequisites:

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

Content	**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 below mentioned activity)

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

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

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

Semester: III						
NATIONAL CADET CORPS (NCC) (Practical)						
Course Code	**:**	**HS237LB**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**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 throughout the semester e.g., Blood donation Camp, Swachhata Abhiyan, Constitution Day, All National Festival						

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand that drill as the foundation for discipline and to command a group for common goal.
CO2	Understand the importance of a weapon its detailed safety precautions necessary for prevention of accidents and identifying the parts of weapon.
CO3	Understand that trekking will connect human with nature and cross the obstacles to experience army way of life.
CO4	Understand the various social issues and their impact on social life, Develop the sense of self-less social service for better social & community life.

Reference Books	
1.	NCC Cadet Hand Book by R K Gupta, Ramesh Publishing House, New Delhi, Book code:R- 1991, ISBN: 978-93-87918-57-3, HSN Code: 49011010
2.	nccindia.ac.in

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour 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						
PHYSICAL EDUCATION (SPORTS & ATHLETICS) (Practical)						
Course Code	**:**	**HS237LC**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**30P**		**SEE Duration**	**:**	**2.5 Hrs**
Content						**30 Hrs**

Topics for Viva:

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

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

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1) Justification for Importance, need of the hour 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						
MUSIC (Practical)						
Course Code	**:**	**HS237LD**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**13P**		**SEE Duration**	**:**	**02 Hrs**
Content						**13 Hrs**

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

Students have to form groups of 2-4 and present a musical performance/ a musical task which shall be given by the experts. The experts shall judge the groups and award marks for the same.
CIE will be evaluated based on their presentation, approach, and implementation strategies. Students need to submit their certificates of any event they participated or bagged prizes in. This shall also be considered for CIE evaluation.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Understand basics of Music and improve their skills.
CO2	Appreciate the impacts on health and well-being.
CO3	Perform and present music in a presentable manner.
CO4	Develop skills like team building and collaboration.

Reference Books	
1.	Music Cognition: The Basics by Henkjan Honing.
2.	Basic Rudiments Answer Book - Ultimate Music Theory: Basic Music Theory Answer Book by Glory St Germain.
3.	Elements Of Hindustani Classical Music by Shruti Jauhari.
4.	Music in North India: Experiencing Music, Expressing Culture (Global Music Series) by George E. Ruckert.

ASSESSMENT AND EVALUATION PATTERN		
WEIGHTAGE	**50%**	**50%**
	CIE	**SEE**
Presentation 1- Selection of topic- (phase 1): Justification for Importance, need of the hour 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	**:**	**HS237LE**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**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	**:**	**HS237LF**		**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 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						
ART WORK & PAINTING (Practical)						
Course Code	**:**	**HS237LG**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**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 compulsorily take part in the museum visit. CIE will be evaluated based on a still life piece, a composition using any one of the media of composition and a presentation on Indian art styles and creation of a piece pertaining to the presented art style.

Course Outcomes: After completing the course, the students will be able to: -	
CO1	Use lines, shapes, and colors to depict the various sentiments and moods of life and nature.
CO2	Use one's creativity to develop forms and color schemes, as well as the ability to portray them effectively in drawing and painting on paper.
CO3	Develop the ability to properly use drawing and painting materials (surfaces, tools and equipment, and so on).
CO4	Improve their observation abilities by studying everyday items as well as numerous geometrical and non-geometrical (i.e., organic) shapes found in life and nature and to hone their drawing and painting talents in response to these insights.

Reference Books	
1.	Catching the Big Fish: Meditation, Consciousness, and Creativity, David Lynch
2.	Art & Fear: Observations on the Perils (and Rewards) of Artmaking, David Bayles & Ted Orland

SESSMENT 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	**:**	**HS237LH**		**CIE**	**:**	**50 Marks**
Credits: L: T: P	**:**	**0:0:2**		**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 (Mandatory Audit Course) (Common to all Programs)						
Course Code	**:**	**CS139AT**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0(Audit)**		**SEE**	**:**	**--**
Total Hours	**:**	**30L**		**SEE Duration**	**:**	**--**

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

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

Reference Books	
1.	Programming in C, Reema Thareja, 2018, Oxford University Press. ISBN: 9780199492282.
2.	The C Programming Language, Kernighan B.W and Dennis M. Ritchie, 2015, 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 **Category: PROFESSIONAL CORE COURSE** **(Theory)** **(AS, CH, CV, EE, EI, ET, ME)**						
Course Code	**:**	**MA241TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**2:1:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**30L+26T**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Random Variables: Random variables-discrete and continuous, probability mass function, probability density function, cumulative distributon function, mean and variance. Two or more random variables - Joint probability mass function, joint probability density function, conditional distribution and independence, Covariance and Correlation. 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.	

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

Reference Books	
1	Probability & Statistics for Engineers & Scientists, Ronald E. Walpole & Raymond H. Myers, 9th edition, 2016, Pearson Education, ISBN-13: 978-0134115856.
2	Applied Statistics and Probability for Engineers, Douglas C. Montgomery and George C. Runger, 6th Edition, John Wiley & Sons, 2014, ISBN:13 9781118539712, ISBN (BRV):9781118645062.
3	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: 817409-195-5.

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 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**

CO-PO Mapping												
CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	1	-	2
CO2	3	2	2	1	1	-	-	-	1	1	-	2
CO3	3	3	2	2	1	-	-	-	1	2	-	2
CO4	3	3	3	2	-	-	-	-	1	1	-	3

High-3: Medium-2: Low-1

Semester: IV						
ENVIRONMENT AND SUSTAINABILITY **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**CV242TA**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3 Hours**

Unit-I — **10 Hrs**

ENVIRONMENT AND BIODIVERSITY

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

ENVIRONMENTAL POLLUTION

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

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

Unit – II — **08 Hrs**

RENEWABLE SOURCES OF ENERGY

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

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

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

Unit –III — **08 Hrs**

SUSTAINABILITY AND MANAGEMENT

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

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

Unit –IV — **08 Hrs**

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

SUSTAINABILITY PRACTICES

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

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

Unit –V — **08 Hrs**

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

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

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

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

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

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

Semester: IV						
MATERIALS SCIENCE FOR ENGINEERS **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**ME242TB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3 Hours**

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

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

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

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

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

Semester: IV						
BIO SAFETY STANDARDS AND ETHICS **Category: Basket Course- Group A** **(Common to all Programs)** **(Theory)**						
Course Code	**:**	**BT242TC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3 Hours**

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

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

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

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

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

Semester: IV						
AEROSPACE PROPULSION **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	**AS343AI**		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	**45L+28P**		**SEE Duration**	**:**	**3.00 +3.00 Hours**

Unit-I	**10 Hrs**
Fundamentals of Aerospace propulsion: Introduction, Illustration of working of gas turbine engine, Working and characteristics of Turbojet, Turboprop, Turbofan, Ramjet & Scramjet Engines, Spooling of Jet Engines, Thrust Augmentation System: Afterburner and Water Injection.	
Unit – II	**10 Hrs**
Jet Engine Performance: Jet Engine Thrust equation (simple derivation), Factors affecting thrust, Airbreathing Engine Performance Parameters: Specific Thrust, Thrust Power, Specific Impulse, TSFC, Propulsive Efficiency, Thermal Efficiency, Numericals on Jet Propulsion Cycle Analysis.	
Unit –III	**08 Hrs**
Aircraft Propulsion Systems: Aircraft Inlets-Working of Subsonic & Supersonic Inlets, Compressors: Operation of Centrifugal & Axial Flow Compressors, Combustion Chambers: Principle of operation, Classification of Combustion Chambers, Turbines: Types of turbines-Operating Principle, Nozzles: Flow through Convergent and Convergent-Divergent Nozzles (Without Derivations and Numericals).	
Unit –IV	**07 Hrs**
Chemical Rocket Propulsion **Solid Rocket propellants:** Working, Properties, Types of Propellants, Propellant Burn Rate, Thrust profiles, Attitude Controls with Solid Propellants, Pyrogen and Pyrotechnique Igniters, Ignition and Thrust Extinction of Solid Propellants. **Liquid Rocket propellants:** Working, Propellant Types, Properties, Propellant feed systems: Pump and Gas Pressure Feed systems, Injectors and Atomizers.	
Unit –V	**10 Hrs**
Advanced Propulsion Systems: Electrothermal Thrusters: Arc-jet Thrusters, Ion Propulsion, Plasma Thrusters: Hall Effect Thrusters, Electric Power Generation: Solar Cells, Solar Generators, Radioactive Thermal Generators, Nuclear Fission Power Generators. **Rocket Performance:** Rocket equation, Performance Parameters: Thrust, Total Impulse, Specific Impulse, Specific propellant consumption, Effective Exhaust Velocity, Characteristic Velocity, Mass Ratio, Propellant Mass Fraction, Impulse to weight ratio, Thrust to weight ratio, Energy and Efficiencies, Numerical examples.	

LABORATORY EXPERIMENTS
1. Performance analysis of a micro gas turbine/jet propulsion system
2. Determination of Performance characteristics of a fixed pitch aircraft propeller
3. Determination of Performance characteristics of a variable pitch aircraft propeller-Open Experiment
4. Measurement of burning velocity of a pre-mixed flame in a gas turbine combustion chamber
5. Determine the pressure and velocity variation of an exhaust gas flowing out of a convergent nozzle
6. Determination of pressure and velocity variation of a supersonic exhaust jet flowing out of a convergent-divergent nozzle
7. Study of pressure distribution across a turbine cascade
8. Study of flow through an axial cascade turbine blade row
9. Preparation of Solid Propellant Rocket Fuel- Open Experiment
10. Evaluation of Burning Characteristics of Solid Propellant Fuel- Open Experiment

Reference Books	
1	Gas Turbines, V Ganesan, 3rd Edition, 2017, McGraw Hill Education, ISBN-10: 0070681929
2	Gas Turbine Propulsion, D P Mishra, 2nd Edition, M V Learning, 2015, ISBN: 978-81-309-27527
3	Elements of Propulsion: Gas Turbines and Rockets, Jack D Mattingly, 5th Edition, 2006, American Institute of Aeronautics and Astronautics (AIAA), ISBN: 1563477793.
4	Rocket Propulsion Elements, Sutton G P, 8th Edition, 2010, John Wiley, New York, ISBN:9781118174203
5	Understanding Aerospace Chemical Propulsion, H S Mukunda, 1st Edition, 2017, I K International Publishing House, ISBN: 978-93-85909-42-9
6	Rocket and Spacecraft Propulsion: Principles, Practices and Developments, Martin J L Turner, 3rd Edition, 2009, Praxis Publishing Ltd, Chichester, UK, ISBN 978-3-540-69202-7

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY & PRACTICE)		
#	**COMPONENTS**	**MARKS**
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
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 & PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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						
AEROSPACE STRUCTURES **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	**AS244AI**		**CIE**	**:**	**100 +50 Marks**
Credits: L:T:P	**:**	**3:0:1**		**SEE**	**:**	**100 +50 Marks**
Total Hours	**:**	**45L+28P**		**SEE Duration**	**:**	**3.00 +3.00 Hours**

Unit-I	**10 Hrs**
Loads on Aircraft: Structural nomenclature, Load Factors, Wing Design Loads, Empennage Loads, and Fuselage loads, Propulsion Loads, landing gear loads, Miscellaneous loads, Velocity diagram V-n diagram for the loads acting on the aircraft, salient features of the V-n diagram. Flight envelope for different flying conditions.	
Unit – II	**10 Hrs**
Shear Flow in Open & Closed Sections: Open Sections: Concept of shear flow, Shear Flow in Thin walled beams, the shear centre and Elastic axis. **Closed Sections***:* Bredt - Batho theory, shear centre of closed sections	
Unit –III	**10 Hrs**
Buckling of Columns : Introduction, Critical Load, Euler's Critical Load for various end conditions, Slenderness ratio, Rankine's Crippling Load	
Unit –IV	**07 Hrs**
Design of Aircraft Structures: Design criteria, Safety Factor, Life Assessment procedures, Damage tolerance and Fail safe Design.	
Unit –V	**08 Hrs**
Bolted Riveted and Welded Connections: Failure of single bolt fitting, Lug strength analysis under Axial, Transverse and Oblique Loading, Riveted Connections, Welded Connections.	

LABORATORY EXPERIMENTS
1. Tensile Characterization of Aerospace Alloys 2. Fatigue Behaviour of Aerospace Alloys 3. Crack Propagation behaviour of Aerospace Alloys 4. Energy absorbed under an impact velocity (Izod and Charpy Test) 5. Geometry cleanup for FE modelling 6. 2D Meshing of Aerospace Component 7. Solid and 3D meshing of Aerospace Component 8. Failure of a circular plate subjected to the impact of an infinite rigid sphere 9. Introduction on how to simulate a bird strike on the windshield 10. Study of the stress wave propagation and the strain rate effect on the Hopkinson bar. 11. Topology Optimization of Aerospace Components 12. Shape Optimization of Aerospace Component

Reference Books	
1	Megson, T.M.G 'Aircraft Structures for Engineering Students', Edward Arnold, 1995. ISBN: 978-0-75066-7395
2	Donaldson, B.K., "Analysis of Aircraft Structures – An Introduction", McGraw-Hill, 1993. ISBN:978-0521865838
3	Peery, D.J., and Azar, J.J., "Aircraft Structures", 2nd edition, McGraw, Hill, N.Y., 1993. ISBN-10:0486485803
4	C. T. Sun, "Mechanics of Aircraft Structures" Wiley-Interscience, March 1998, ISBN-13: 9780471178774

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY & PRACTICE)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. **TWO QUIZZES** will be conducted & Each Quiz will be evaluated for 10 Marks adding up to 20 Marks. **THE SUM OF TWO QUIZZES WILL BE CONSIDERED AS FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test consisting of descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). **TWO TESTS** will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. **Phase I (20) & Phase II (20) ADDING UPTO 40 MARKS**.	**40**
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 & PRACTICE)	**150**

RUBRIC FOR SEMESTER END EXAMINATION (THEORY)		
Q. NO	**CONTENTS**	**MARKS**
	PART A	
1	Objective type 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						
FUNDAMENTALS OF AVIONICS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	**AS345AT**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Hours	**:**	**45 L**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**09 Hrs**
Electronic Circuits: Qualitative Analysis of Amplifiers and Feedback Amplifiers, Oscillators; Wave shaping circuits; A/D - D/A converters; Single/multi-stage Mixers & Modulators / Demodulators	
Unit – II	**10 Hrs**
Transmission Lines: Introduction, transmission lines equations and significance, termination of line by infinite line, by characteristic impedance, short circuit line, open circuit line, VSWR, problems Microstrip lines. **Qualitative Analysis of Waveguides:** Rectangular and circular type, TE and TM waves in wave guides, their transmission properties and attenuation., E-plane & H Plane Waveguides, Magic Tee, Circulator, Duplexer and their S matrices, Wave guide resonator, loaded and unloaded.	
Unit –III	**11 Hrs**
Propagation of EM Waves: Electromagnetic Spectrum; Basics of E M Wave, Polarization, Types of Polarization, Modes of Radio wave Propagation, Surface wave, Troposphere duct Propagation, Tropo-scatter Propagation, Ionosphere Propagation, Magneto-ionic theory, Secant law, MUF, Critical frequency, Skip distance. Fading & Remedial measures. **Antenna Basics & Microwave Antenna**: Oscillating dipole: Electromagnetic radiation, retarding potential, Antenna parameters: directivity, beam width, gain, radiation, effective aperture, Friss transmission formula **Antenna array:** Horn, Parabolic Reflector and its feed, Cassegrain antenna, Slot array, lens antenna. Beam Forming, Phased Arrays.	
Unit –IV	**07 Hrs**
Elements of Communication Systems: Definition of Signal & System, Types of Signals, Classification of Signals, Classification of Systems; Signals Gain, Attenuation & Decibels; Filters & their classification,; Noise & SNR comparison;, Frequency Synthesizer, Phase lock loop, Modulator / Demodulator, Block Diagrams of Microwave Transmitter / Receiver.	
Unit –V	**09 Hrs**
Basics of Digital Communication: Pulse Modulation, Sampling, quantizing, coding, PCM, DPCM, multiplexing-audio/video; Digital modulation: ASK, FSK, PSK; Multiple access: TDMA, FDMA, CDMA.	

Reference Books	
1	Electronic Devices & Circuit Theory : Robert L Boylestad & Louis Nashelsky, 11th Edition, 1 July 2017, Pearson, ISBN: 978-0-13-262226-4 **(for Unit – I)**
2	Principles of Electronics : A P Malvino & David J Bates, ISBN: 978-0-07-063424-4 Tata McGraw - Hill, New Delhi**(for Unit – I)**
3	Microelectronics, Millman & Grabel, 2nd Edition, 2017, McGraw Hill Education, ISBN-13: 978-0074637364 **(for Unit – I, IV)**
4	Principles of Electronics Communication Systems: Louis E Fresnel Jr, 4th/5th edition, Mc Graw Hill, ISBN 978-0-07-337385-0. **(for Unit – II, III & V)**
5	Electronic Communication Systems: George Kenndy & Bernard Davis, Tata McGraw Hill, 37th reprint 2009, ISBN-13: 978-0-07-463682-4, .ISBN-10: 0-07-463682-0 . **(for Unit – II, III)**
6	Principle of Digital Communication System:Robert G Gallager, 2008 Edition, Cambridge University Press. ISBN-10-0521879078, ISBN-13 978-0521879071. . **(for Unit – V)**

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

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

Semester: IV						
DESIGN THINKING LAB **Category: Professional Core Course** **(Practice)**						
Course Code	**:**	**AS247DL**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:2**		**SEE**	**:**	**50 Marks**
Hours	**:**	**30P**		**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 (Theory)						
Course Code	**:**	**HS248AT**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**2:0:0**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**28L**		**SEE Duration**	**:**	**02 Hours**

Unit-I — **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 Relationship:
Understanding valuesin human-human relationship; meaning of Justice and program for its fulfilment to ensure mutual happiness; Trustand Respect as the foundational values of relationship, Understanding the meaning of Trust.
Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

Unit –III — **08 Hrs**

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence:
Understanding the harmony in the Nature, Interconnectedness, and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all pervasive space, Holistic perception of harmony at all levels of existence.
Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Course Outcomes: After completion of the course the students will be able to	
CO1	By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions,
CO2	While keeping human relationships and human nature in mind. They would have better critical ability.
CO3	They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
CO4	It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

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

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

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

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

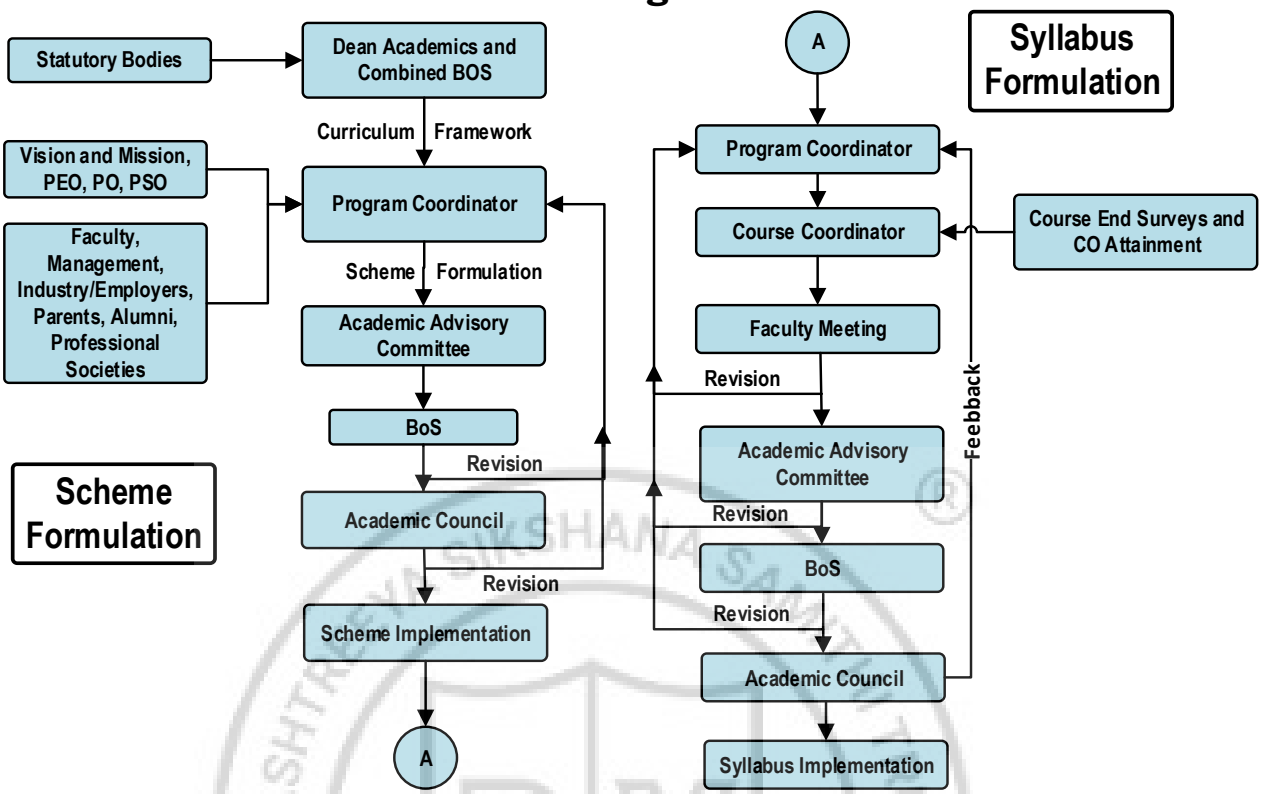
Unit-I	**10 Hrs**
Multivariable Calculus: **Partial Differentiation:** Introduction, simple problems. Total derivative, composite functions. Jacobians – simple problems. **Vector Differentiation:** Introduction, velocity and acceleration, gradient, divergence – solenoidal vector function, curl – irrotational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

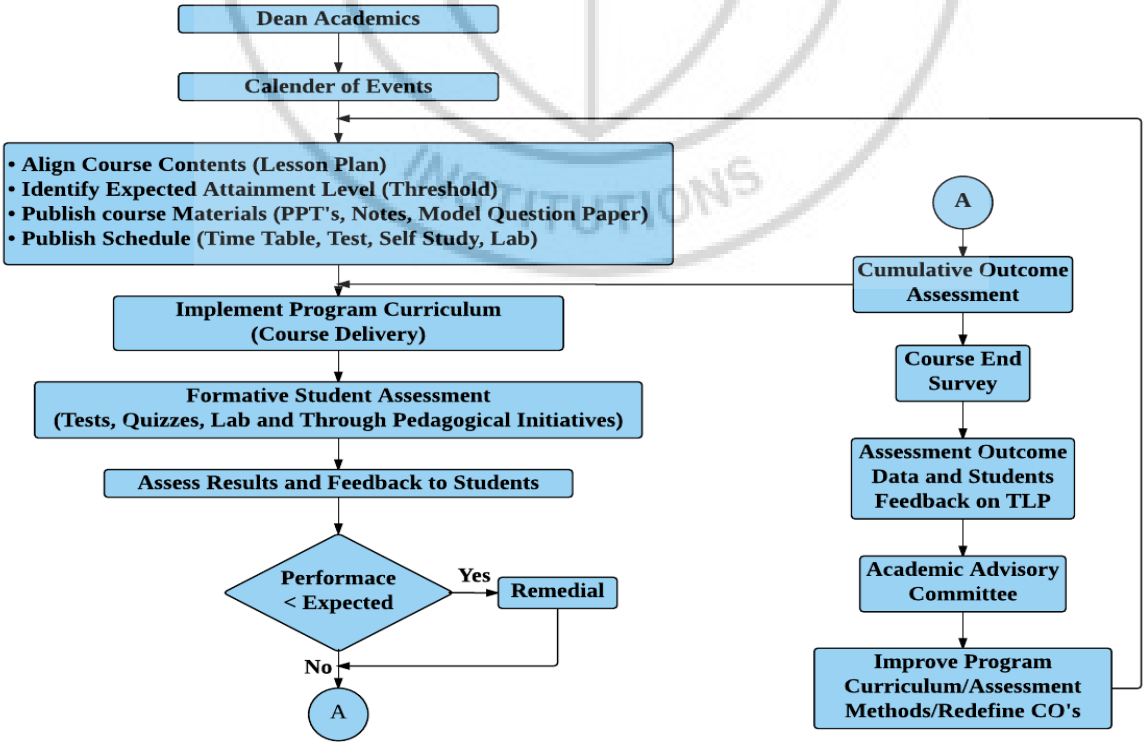
Reference Books	
1	Higher Engineering Mathematics, B.S. Grewal, 44^{th} Edition, 2015, Khanna Publishers, ISBN: 978-81-933284-9-1.
2	Higher Engineering Mathematics, B.V. Ramana, 11^{th} Edition, 2010, Tata McGraw-Hill, ISBN: 978-0-07-063419-0.
3	A Textbook of Engineering Mathematics, N.P. Bali & Manish 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**

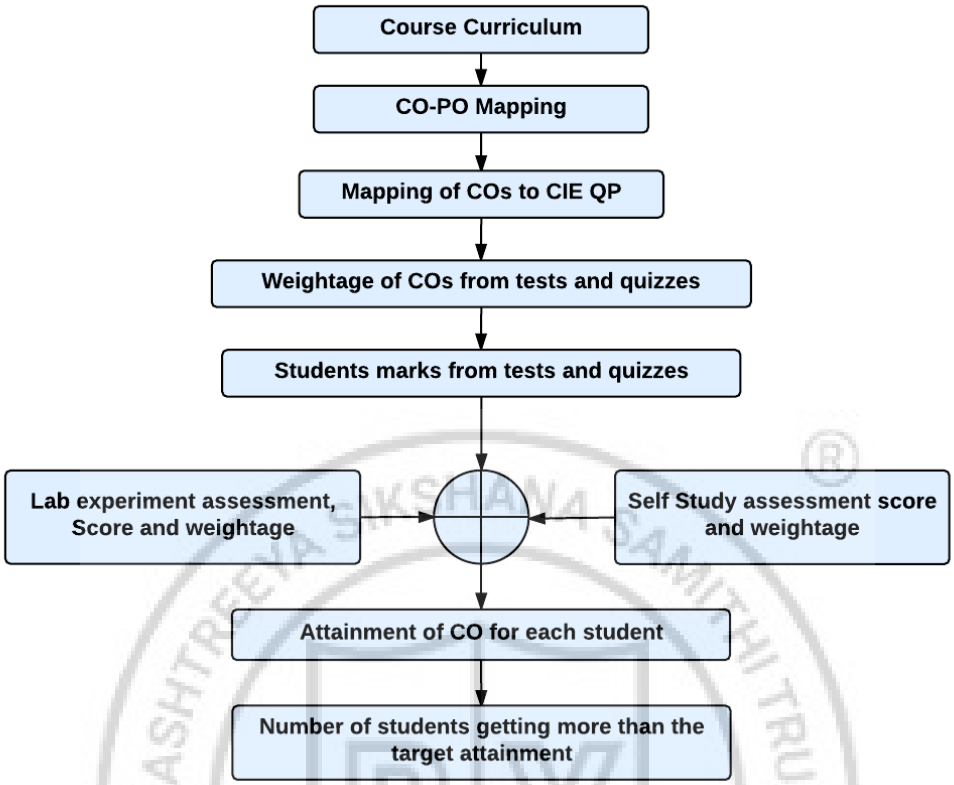
Curriculum Design Process



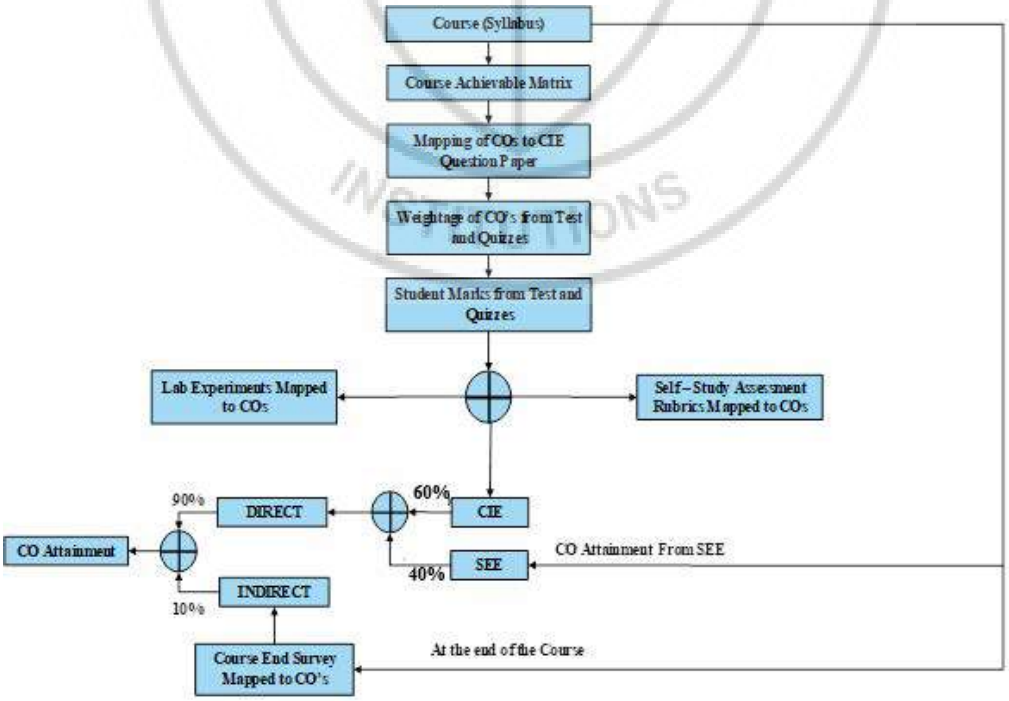
Academic Planning and Implementation



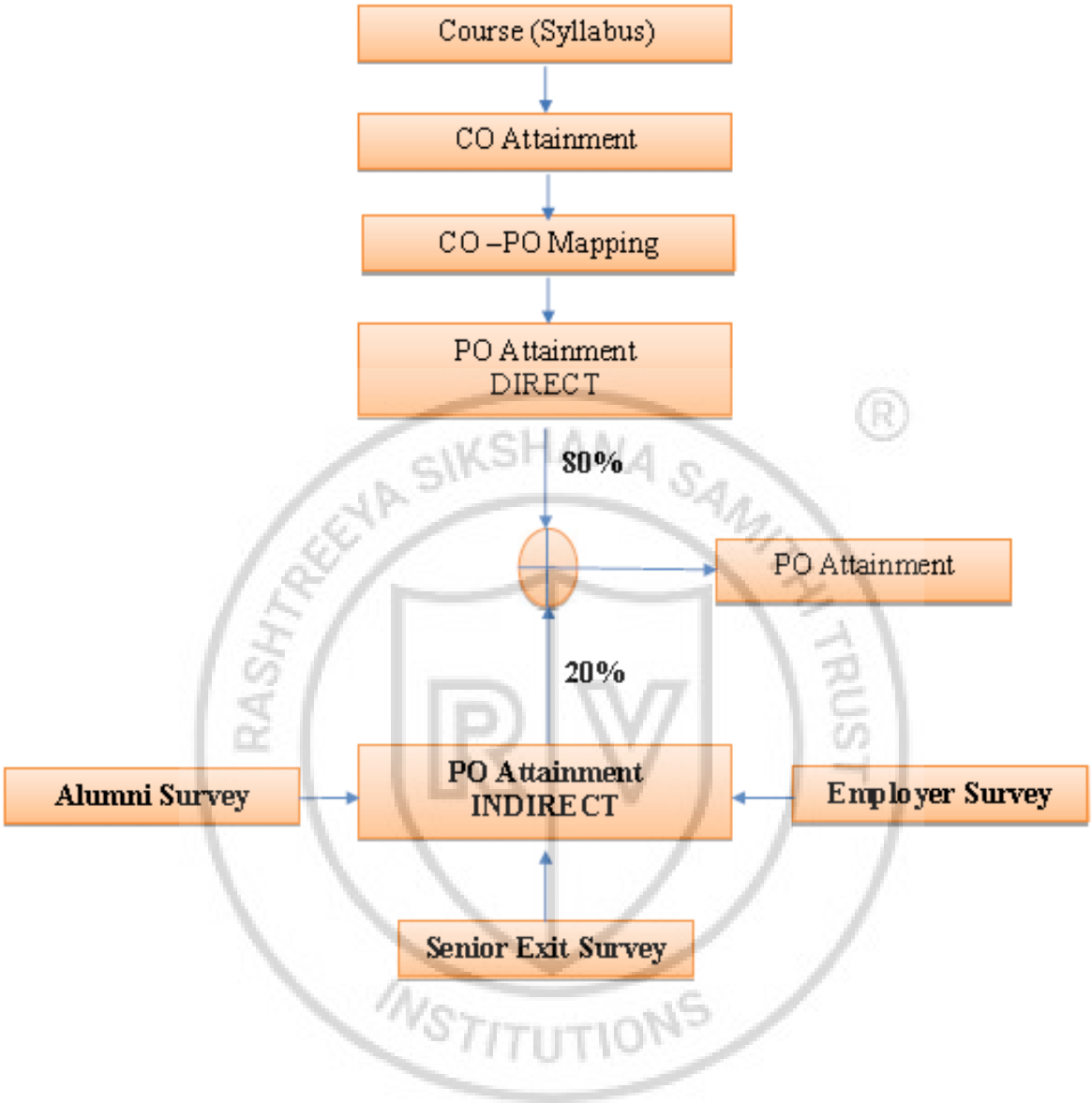
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



KNOWLEDGE & ATTITUDE PROFILE

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

PROGRAM OUTCOMES (POs)

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

INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation