RV College of Engineering®

Undergraduate Programs

Bachelor of Engineering (B.E) in

Aerospace Engineering

Scheme And Syllabus of V & VI 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

RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Go, change the world

SCHEME & SYLLABUS
THIRD YEAR B.E. PROGRAMS

AEROSPACE ENGINEERING

BACHELOR OF ENGINEERING (B.E.)
2022 SCHEME

ACADEMIC YEAR 2024-25

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

V 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	HS351TA	Entrepreneurship and Intellectual Property Rights	3	0	0	3	HS	Theory	1.5	**100**	****	**3**	**100**	****
2	AS252IA	Aerodynamics & Flight Performance	3	0	1	4	AS	Theory + Practice	1.5	**100**	**50**	**3**	**100**	**50**
3	AS253IA	Finite Element Methods	3	0	1	4	AS	Theory + Practice	1.5	**100**	**50**	**3**	**100**	**50**
4	AS254IA	Aircraft Systems & Instrumentation	3	0	1	4	AS	Theory + Practice	1.5	**100**	**50**	**3**	**100**	**50**
5	AS255TBX	Professional Core Elective-I (Group-B)	3	0	0	3	AS	Theory	1.5	**100**	****	**3**	**100**	****
6	AS256TCX	Professional Core Elective-II (Group C)	2	0	0	2	AS	**NPTEL**	1	****	**50**	**2**	****	**50**
						20								

Professional Core Elective-I (Group-B)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	AS255TBA	Aerospace Manufacturing Process	03
2.	AS255TBB	Introduction to Composite Materials	03
3.	AS255TBC	Aircraft Maintenance, Repair and Overhauling	03
4.	AS255TBD	Fundamentals of Satellite System	03

Professional Core Elective-II (Group C) NPTEL			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	AS256TCA	Aerospace Structural Analysis	02
2.	AS256TCB	Introduction to Reliability Engineering	02
3.	AS256TCC	Modelling And Simulation of Dynamic Systems	02
4.	AS256TCD	Manufacturing Guidelines For Product Design	02
5.	AS256TCE	Supply Chain Analytics	02

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Bachelor of Engineering in
AEROSPACE ENGINEERING

VI 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	HS261TA	Principles of Management and Economics	3	0	0	3	HS	Theory	1.5	100	****	3	100	****
2	AS362IA	Gas Dynamics	3	0	1	4	AS	Theory + Practice	1.5	100	50	3	100	50
3	AS363IA	Avionics	3	0	1	4	AS	Theory + Practice	1.5	100	50	3	100	50
4	AS364TA	Structural Dynamics	3	1	0	4	AS	Theory	1.5	100	****	3	100	****
5	AS365TDX	Professional Core Elective-III (Group- D)	3	0	0	3	AS	Theory	1.5	100	****	3	100	****
6	XX366TEX	Institutional Electives – I (Group E)	3	0	0	3	Resp. BoS	Theory	1.5	100	****	3	100	****
7	AS367P	Interdisciplinary Project	0	0	3	3	AS	Project	1	****	50	2	****	50
						24								

Professional Core Elective-III (Group- D)			
Sl. No.	**Course Code**	**Course Title**	**Credits**
1.	AS365TDA	Advanced Aerospace Manufacturing	03
2.	AS365TDB	Computational Fluid Dynamics	03
3.	AS365TDC	Heat Transfer	03
4.	AS365TDD	Space Vehicle Design	03
5.	AS365TDE	Cryogenic Engineering	03
6.	AS365TDF	Product, Design and Development for Aerospace Applications	03

Institutional Electives-I Group-F				
Sl. No.	**Course Code**	**BoS**	**Course Title**	**Credits**
1.	AS266TEA	AS	Fundamentals of Aerospace Engineering	03
2.	BT266TEB	BT	Bioinformatics	03
3.	CH266TEC	CH	Industrial Safety Engineering	03
4.	CS266TED	CS	Robotics Process Automation	03
5.	CV266TEE	CV	Intelligent Transport Systems	03
6.	CV266TEF	CV	Integrated Health Monitoring of Structures	03
7.	CM266TEG	CM	Advanced Energy Storage for E-Mobility	03
8.	EC266TEH	EC	Human Machine Interface(HMI)	03
9.	EE266TEJ	EE	Energy Auditing and Standards	03
10.	EI266TEK	EI	Biomedical Instrumentation	03
11.	ET266TEM	ET	Telecommunication Systems	03
12.	ET266TEN	ET	Mobile Communication Networks and Standards	03
13.	IS266TEO	IS	Mobile Application Development	03
14.	IM266TEQ	IM	Elements of Financial Management	03
15.	IM266TER	IM	Optimization Techniques	03
16.	ME266TES	ME	Automotive Mechatronics	03
17.	MA266TEU	MA	Mathematical Modelling	03
18.	MA266TEV	MA	Mathematics of Quantum Computing	03
19.	HS266TEW	HS	Applied Psychology for Engineers	03
20.	HS266TEY	HS	Universal Human Values	03

Semester: V						
ENTREPRENEURSHIP & INTELLECTUAL PROPERTY RIGHTS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	HS351TA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 Hrs**

Introduction to Entrepreneurship: Definition and Scope of Entrepreneurship, Importance of Entrepreneurship in Engineering Innovation and Economic Growth, Techniques for Identifying Entrepreneurial Opportunities, Types of Entrepreneurs: Innovative, Imitative, Fabian, Characteristics and Traits of Successful Entrepreneurs.

Role in economic development- Emerging Trends in Entrepreneurship, Entrepreneur and Entrepreneurship, characteristics of Entrepreneur, Myths about Entrepreneurship, Entrepreneur vs Intrapreneur, Role of Entrepreneurial Teams

Activities: Case study on Entrepreneurship in Indian Scenario, Ideation Workshops and Hackathons.

Unit – II	**08 Hrs**

Entrepreneurial Opportunity Evaluation: Identifying Market Opportunities and Trends, Integration of Engineering Principles in Ideation Process, Cross-Disciplinary Collaboration for Technological Innovation, Assessing Market Feasibility and Demand Analysis, Evaluating Technical Feasibility: Prototype Development, Proof of Concept, Financial Feasibility Analysis: Cost Estimation, Revenue Projection, Break-Even Analysis**.**

Business Planning and Strategy Development: Elements of a Business Plan, Executive Summary, Company Description, Market Analysis, writing a Business Plan: Structure and Components, Strategic Planning: Vision, Mission, Goals, Objectives, SWOC Analysis, Competitive Strategy: Porter's Generic Strategies, Differentiation, Cost Leadership, Focus Strategy, Growth Strategies: Organic Growth, Mergers and Acquisitions, Strategic Alliances

Activities: Writing a Business Plan on given templates, Developing Business Models and Prototypes Based on Generated Ideas

Unit –III	**10 Hrs**

Entrepreneurial Marketing and Sales: Basics of Marketing: Product, Price, Place, Promotion (4Ps), Market Segmentation, Targeting, and Positioning (STP), Branding and Product Development Strategies, Creating a Unique Value Proposition (UVP) Digital Marketing: Social Media Marketing, Content Marketing, SEO, SEM, Sales Techniques and Customer Relationship Management (CRM).

Entrepreneurial Finance and Resource Management: Sources of Financing: Equity Financing, Debt Financing, Venture Capital, Angel Investors, Crowdfunding, Financial Management: Budgeting, Cash Flow Management, Financial Statements Analysis, Risk Management and Insurance, Human Resource Management: Recruitment, Training, Performance Evaluation, Legal and Ethical Issues in Entrepreneurship: Intellectual Property Rights, Contracts, Corporate Governance

Activities:Case Studies and Practical Applications

Unit –IV	**09 Hrs**

Introduction to IP : Types of Intellectual Property

Patents: Introduction, Scope and salient features of patent; patentable and non-patentable inventions, Patent Procedure - Overview, Transfer of Patent Rights; protection of traditional knowledge, Infringement of patents and remedy, Case studies, Patent Search and Patent Drafting, Commercialization and Valuation of IP.

Trade Marks: Concept, function and different kinds and forms of Trade marks, Registrable and non- registrable marks. Registration of Trade Mark; Deceptive similarity; Transfer of Trade Mark, ECO Label, Passing off, Infringement of Trade Mark with Case studies and Remedies.

Unit –V	**09 Hrs**

Trade Secrets: Definition, Significance, Tools to protect Trade secrets in India.

Industrial Design: Introduction of Industrial Designs Features of Industrial, Design. Procedure for obtaining Design Protection, Revocation, Infringement and Remedies, Case studies.

Copy Right: Introduction, Nature and scope, Rights conferred by copy right, Copy right protection, transfer of copy rights, right of broad casting organizations and performer's rights, Exceptions of Copy Right, Infringement of Copy Right with case studies.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the concepts of entrepreneurship and cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership.
CO2	Comprehend the process of opportunity identification of market potential and customers while developing a compelling value proposition solutions.
CO3	Analyse and refine business models to ensure sustainability and profitability and build a validated MVP of their practice venture idea and prepare business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture.
CO4	Apply insights into the strategies and methods employed to attain a range of benefits from these IPs and deliver an investible pitch deck of their practice venture to attract stakeholders
CO5	Knowledge and competence related exposure to the various Legal issues pertaining to Intellectual Property Rights with the utility in engineering perspectives

Reference Books:	
1	Donald F. Kuratko ,"Entrepreneurship: Theory, Process, and Practice", South-Western Pub publishers, 10th edition, 2016,978-ISBN-13: 1305576247
2	Eric Ries, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Currency Publishers,1st Edition, 2011, ISBN-13: 978-0307887894.
3	Dr B L Wadehra, Law Relating to Intellectual Property, universa Law publishers 05th edition, ISBN : 9789350350300 .
4	Intellectual Property Rights: Unleashing Knowledge Economy, Prabuddha Ganguly, 1st Edition, 2001, Tata McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 0074638602.

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. Each test will be evaluated for 50 Marks, adding up to 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Some of the Experiential learning topics may include Reading Leadership books and summarizing, Analysis and interpretation of various economic reports, Visit to various organizations to understand organizational mechanics. 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; wherein one sub division will be a caselet in the related topics)	
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: V						
AERODYNAMICS AND FLIGHT PERFORMANCE **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	AS252IA		**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**
Incompressible Flow over Airfoils: Airfoil Nomenclature, Airfoil Characteristics, The Kutta Condition, Kelvin's circulation theorem and the starting vortex, Classical thin airfoil theory for symmetric Airfoil and cambered airfoil, Airfoil Drag and Flow Separation, Types of Drag, High Lift Devices.	
Unit – II	**12 Hrs**
Incompressible Flow over Finite Wings : Downwash and induced drag on wings, Vortex Filament, Biot-Savart law and Helmholtz's theorems, Prandtl's classical lifting line theory, Elliptical Lift Distribution, Effect of Aspect Ratio, Lifting surface theory: Concept of Panel Method (Without Derivation), Drag-Divergence Mach Number, Critical Mach Number and Transonic Area-Rule.	
Unit –III	**08 Hrs**
Airplane Performance: **Steady Flight**: Unaccelerated steady level flight performance–Thrust available and Required, Power Available and required: Jet and Propeller driven, Maximum Velocity, Altitude effects, Thrust-to-Weight Ratio, Wing Loading, Drag Polar, and Lift-to-Drag Ratio, Aerodynamic Relations.	
Unit –IV	**08 Hrs**
Unaccelerated Aircraft Performance: Rate of Climb, Gliding flight, Absolute and service ceilings, Time to climb. Range and Endurance-Propeller and Jet driven airplane.	
Unit –V	**08 Hrs**
Accelerated Aircraft Performance: Take-off and landing Performance, Turning Flight Performance and V-n Diagram, Accelerated Rate of climb.	

LABORATORY EXPERIMENTS

1. Calibration of a subsonic wind tunnel and test section.
2. Smoke and tuft flow visualization studies on a two-dimensional bluff and streamlined bodies at low speeds.
3. Surface pressure distributions on a two-dimensional circular cylinder at low speeds and calculation of pressure drag
4. Surface pressure distributions on a two-dimensional symmetric airfoil at zero incidences at low speeds
5. Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag.
6. Calculation of total drag of a two-dimensional cambered airfoil at low speeds at incidence using wake survey technique
7. Measurement of flow angularity
8. Atmosphere modelling and estimation of pressure, temperature and Lapse rate for change in altitude.
9. Estimation of Range and endurance for jet and propeller powered aircraft
10. Estimation of thrust required and available with change in velocity and altitude for unaccelerated flight

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Demonstrate a comprehensive understanding of the fundamental principles of aerodynamics that critically influence the aircraft performance
CO2	Ability to distinguish and differentiate between the 2D and 3D aerodynamic bodies and how they impact the performance characteristics of an airplane under different operating conditions
CO3	Analyse and evaluate the performance of aircraft in various flight regimes, including steady and unsteady flight, as well as accelerated and unaccelerated manoeuvres, by applying theoretical models and principles of Aerodynamics
CO4	Applying fundamentals and advanced aerodynamic theories and methodologies to predict and optimize the performance characteristics of aircraft

Reference Books	
1	Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
2	Aircraft Performance and Design, J D Anderson, Indian Edition, McGraw Hill Education-2017, ISBN-10: 9780070702455,ISBN-13 : 978-0070702455
3	Aerodynamics for Engineers, John J. Bertin, Pearson, 9788177585445 (ISBN10: 8177585444)

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**. **Some of Sample topics are** **Aerodynamics:** Experiments/ Numerical Simulation of airfoil characteristics for various flow conditions such as a) Fixing angle of attack and varying upstream Mach number b)Fixing Mach number and varying angle of attack / study on Wind Tunnel Testing/ Study on Measurement Techniques in Wind Tunnels: **Flight performance:** MAT Lab based experiments on flight mechanics: Some samples are Atmosphere modeling and estimation of pressure, temperature and Lapse rate for change in altitude/ Determination of Airspeed-TAS,CAS/ Estimation of Range and endurance for jet propelled aircraft/ propeller powered aircraft/ Estimation of thrust required and available with change in velocity and altitude for un accelerated flight/ Estimation of take -off distance/Landing distance of an aircraft	**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: V						
FINITE ELEMENT METHODS **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	AS253IA		**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**
Introduction: Introduction to FEM, Historical background, Difference between discrete and continuous system, Classification of common methods, Finite element method vs. Classical methods, General description in FEM, Steps in FEM, Applications of FEM, Types of elements based on geometry, advantages and disadvantages of FEM, Stiffness Matrix formula for a bar and Beam elements.	
Unit – II	**11 Hrs**
Interpolation Models and Higher Order Elements: Interpolation polynomials, Types of displacement functions for 1D and 2D elements, Shape function of three-noded Triangular Element (TRIA 3), Four-Noded Quadrilateral Element (QUAD 4), Shape Functions of 2, 3, and 4 Noded bar element, Serendipity family, Lagrange family, Shape functions for Higher Order Elements.	
Unit –III	**08 Hrs**
Solution of 1-D Bars and Beams: Derivation of element stiffness matrix & strain displacement matrix for a bar element, Solutions of bars with constant, tapered and stepped cross sections for displacements, reactions and stresses by using penalty approach and elimination approach. Iso-parametric, Sub parametric and Super parametric elements, Finite element method applied to 1-D bars and beams - Numericals.	
Unit –IV	**08 Hrs**
Beams & Trusses: Hermite shape functions for beam element, Derivation of element stiffness matrix, strain displacement and load vector for beam elements, numerical problems on beams carrying concentrated, UDL and linearly varying loads, Element stiffness matrix derivation for trusses, Numerical on Trusses.	
Unit –V	**08 Hrs**
Mathematical Preliminaries and Basic Procedure: Introduction to Calculus of Variation, Principle of Virtual Work, Principle of Minimum Potential Energy, Rayleigh- Ritz Method, Obtaining the Variational form from a differential equation- 1D Bar Element, Numerical on 1D Bar Elements using Rayleigh-Ritz and Galerkin's Method, Displacement method of finite element formulation. Convergence criteria, Discretisation process.	

LABORATORY EXPERIMENTS

1. Computation of deflection of Bars with Constant Cross-sectional Area (Case 1: Single Element; Case 2: Multiple Elements)
2. Computation of deflection of Stepped Bars (Case 1: Constant cross section in each step; Case 2: Tapered Cross sectional area; Case 3: Stepped bar having different materials)
3. Static analysis of a Simple Cantilever Beam (Using shell and Solid elements having different cross sections – Four cases)
4. Stress Analysis of a Cantilever beam subjected to UDL to interpret SFD and BMD
5. Interpreting SFD and BMD for a cantilever beam with a tapered C-Section under UVL.
6. Rectangular plate with Cut-Out and uniformly compressed in one direction.
7. Static Analysis of a composite sandwiched cantilever beam to determine the displacement and the stress.
8. Modal Analysis of a composite Laminated plate.
9. Modal Analysis of a wing (Case 1: Symmetrical Aerofoil; Case 2: Rectangular cantilever plate)
10. Flutter Analysis of a 2D wing
11. Divergence Speed prediction for a 2D wing

Course Outcomes: After completing the course, the students will be able to:-	
CO1	To comprehend the basic fundamentals of Finite Element Method by solving physical problems involving partial differential equations
CO2	Build mathematical formulations utilizing Principle of virtual work and Minimum potential energy
CO3	Understand the role and significance of shape functions in Finite Element Methods.
CO4	Apply the procedures of FEM to obtain the solutions for truss, beams and various real life problems.

Reference Books	
1	The Finite Element Method: Its Basis and Fundamentals, O.C. Zienkiewicz and R.L. Taylor, 7th Edition, 2013, Butterworth-Heinemann, ISBN: 978-0080472775
2	Finite Element Procedures,Klaus Jürgen Bathe, 2nd Edition, 2014, Klaus-Jurgen Bathe, ISBN: 978-0979004957
3	A First Course in the Finite Element Method, D. L. Logan, 6th Edition, 2016, Cengage Learning, 978-1305635111
4	The Finite Element Method in Engineering, S. S. Rao, 5th Edition, 2010, Butterworth-Heinemann, 978-1856176613
5	Concepts and Applications of Finite Element Analysis, R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, 4th Edition, , 2003, John Wiley & Sons, 978-0471356059
6	Finite Elements in Engineering, T. R. Chandrupatla, 2nd Edition, 2013 PHI Learning, 978-8120327720
7	Finite Element Analysis: Theory and Application with ANSYS, Saeed Moaveni, 4th Edition, 2015, Pearson, 978-0133840803

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: V						
AIRCRAFT SYSTEMS & INSTRUMENTATION **CATEGORY: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	AS254IA		**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	**14 Hrs**
Aircraft Power Generation Systems: **Aircraft Electrical System:** Aircraft Power Generation & Distribution System. Components of Aircraft Electrical System – Aircraft battery, Aircraft Generators (AC/DC Generators), Aircraft Alternators: Theory of operation Alternator regulation, Fundamentals of Constant speed drives (CSD) and Variable Speed Constant Frequency (VSCF) Integrated Drive Generators (IDG). **Aircraft Hydraulic & Pneumatic Systems** Components of a typical Hydraulic system, Working of Hydraulic system, Power packs, Hydraulic actuators. Aircraft, Landing gear and Wheel Braking and Anti-Skid & Shimmy System. Pneumatic system and its components, **Electrical, Hydraulic & Pneumatic system Instruments and information display.**	
Unit – II	**10 Hrs**
Gyroscopic Instruments & Magnetic Reference Heading System: Type of Gyroscopes, Principles of Mechanical, MEMS and Optical Gyroscopes, Properties of Mechanical Gyroscope-Rigidity & Precession, limitations of gyroscope, Artificial Horizon, Errors due to acceleration and turning, Turn and Bank indicator. Terrestrial magnetism, Aircraft magnetism, Direct Reading Compasses, Magnetic Heading Reference System & Remote Indicating Compass System Block Diagram - Flux Detector Valve, Direction Indicator.	
Unit –III	**04 Hrs**
Aero Engine Systems: Types of Starting and Ignition systems, Engine starting sequence, Engine Oils and a typical Engine Lubricating system. Engine Fuel System & functioning of a typical engine fuel control unit. **Aero Engine Instruments:** Pressure measurements & indicating systems, pressure switches, Temperature measurements & Indicating systems.	
Unit –IV	**07 Hrs**
Air-conditioning and Pressurisation Systems: Cockpit & Cabin Temperature control system, De-icing systems, Cold air units, Compact heat exchangers, Cockpit and Cabin Pressurization valves, filters, air bottles, capsules and bellows, indication and warnings. Systems & sensors	
Unit –V	**10 Hrs**
Air Data Systems: Pitot-static Sensing probes, Air Speed Indicator, Altimeter, Vertical speed indicator, Angle of Attack Sensing & indication, Mach meter, Air Data Computer and its functioning with respect to FBW system, Aerodynamic Alerting Systems. **Flight Control Systems:** Primary and secondary flight controls, Conventional Flight control linkage System, Power Assisted and fully powered flight controls. Fly By Wire Control System	

LABORATORY EXPERIMENTS

Part – I : Hydraulics & Pneumatic System Lab

1. Characteristic Curve of Variable Displacement Hydraulic Pump.
2. Study of Application of 4/3 Directional Control Valve (Tandem & Closed Centre).
3. Study of Operation of Hydraulic Motor Using 4/3 Directional Control Valve.
4. Study of Operation of Accumulator Using 4/3 Directional Control Valve.
5. Study of Application of Pressure Switch Using 4/2 Directional Control Valve.
6. Study of Position Dependent Control of a Double Acting Cylinder with Mechanical Limit Switches.
7. Study of Logical Control of Pneumatic circuit with 'AND' & 'OR' function using Electro pneumatics

Part – II : Aircraft Instrumentation Lab

8. **(A)** Measurement of Aircraft Pressure, using Sensor Test Bed.
   (B) Measurement of Aero-engine RPM using Sensor Test Bed.

(C) Measurement of Aero-engine Temperature using Sensor Test Bed.

9. Measurement of Fuel Flow & Quantity of Fuel Consumed in Aero-Engine using Fuel Flow Transmitter using sensor Test Bed.

10. Study of Gyroscopic Behaviour of Rotating Masses and Verification of Gyroscopic Relationship (Using Electromechanical Gyroscope using Table Top Model).

11. Measurement of Roll, Pitch and Yaw with Artificial Horizon and Measurement of direction using Magnetometer.

Part – III : Air Data System Lab

1. 12. Measurement of Air Data Parameters Using Air Data test Set.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the requirement of aircraft systems in an aircraft. Develop understanding of basic design approach for aircraft systems.
CO2	Critically evaluate design and functioning of the aircraft systems and associated components.
CO3	Understand the concept, sensors, components, their integration and functioning in Digital Fly-By-Wire Flying Control System
CO4	Comprehend the complexities involved during design and development of instrumentation and displays of flight vehicle.

Reference Books	
1	E.H.J.Pallet, Aircraft Instruments, 1st Revised Edition, 1992, Prentice Hall of India, ISBN-9780273015390
2	Moir, I. and Seabridge, A.,Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration, 3rd Edition, 2008, Wiley Publications, ISBN- 978-0470059968
3	Harris, D., Ground Studies for Pilots: Flight Instruments and Automatic Flight Control Systems, sixth edition 2004, Blackwell Science, ISBN: 978-0632059515
4	Moir, I. and Seabridge, Civil Avionics Systems, AIAA (American Institute of Aeronautics & Astronautics) Wiley; 2 edition (October 14, 2013), ISBN: 978-1118341803

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: V						
AEROSPACE MANUFACTURING PROCESS **Category: PROFESSIONAL CORE ELECTIVE-I GROUP B** **(Theory)**						
Course Code	**:**	AS255TBA		**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**
Limits, fits and tolerances: Definition of tolerance, Indian standards, concept of limits of size and tolerances, definition of fits, types of fits, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges. **Geometric Dimensioning and Tolerance:** Introduction to GD &T, symbols, form tolerance-flatness, cylindricity, straightness, circularity, orientation tolerances-perpendicularity, parallelism and angularity. Elements of surface texture, factors affecting surface finish, methods of measuring surface finish, indication of surface roughness symbols used.	
Unit – II	**08 Hrs**
Introduction to Manufacturing principle and Processes of Major Aircraft Metal Product. Casting Processes: Sand moulding, Centrifugal casting, Pressure casting, Die Casting, Investment Casting, Evaporative Pattern Casting, Casting of Aluminum Billet for Extrusion or forging. **Metal Cutting:** Orthogonal and Oblique Cutting, Types of Chips, Thermodynamics in Metal Cutting, Cutting Parameters- Tool wear and Tool Life. Machining of Various Metals Used in aerospace materials-Aluminium, Titanium, Steel-composite.	
Unit –III	**08 Hrs**
Sheet Metal Working: Shearing mechanism, blanking, piercing, punching. Forming processes like bending, deep drawing, Rubber Pad forming, Stretch forming. Elements of die; punch and die clearances; Progressive, compound and combination dies. Applications of sheet formed products in Aerospace industries. **Welding & Joining Technologies: S**pecification of electrodes, Friction Welding - Rotary, Linear, Friction-Stir Welding. Laser beam welding, Electron Beam, Plasma Arc Welding, Gas Metal and Gas Tungsten Arc Welding, Welding Defects.	
Unit –IV	**08 Hrs**
Powder Metallurgy: Introduction. Production of metal powders. Compaction and sintering processes. Secondary and finishing operations. Economics, advantages, and applications of powder metallurgy in Aerospace Parts. **Introduction to Advanced Manufacturing Processes**: Rapid Prototyping, Direct Metal Deposition, Fine blanking, Immersive Virtual Reality.	
Unit –V	**10 Hrs**
Processing of Composite: Role of Composites in Major Aircraft Components, Hand Layup, Machine Layup, Filament Winding, Vacuum bagging, Tape Lamination, Fiber Placement, Drape Forming, Liquid Composite Molding -Resin Transfer Molding, Vacuum-Assisted RTM, Resin Film Infusion, Pultrusion. Thermoplastic composites – thermoplastic consolidation, thermoforming, thermoplastic joining.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the importance of geometric dimension and tolerance in the field of engineering, especially in Aerospace Engineering
CO2	Comprehend the various techniques and methodologies for producing Aerospace Components
CO3	Assess the influence of various parameters involved in each manufacturing technologies
CO4	Apply a particular technique for manufacturing a given Aerospace Component

Reference Books	
1	Manufacturing Technology for Aerospace structural Materials, F C Campbell, 2006 1st Edition, Elsevier, ISBN-13: 9781856174954
2	Aerospace Manufacturing Processes, Pradip K. Saha, 1st Edition, 2016, CRC Press – Taylor & Francis Group, ISBN: 9781315367965
3	Geometric Dimensioning and Tolerancing for Mechanical Design, Gene Cogorno, 2nd Edition 2011, McGraw-Hill, ISBN-13:978-0071772129
4	Manufacturing Engineering & Technology, Serope Kalpakjian, 7th Edition, 2018, Pearson Publishers ISBN-13: 9789332587908.
5	Metrology & Measurement, Anand K Bewoor, Vinay A Kulkarni, 4th Edition, 2009, McGraw-Hill. ISBN-13: 978-0070140004

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: V						
INTRODUCTION TO COMPOSITE MATERIALS **Category: PROFESSIONAL CORE ELECTIVE-I GROUP B** **(Theory)**						
Course Code	**:**	AS255TBB		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**12 Hrs**
Introduction to Composite Materials: Introduction and Classification of composites, Overview of Advantages and Limitations of Composite Materials, Micro mechanics, Macro mechanics, Homogeneity, Heterogeneity, Inhomogeneity, Isotropy, Anisotropy/Orthotropy. General Anisotropic Material, Specially Orthotropic Material, Transversely Isotropic Material, Orthotropic Material Under Plane Stress, Isotropic Material.	
Unit – II	**09 Hrs**
Strength of Unidirectional Lamina-Micro mechanics: Elasticity approach, Ultimate strength of unidirectional lamina, strength of materials approach, Semi empirical Models.	
Unit –III	**08 Hrs**
Strength of Composite Lamina-Macro mechanics: Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Hooke's Law for a Two-Dimensional Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina, Strength Failure Theories of an Angle Lamina.	
Unit –IV	**06 Hrs**
Failure, Analysis, and Design of Laminates: Introduction, Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues.	
Unit –V	**10 Hrs**
Experimental Methods For Testing Of Composite Materials: Characterization of Constituent Materials, Physical Characterization of Composite Materials, Determination of Tensile Properties of Unidirectional Lamina, Determination of Compressive Properties of Unidirectional lamina, Determination of Shear Properties of Unidirectional lamina.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites
CO2	Analyse the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behaviour of fibre-reinforced composites
CO3	Apply knowledge of composite mechanical performance and manufacturing methods to a composites design project
CO4	Criticize the design and application of fibre-reinforced composites for various loading conditions

Reference Books	
1	Manufacturing Technology for Aerospace structural Materials, F C Campbell, 2006 1st Edition, Elsevier, ISBN-13: 9781856174954
2	Aerospace Manufacturing Processes, Pradip K. Saha, 1st Edition, 2016, CRC Press – Taylor & Francis Group, ISBN: 9781315367965
3	Geometric Dimensioning and Tolerancing for Mechanical Design, Gene Cogorno, 2nd Edition 2011, McGraw-Hill, ISBN-13:978-0071772129
4	Manufacturing Engineering & Technology, Serope Kalpakjian, 7th Edition, 2018, Pearson Publishers ISBN-13: 9789332587908.
5	Metrology & Measurement, Anand K Bewoor, Vinay A Kulkarni, 4th Edition, 2009, McGraw-Hill. ISBN-13: 978-0070140004

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: V						
AIRCRAFT MAINTENANCE, REPAIR & OVERHAULING **Category: PROFESSIONAL CORE ELECTIVE-I GROUP B** **(Theory)**						
Course Code	:	AS255TBC		**CIE**	**:**	**100 Marks**
Credits: L:T:P	:	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	:	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Fundamentals of Maintenance & Certification Types of maintenance, Redesign, Failure rate pattern, Other maintenance considerations. Aviation industry certification requirements, Type certificate (FAA form 8110.9), Airworthiness certificate (FAA form 8100-2), Aviation maintenance certifications, General, Airframe, Power plant, Avionics courses.	
Unit -II	**09 Hrs**
Documentation for Maintenance Manufacturers documentation, Airplane maintenance manual, Fault insulation manual, Illustrated parts catalogue, structural repair manual, wiring diagram manual, Master minimum equipment, Federal Aviation regulation (FAR), Advisory circulars, Airworthiness direction ATA document standards, Technical policies and procedure manuals (TPPM).	
Unit -III	**08 Hrs**
Aircraft Management Maintenance Structure, Role of aviation management, Line supervisory management, Management areas of concern in airlines, Manager of overhaul shops, Line maintenance control centre flight line (prefight & post flight), Aircraft Logbook, Maintenance crew skill requirements.	
Unit -IV	**09 Hrs**
Hanger Maintenance (on Aircraft) & Material Support Introduction, organization of hanger maintenance, Non- routine item, parts availability, cannibalization, Types of shops- sheet metal shop, Aircraft interior shop, Engine shop, Avionics shop, ground support equipment, outsourcing of shop maintenance work, operation of overhaul shops, Material support, Material management inventory control, Support functions of material, Parts ordering, Storage, Issue, control and handling, Parts receiving quality control, calibration program, stock level adjustments, shelf life, exchanges, warranty & modifications of parts.	
Unit -V	**09 Hrs**
Maintenance Safety & Trouble shooting Safety regulations, occupational safety and health standards maintenance safety program, Airlines safety management, General safety rules, Accident & injury reporting, Hazardous materials storage and handling aircraft furnishing practices trouble shooting, Knowledge of malfunctions.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand core principles and regulations for aircraft maintenance and certification
CO2	Comprehend skills for effective documentation in compliance with industry standards
CO3	Apply knowledge to ensure safety, troubleshoot, and maintain airworthiness
CO4	Acquire expertise in hangar maintenance procedures, including facility upkeep, equipment management, and safety protocols to support efficient aircraft maintenance operations

Reference Books	
1	Aviation Maintenance Management, Harry A Kinnison, Tariq Siddiqui, Mc Graw Hill education, 2012, Private Ltd, ISBN: 9780071805032
2	Aircraft maintenance and repair, Kroes, Watkins, Delp, Mc Graw Hill, 2013 McGraw-Hill Education, 7th edition, 2013, ISBN: 978-0071801508
3	Aircraft Repair Manual, Larry Reithmaier, Palmar Books, Marquette, 1992, ISBN: 978-0932882028
4	Aircraft Maintenance, Brimm. DJ, Bogges, HE, Pitman publishing corp, London, 1952,. ASIN: B000NQ539E

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: V						
FUNDAMENTALS OF SATELLITE SYSTEM **Category: PROFESSIONAL CORE ELECTIVE-I GROUP B** **(Theory)**						
Course Code	**:**	AS255TBD		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction: Payloads & Missions, Objectives & Requirements of a Spacecraft, Overview of Spacecraft Subsystems. **Effect of Space Environment on Design :** Introduction, Pre-operational Spacecraft Environments, Operational Spacecraft Environments, Environmental Effects on Design.	
Unit – II	**09 Hrs**
Attitude Control Systems: Introduction, Overview of ACS, ACS block diagram, Torques And Torquers, Attitude Measurement, Measurement system fundamentals, Types of reference sensor & Inertial sensors. (No numerical and derivation)	
Unit -III	**09 Hrs**
Thermal Control Systems: The Thermal Environment: Types of Thermal Sources, Thermal Balance, Passive and Active thermal control **Electrical Power Systems :** Power System Elements, Primary & Secondary Power Systems.	
Unit -IV	**10 Hrs**
Telecommunication Systems: Role of Communication Systems, Radio Communications: Modulation, Multiple Access, Noise, Radio Propagation, Antennas, Communication Payload: Transponder System. **Telemetry :** System Architecture, Base Band Telemetry system, Modulation, TT&C RF system, Telecommand system, Ground Control Systems.	
Unit -V	**08 Hrs**
Small Satellite Engineering & Applications : Introduction, Small-satellite Design Philosophy, Small-satellite System Design, COTS Components in the Space Environment, Microsatellite Platforms, Minisatellite Platforms and Nanosatellite Platforms, Affordable Launches for Small Satellites, In-orbit Operations, Small-satellite Applications, Picosatellites and Recent Advances in Miniaturization.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental concepts of different satellite subsystems
CO2	Demonstrate the working principles of different types of subsystems
CO3	Identify and Classify the required subsystem and its type employed based on the mission
CO4	Compute and Evaluate the fundamental parameters involved in the satellite subsystem design

Reference Books	
1	Peter Fortescue, John Stark and Graham Swinerd, Spacecraft Systems Engineering, 4th edition, Wiley publications, ISBN : 978-0-470-75012-4
2	Space Mission Analysis and Design (Third Edition) by James R.Wertz and Wiley J.Larson,1999
3	James R.Wertz "Spacecraft Attitude Determination and Control", Kluwer Academic Publisher, 1988.
4	Marcel J.Sidi "Spacecraft Dynamics and Control", Cambridge University press, 1997.

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**

Semester: V						
AEROSPACE STRUCTURAL ANALYSIS **Category: PROFESSIONAL CORE ELECTIVE-II GROUP C (NPTEL ELECTIVE)** **(Theory)**						
Course Code	**:**	AS256TCA		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**10 Hrs**
Introduction: Introduction to aircraft structures and their uniqueness. A brief history on evolution of aircraft structures Structural components of an aircraft and their functionalities. Recap of theory of elasticity.	
Unit – II	**10 Hrs**
Torsion of thin-walled structures: Torsion of non-circular cross-section. St. Venant's theory and Prandtl's stress function. Torsion: Membrane analogy. Torsion of thin walled structures with single and multiple cells, Bi-directional bending. Sectional properties of thin walled cross-sections. Bending of thin-walled structures	
Unit –III	**10 Hrs**
Shear forces on thin walled structures. Analysis of single and multiple cells cross-section under shear load, Shear center. Shear center of different thin-walled crosssection, Skin-stringer idealization. Skin-stringer idealization of different structural components, Buckling of columns. Introduction to buckling of plates	

Reference Books	
1	Aircraft Structures for Engineering Students, T H G Megson
2	Analysis of Aircraft Structures, B. K. Donaldson
3	Aircraft Structures, D. J. Peery and J. J. Azar

Semester: V						
INTRODUCTION TO RELIABILITY ENGINEERING **Category: PROFESSIONAL CORE ELECTIVE-II GROUP C (NPTEL ELECTIVE)** **(Theory)**						
Course Code	**:**	AS256TCB		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**10 Hrs**
Introduction and Definitions, Constant Failure Rates Models, Time Dependent Failure Rate Models.	
Unit – II	**10 Hrs**
System Reliability Modeling: Series, parallel, series-parallel, and k-out-of-m modeling., Markov Modeling: standby, shared systems etc.	
Unit –III	**10 Hrs**
Reliability Estimation (Non-Parametric), Reliability Estimation (Distribution Fitting), Maintainability and Availability Analysis.	

Reference Books	
1	Charles E. Ebeling (2019) "An Introduction to Reliability and Maintainability Engineering", 3rd edition, Publisher: McGraw Hill Education.
2	Patrick D. T. O'Connor, Andre Kleyner (2012) "Practical Reliability Engineering", 5th edition, Publisher: Wiley.
3	Roy Billinton, Ronald N. Allan (1992) "Reliability Evaluation of Engineering Systems: Concepts and Techniques", 2nd edition, Publisher: Springer.
4	Mohammad Modarres, Mark P. Kaminskiy, VasiliyKrivtsov (2016) "Reliability Engineering and Risk Analysis: A practical guide", 3rd edition, Publisher: CRC Press.
5	Krishan B. Misra, "reliability analysis and prediction: a methodology oriented treatment", Publisher: Elsevier.

Semester: V						
MODELLING AND SIMULATION OF DYNAMIC SYSTEMS **Category: PROFESSIONAL CORE ELECTIVE-II GROUP C (NPTEL ELECTIVE)** **(Theory)**						
Course Code	**:**	AS256TCC		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**12 Hrs**
Introduction to Modelling and Simulation, Bond Graph Modelling of Dynamic Systems, Basic System Models	
Unit – II	**10 Hrs**
System Models of Combined Systems, Dynamic Response and System Transfer Function	
Unit –III	**08 Hrs**
Block diagram/Signal flow diagram/State Space formulation and Frequency response. Simulation and Simulation application, Parameter Estimation, System Identification and Optimization	

Reference Books	
1	NA

Semester: V						
MANUFACTURING GUIDELINES FOR PRODUCT DESIGN **Category: PROFESSIONAL CORE ELECTIVE-II GROUP C (NPTEL ELECTIVE)** **(Theory)**						
Course Code	**:**	AS256TCD		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

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

Reference Books	
1	.Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. Knight, Marcel Dekker, University of Rhode Island Kingston, New York, USA.
2	Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, McGraw-Hill companies, New York, USA.
3	Design for Manufacturability Handbook, James G. Bralla, McGraw-Hill companies, New York, USA.
4	Manufacturing Processes: Casting, Forming and Welding: H. S. Shan, Cambridge University Press.

Semester: V						
SUPPLY CHAIN ANALYTICS **Category: PROFESSIONAL CORE ELECTIVE-II GROUP C (NPTEL ELECTIVE)** **(Theory)**						
Course Code	**:**	AS256TCE		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	2:0:0		**SEE**	**:**	**50 Marks**
Hours	**:**	30 L		**SEE Duration**	**:**	**1.5 Hours**

Unit-I	**10 Hrs**
Context of today's supply chains (SC) analytics, Understanding and defining the supply chain analytics (SCA) Revisions of Basic Lessons of Supply Chain Management, Why is Analytics Important in a supply chain?, Relating Operations Management with Supply chain concepts with SC Analytics, The importance of supply chain analytics in the flows involving material, money, information and ownership. Supply chain analytics, Key issues in supply chain analytics, What involves in supply chain analytics, Concept of Descriptive Analytics in a Supply Chain, Discussion on a Few Supply Chains Analytics applications in India (students participation is expected), Decision Domains in in supply chain analytics	
Unit – II	**10 Hrs**
Foundation of Business Anlaytics (BA), E2: Introduction to Modeling, Approaches for Optimization and Simulation, Modeling software, Supply Chain (SC), Decisions that requires mathematical or interpretative modelingUnderstanding of Data and its role in Analytics, Analytics of a Transportation problem in a Supply Chain, Managerial implication of results of analytics, A case study of supply chain analytics.	
Unit –III	**10 Hrs**
Foundation of prescriptive analytics in network planning in a supply chain, Network Planning in a Supply Chain, Importance of Network Planning, Design of Logistics Network using Heuristics/optimization (Exercise 3.4 Levi (2008)), Concept of 3PL/4PL in a Supply Chain, Case Study: GATI, Foundation of Modeling Coordination Decisions in Supply Chain Management, Foundation of performance management in supply chain management, it enablement of supply chains, role of ICT in supply chains	

Reference Books	
1	Supply chain management by Sunil Chopra, and Peter Meindl, Pearson
2	Jeremy F. Shapiro. Modeling the Supply Chain. Duxbury Thomson Learning
3	D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, and Ravi Shankar, Designing and Managing the Supply Chain concepts, Strategies and Case studies, Third Edition, Tata McGraw Hill, New Delhi, 2008.
4	Rahul Saxena • Anand Srinivasan, Business Analytics

Semester: VI						
PRINCIPLES OF MANAGEMENT & ECONOMICS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	HS261TA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45 Hrs		**SEE Duration**	**:**	**3 Hours**

Unit-I	**06 Hrs**
Introduction to Management: Management Functions – POSDCORB – an overview, Management levels & Skills, Management History - **Classical Approach:** Scientific Management, Administrative Theory, **Quantitative Approach:** Operations Research, **Behavioral Approach:** Hawthorne Studies, **Contemporary Approach:** Systems Theory, Contingency Theory. **Caselets / Case studies**	
Unit – II	**10 Hrs**
Foundations of Planning: Types of Goals & Plans, Approaches to Setting Goals & Plans, Strategic Management Process, Corporate strategies – types of corporate strategies, BCG matrix, Competitive Strategies – Porters Five force Model, types of Competitive Strategies. **Caselets / Case studies** **Organizational Structure & Design:** Overview of Designing Organizational Structure - Work Specialization, Departmentalization, Chain of Command, Span of Control, Centralization & Decentralization, Formalization, Mechanistic & Organic Structures. **Caselets / Case studies**	
Unit –III	**10 Hrs**
Motivation: Early Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Theory Y, Herzberg's Two Factor Theory. Contemporary Theories of Motivation: Adam's Equitytheory, Vroom's Expectancy Theory. **Caselets / Case studies** **Leadership:** Behavioral Theories: Blake & Mouton's Managerial Grid, Contingency Theories of Leadership: Hersey & Blanchard's Situational Leadership, Contemporary Views of Leadership: Transactional & Transformational Leadership. **Caselets / Case studies**	
Unit –IV	**10 Hrs**
Introduction to Economics: Microeconomics and Macroeconomics, Circular flow model of economics, An Overview of Economic Systems. **Essentials of Microeconomics:** Demand, Supply, and Equilibrium in Markets for Goods and Services, Price Elasticity of Demand and Price Elasticity of Supply, Elasticity and Pricing, Numericals on determining price elasticity of demand and supply. Changes in Income and Prices Affecting Consumption Choices, Monopolistic Competition, Oligopoly.	
Unit –V	**09 Hrs**
Macroeconomic Indicators: Prices and inflation, Consumer Price Index, Exchange rate, Labor Market, Money and banks, Interest rate. Gross Domestic product (GDP) - components of GDP, Measures of GDP: Outcome Method, Income method and Expenditure method, Numericals on GDP Calculations, ESG an overview. **Macroeconomic models**- The classical growth theory, Keynesian cross model, IS-LM-model, The AS-AD model, The complete Keynesian model, The neo-classical synthesis. National Budgeting process in India	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Elucidate the principles of management theory & recognize the characteristics of an organization.
CO2	Demonstrate the importance of key performance areas in strategic management and design appropriate organizational structures and possess an ability to conceive various organizational dynamics.
CO3	Compare and contrast early and contemporary theories of motivation and select and implement the right leadership practices in organizations that would enable systems orientation.
CO4	Demonstrate an understanding on the usage and application of basic economic principles.
CO5	Appreciate the various measures of macro-economic performance and interpret the prevailing economic health of the nation.

Reference Books	
1	Management, Stephen Robbins, Mary Coulter &NeharikaVohra, 15th Edition, 2021, Pearson Education Publications, ISBN: 13: 978-0-13-558185-
2	Management, James Stoner, Edward Freeman & Daniel Gilbert Jr, 6th Edition, 2009, PHI, ISBN: 81-203-0981-2
3	Principles of Microeconomics, Steven A. Greenlaw, David Shapiro, 2nd Edition, 2017, ISBN:978-1-947172-34-0
4	Macroeconomics: Theory and Policy, Dwivedi D.N, 5th Edition, 2021, McGraw Hill Education; ISBN : 9789353163334

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. Each test will be evaluated for 50 Marks, adding up to 150 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Some of the Experiential learning topics may include Reading Leadership books and summarizing, Analysis and interpretation of various economic reports, Visit to various organizations to understand organizational mechanics. 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; wherein one sub division will be a caselet in the related topics)	
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: VI						
GAS DYNAMICS **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	AS362IA		**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	**12 Hrs**
Basics of Compressible Flows: Bernoulli's equation for Compressible Flows, Effect of Mach number on Compressibility, Area velocity relation, Isentropic flow in variable area Duct,-Area ratio as a function of Mach number, Impulse function. **Introduction to Shock Waves :** Shock wave introduction, Flow through Convergent nozzle, C-D nozzle and C-D diffuser, Variation of mass flow through Nozzles, Governing Equations of Normal Shock Wave, Prandtl Meyer relation and Rankine-Hugoniot equation.	
Unit – II	**10 Hrs**
Oblique Shock Waves: Oblique shocks and corresponding relations (No Derivations), Shock polar & Hodograph plane, Supersonic flow over a wedge and cone, Regular reflection from a solid boundary, Intersection of Oblique shock waves of same and opposite families, pressure deflection diagrams, Mach reflection, Detached shock wave	
Unit –III	**08 Hrs**
Expansion waves: Supersonic compression and supersonic expansion waves, Prandtl-Meyer Expansion Function (No Derivation), Shock expansion theory, Wave reflection and wave intersection shock system	
Unit –IV	**07 Hrs**
Fanno Flow : Flow with friction in constant area duct, Fanno lines, Fanno equation, Definition of friction constant, Friction loss, Effect of wall friction on flow properties, Local flow properties in terms of local, Mach number (No Derivation-Only Numericals) **Rayleigh Flow :** Flow with heating or cooling in ducts, Governing equations, Slope of Rayleigh line, Entropy considerations. Maximum heat transfer (No Derivation-Only Numericals)	
Unit –V	**08 Hrs**
High Speed Wind Tunnel Testing: Types of High Speed Wind Tunnels, Components and Operation Methods, Method of Characteristics-Concepts of Characteristics, Compatibility relations, Moving Normal Shock Waves, Principle of operation of Shock Tubes.	

LABORATORY EXPERIMENTS
1. Calibration of supersonic wind tunnel test section.
2. Determination of shock pattern and pressure distribution over a flat plate at various angles of attack.
3. Supersonic flow studies over a varying concave ramp and determination of flowfield properties.
4. Supersonic flow studies over a varying convex ramp and determination of flowfield properties.
5. Flow visualization through a supersonic inlet and measurement of surface pressure distribution.
6. Flow visualization over delta wing aircraft and measurement of surface pressure distribution at various angles of attack.
7. Determination of oblique shock angle for flow over a wedge and measurement of surface pressure distribution.
8. Determination of oblique shock angle for flow over a cone and measurement of surface pressure distribution.
9. Determination of shock pattern and pressure distribution over a diamond shaped airfoils at various angles of attack.
10. Determination of shock pattern and pressure distribution over a biconvex airfoils at various angles of attack
11. Estimation of aerodynamic characteristics of a missile configuration at various angles of attack.
12. Flow visualization over fore body configurations.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply the thermodynamics concepts in relation to compressible flows and derive relationships between various compressible flow parameters
CO2	Summarize the various properties of compressible flow
CO3	Conclude the behaviour of compressible flows for various aerospace applications
CO4	Evaluate the characteristics of the compressible flows through suitable measuring equipment's.

Reference Books	
1	Modern Compressible Flow with Historical Perspective, Anderson, J. D., 3 edition (1 August 2002) McGraw-Hill Education; ISBN- 978-0072424430
2	Elements of Gas Dynamics, Liepmann, H. W. and Roshko, A., (January 11, 2002), Dover Publications, ISBN- 978-0486419633
3	Gas Dynamics, John, J. E. A. and Keith, T., Prentice Hall (2006) ISBN- 978-0131206687
4	Fundamentals of Gas Dynamics, Zucker, R. D. and Biblarz, O., 2nd Revised edition (13 September 2002), John Wiley & Sons; ISBN- 978-0471059677
5	Fundamentals of compressible flow with Aircraft and Rocket propulsion , S M Yahya, New age international publishers, ISBN-81-224-1468-0

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**. Some of sample topics are: a)Numerical simulation of supersonic bodies at fixed angle of attack with varying Mach number b)Numerical simulation of supersonic bodies at variable angle of attack for a given Mach number	**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: VI						
AVIONICS **Category: PROFESSIONAL CORE COURSE** **(Theory & Practice)**						
Course Code	**:**	AS363IA		**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**
Principle of Avionics: Need for Avionics in civil and military aircraft and space systems, Typical avionics sub systems. **Display and Control systems**– Fundamentals of Head Up Display for Military & Civil aircraft, Helmet Mounted Display & Sights (HMDS), Cockpit Displays - MFD, EFIS & Concept of Glass Cockpit. **Avionic Data Buses** & **Avionic Architectures -** For Civil & Military Aircraft: ARINC-429, Mil-Std-1553, AFDX and CAN Bus. Federated and IMA Architectures.	
Unit – II	**10 Hrs**
Radar and Tracking: Fundamentals of Primary and Secondary Radars, FMCW Radar & Radio Altimeter System, Pulse Doppler Radar, Moving Target Indicator Radar, Limitation of MTI performance. MTI from a moving platform (AMTI), Conical Scan and Sequential lobbing, Mono Pulse Tracking, Airborne Weather Radar, Phased Array Radar (AESA & PESA). **Secondary Radar Systems**-Traffic Collision and Avoidance System (TCAS), Identification of friend or Foe(IFF), Automatic Dependant Surveillance – Broadcast(ADS-B)	
Unit –III	**10 Hrs**
Navigation Systems: **Position Fixing & Dead Reckoning, C**lassification of various Navigation systems, Principle of operation & Components of Inertial Navigation System, Strap down navigation system. **Radio Navigation** - Principle, operation and characteristics of: Radio Direction finder, ADF system, VOR and DVOR, DME & TACAN, Instrument Landing System (ILS), Doppler Navigational System, **Satellite Navigational System** – Basics of Satellite Communication System, Fundamentals of Satellite Navigation, - GNSS architecture, Positioning, Signals & range measurements; GPS, ADS-B, NAVSAT, DGPS, **Integrated Navigation** – INS & GNSS Integration	
Unit –IV	**07 Hrs**
Avionic Systems of UAVs: Sensors used in UAVs, Electrical Power sources, Drone Gyro Stabilisation, IMU and Flight Controllers, Actuators; Command & control Telemetry link**.**	
Unit –V	**08 Hrs**
Air Traffic Control: Air Traffic Control, Various Zones, IFR & VFR Routes, **Guidance Systems:** Basic Guidance system, Types of Guidance systems.	

LABORATORY EXPERIMENTS
1. To learn ARINC 429 Avionic Data Buses and its Terminologies. Understanding ARINC 429 Bus Transmission and Reception using Labels . 2. Understanding ARINC 429 Bus Communication between Simple Tx and Rx. Study of Different Avionics Data Buses and Configuration with Message Transfer with ARINC-429. 3. Understanding ARINC 429 Bus Real time sensor Data Transmission and Reception using Labels. 4. To learn MIL-Std – 1553 Data Buses and its Terminologies Bus Controller, Remote terminal, & Bus Monitor. 5. To understand the programming and Configuration involved in Data Transmission with Mil-1553 Data Bus between Remote Terminal & Bus Controller.

6. Study of Working of Doppler Radar. Using Doppler Radar principle, understand the measurement of Time & frequency measurement with the help of moving pendulum.
7. Using principle of radar, Conduct the study for (i) Alarm system (ii) Detection of Vibrations of Tunning Forks, (iv) Counting of Objects (v) Measuring RPM of a moving Object
8. Study the effect of different types of materials on Radar receiving or detection.
9. Establishing a satellite digital audio/video link between Up-link transmitter & Down-link Receiver, through Satellite Transponder.
10. Verify test digital data transmission and reception using Satellite Transponder Link; Also demonstrate the Directivity of Dish Antenna in Satellite Communication Link.
11. Study of Digital Base band modulation Scheme (BPSK & QPSK), its Time domain analysis & Frequency domain analysis.
12. To perform the bit error rate measurement using internal test data mode and calculate the Carrier to Noise ratio for a satellite link.

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the need and evolution of Avionics and Avionic Architectures
CO2	Understand the fundamentals of cockpit displays, cockpit layouts and various techniques of data transfer in avionic systems.
CO3	Understand the fundamental functioning of various ground & airborne Radio Navigational and Satellite navigational aids as employed in aviation in association with Air Traffic Control.
CO4	Develop the understanding of navigation and control of Unmanned Aerial Vehicles.

Reference Books	
1	Brain Kendal, "Manual of Avionics", The English Book Hause, 3rd Edition, New Delhi, 1993, ISBN:978-0632034727.
2	Spitzer, C.R., "Digital Avionic Systems", Prentice Hall, Englewood Cliffs, N.J., USA., 1987, ISBN:978-1930665125
3	Civil Avionic Systems, Ian Moir, Allan Seabridge, Malcolm Jukes,
4	Middleton, D.H., Ed., "Avionics Systems, Longman Scientific and Technical",Longman Group UK Ltd., England, 1989, ISBN- 9780582018815
5	Military Avionics Systems, Ian Moir, Allan G Seabridge, John Wiley & Sons, 2006 ISBN-13 978-0-470-01632-9,
6	Introduction to Avionics, R P G Collins, 3rd Edition, Springer Dordrecht Heidelberg London, ISBN 978-94-007-0707-8.
7	Principles of GNSS, Inertial, and Multi-sensor Integrated Navigation Systems, Paul D. Groves, 2008, Artech House, ISBN-13: 978-1-58053-255-6

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, Analysing, 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: VI						
STRUCTURAL DYNAMICS **Category: PROFESSIONAL CORE COURSE** **(Theory)**						
Course Code	**:**	AS364TA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:1:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L+30T		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Introduction: Types of vibrations, Definitions, Derivations for spring mass systems, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats phenomenon, Fourier series applied to vibration problems, Numerical on Fourier series, superposition of SHM and beats.	
Unit – II	**10 Hrs**
Damped and Undamped Vibrations: Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations and Problems. Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.	
Unit –III	**09 Hrs**
Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - Magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.	
Unit –IV	**08 Hrs**
Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, Undamped dynamic vibration absorber and Problems.	
Unit –V	**08 Hrs**
Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	State and classify the principle of vibrations
CO2	Analyse and solve the problems associated with damped and un-damped vibrations
CO3	Demonstrate the effect of external excitation on a 1D system and identify their critical parameters
CO4	Evaluate a Multi DOF system for modes of vibration and appreciate the effect of dampers

Reference Books	
1	Mechanical Vibrations, Singiresu S. Rao,6th Edition, 2003, Pearson, ISBN: 978-0134361307
2	Principles of Vibration, Benson H Tongue, 2nd Edition, 2002, Oxford University Press, ISBN: 978-0195106619
3	Theory of Vibration with Applications, Thomson, W.T., 5th Edition, 28 August 1997, Pearson , 978-0136510680
4	Fundamentals of Mechanical Vibrations, Kelly, Har/Dsk Edition, 2000, McGraw Hill Publications, ISBN: 978-0079116611

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**

Semester: VI						
ADVANCED AEROSPACE MANUFACTURING **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.	
Unit – II	**10 Hrs**
Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM – Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics, performance, EDM – principles, equipment, generators, analysis of R-C circuits, MRR , Surface finish, WEDM.	
Unit –III	**09 Hrs**
Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.	
Unit –IV	**08 Hrs**
Additive Manufacturing: Introduction, Need for Additive Manufacturing, Advantages and Limitations of AM, Classification, Distinction between AM and CNC, other related technologies, Stereo lithography Apparatus (SLA), Laminated Object Manufacturing (LOM), Selective laser sintering (SLS): Process, working principle, Layering technology.	
Unit –V	**08 Hrs**
Understanding Lean Manufacturing- Principles of Lean Manufacturing -Basic elements of lean manufacturing, Introduction to LM Tools, Lean revolution in Toyota, Systems and systems thinking, Basic image of lean production, Customer focus, JIT system, Kanban, Kanban rules, Various case studies of implementation of lean manufacturing at industries.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the scope and importance of surface treatment, including methods of cleaning and various surface coating techniques, including ceramic and organic methods.
CO2	Describe the principles, equipment, and process characteristics of Non-Traditional Machining
CO3	Possess in-depth knowledge of ceramic processing and additive manufacturing technologies in aerospace manufacturing
CO4	Familiar with working principles and layering technology of specific additive manufacturing technologies

Reference Books	
1	Manufacturing Engineering and Technology, S. Kalpakjian, and S.R. Schmidt, 7 th Edition, Pearson India, 2009
2	Additive manufacturing technologies, I. Gibson, D. W. Rosen, and B. Stucker New York: Springer. 2010
3	Principles of Modern Manufacturing, M. P. Groover, 5'' Edition, Wiley, India, 20143
4	Rapid prototyping: Principles and Applications - Chua C.., Leong K.F and LIM C.S World Scientific publications , 3rd Edition, 2010.

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**

Semester: VI						
COMPUTATIONAL FLUID DYNAMICS **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDB		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Fundamentals: Application of CFD, Models of flows, Substantial derivative, Divergence of velocity, Continuity, Momentum and Energy equations, derivation in various forms, Integral versus Differential form of equations, Comments on governing equations.	
Unit – II	**10 Hrs**
Mathematical Behaviour of Partial Differential Equations : Classification of partial differential equations, Cramer rule and Eigen value method, Hyperbolic, parabolic and elliptic forms of equations, Impact on physical and computational fluid dynamics, case studies: steady inviscid supersonic flow, unsteady inviscid flow, steady boundary layer flow and unsteady thermal conduction.	
Unit –III	**09 Hrs**
Discretization: Introduction, Finite differences, difference equations, Explicit and implicit approaches, Errors and analysis of stability (FTCS, CTCS & Dufort-Frankel schemes). **Transformations:** Introduction, transformation of the governing partial differential equations, Matrices and the Jacobian of transformation.	
Unit –IV	**08 Hrs**
Numerical Grid Generation : Body–fitted coordinate system, Need for grid generation, Essential properties of grids, Various grid generation techniques - Algebraic, and Numerical grid generation, Elliptic grid generation, Structured, Un-structured grids, Adaptive grids, Grid Stretching.	
Unit –V	**08 Hrs**
Finite Volume Techniques & Solving Techniques: Finite Volume Discretization - Cell Centered Formulation, High resolution finite volume upwind Scheme, Runge - Kutta Time Stepping, Multi - Time –Step Integration scheme, Cell Vertex Formulation, LAX-WENDROFF Technique, Relaxation technique, Point iterative method, Successive over-relaxation/under relaxation, Aspects of numerical dissipation and dispersion, artificial viscosity, The Alternating-Direction- (ADI) Implicit Technique, Approximate factorization scheme, Upwind schemes, Flux vector splitting.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental concepts of computational fluid dynamics
CO2	Derive, formulate and apply suitable governing expressions and methods for solving Physical problems
CO3	Classify the physical problem and convert the same to computational domain with appropriate mathematical conditions
CO4	Evaluate the flow field using different numerical methods of computation and interpret the solution results

Reference Books	
1	John D Anderson Jr., Computational Fluid Dynamics, the Basics with Applications, 1st July, 4th Edition McGraw Hill International Edn, ISBN: 978-1259025969
2	Oleg Zikanov, Essential Computational Fluid Dynamics, 2nd Edition, Willey ,ISBN: 978-1-119-47462-3
3	Date, A. Introduction to Computational Fluid Dynamics, Cambridge University Press. (2005).
4	S. V. Patankar, Numerical Heat Transfer and Fluid Flow, 1st Edition, 1980, CRC Press, ISBN: 978-0891165224

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**

Semester: VI						
HEAT TRANSFER **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDC		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction: Modes of heat transfer-conduction, convection and radiation, Material properties of importance in heat transfer, Thermal conductivity, Specific heat capacity. **Conduction Heat Transfer:** Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation), Numericals. **Transient Conduction:** Lumped parameter analysis, Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere, Numerical problems	
Unit – II	**09 Hrs**
Convective Heat Transfer: Principle of heat flow in fluids, heat transfer coefficient, overall heat transfer coefficient, Velocity boundary layer, Thermal Boundary layer, Significance of dimensionless numbers for internal and external flow (discussion only), Numerical problems. **Forced Convection:** Momentum and Energy equations for hydrodynamic and thermal boundary layer over a flat plate, Dimensional analysis for forced and natural convection, Numerical problems. **Natural Convection:** Empirical correlations of flow around flat vertical plate, horizontal flat surface, horizontal cylinder, sphere and enclosure, Numerical problems	
Unit -III	**09 Hrs**
Radiation Heat Transfer: Introduction to radiation heat transfer, Properties of radiation, Shape factor, Relation between shape factors, radiation heat transfer between non – black bodies, Infinite parallel plates, Radiation shields, Transmissivity, absorptivity and reflectivity, Specular and diffuse surfaces Numericals	
Unit -IV	**10 Hrs**
Introduction to Combustion: Introduction, Applications of Combustion, Types of fuels and various modes of combustion, review of basic thermodynamics, thermodynamic properties, Stoichiometry, Thermo-chemistry, adiabatic temperature, chemical equilibrium, theoretical air – fuel ratio, Numerical problems.	
Unit -V	**08 Hrs**
Chemical Kinetics: Introduction, Rates of reactions and their temperature dependence - The Arrhenius rate expression & Transition state and recombination rate theories, Simultaneous interdependent reactions, Chain reactions, the partial equilibrium assumption, Pressure effect in fractional conversion, Chemical kinetics of large reaction mechanisms – Sensitivity analysis, Rate of production analysis, Coupled thermal and chemical reacting systems & Mechanism simplification	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental concepts of different satellite subsystems
CO2	Demonstrate the working principles of different types of subsystems
CO3	Identify and Classify the required subsystem and its type employed based on the mission
CO4	Compute and Evaluate the fundamental parameters involved in the satellite subsystem design

Reference Books	
1	Heat Transfer, Holman B.K.,McGraw Hill, 9th Edition., 2002, ISBN: 978-0078447853
2	Heat Transfer: Principles and Applications, Dutta B.K., PHI, 2001, ISBN:978-8120316256
3	Heat Transfer, Chapman, A.J, 4th Edition. Maxwell Macmillan International Edition, 1984, ISBN: 978-0023214509
4	Fundamentals of Combustion, D.P. Mishra, 3rd Edition Prentice Hall of India, New Delhi, 2008. ISBN: 978-8120333482

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**

Semester: VI						
SPACE VEHICLE DESIGN **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDD		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
History of rocketry & launch vehicles , Ascent Mission Basics, Force and Geometry Models 1 & 2, Idealized Performance, Current & future launch vehicles. Orbit/trajectory requirements and missions.	
Unit – II	**10 Hrs**
Idealized Performance, Trajectory Under Gravity, Impact of Gravity, Impact of Drag, Δv & initial sizing, inboard profile & layout. Engine selection. Preliminary mass estimation	
Unit –III	**10 Hrs**
Ascent Mission Design, Multi-stage Rocket Concept, Multi-stage Design Basics, Multi-stage Formulation, Optimal Staging Concept, Lagrange's Solution, Approximate Staging Solution	
Unit –IV	**08 Hrs**
Concept of Rocket Variant , Variant Design Solution, Parallel Staging Concept, Relativistic and SSTO Rocket Concepts, Air-breathing Rockets and Ballistic Missiles	
Unit –V	**07 Hrs**
Jet Damping and Spin in Rockets and Missiles, Basics of Rocket Launching, Fundamentals of Re-entry, Typical Re-entry Techniques	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the fundamental concepts of development of various launch vehicle
CO2	Demonstrate the working principles of different types of space vehicle
CO3	Identify and Classify the required systems, trajectory and orbit employed based on the mission requirements
CO4	Compute and Evaluate the fundamental parameters involved in the stage design and vehicle sizing for specific missions

Reference Books	
1	Space Vehicle Design, Griffin and French, AIAA, 2004, ISBN 1563475391
2	Spacecraft Systems Engineering P. Fortescue, J. stark, and G. Swinerd Wiley-Blackwell 4th revised Edition ,2011
3	Manned Spacecraft Design Principles, Sforza, 3rd Edition Elsevier, 2016, ISBN 9780128044254.
4	Elements of Space Technology, R. Meyer, 3rd Edition , Academic Press, 1999, ISBN 0124929400
5	Astronautics, U. Walter, 2nd Edition WILEY-VCH, 2008, ISBN 9783527406852

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: VI						
CRYOGENIC ENGINEERING **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDE		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Introduction to Cryogenics: Introduction, Historical Background, Present areas involving Cryogenics Engineering, Low temperature Properties of Engineering materials, Production of low temperatures, Thermodynamically ideal gas liquefaction system, Joule-Thomson effect, Properties of Cryogenic fluids.	
Unit – II	**10 Hrs**
Gas Liquefaction Systems: Gas liquefaction systems for gases other than Neon, Hydrogen and Helium; Simple Linde-Hampson system, pre cooled Linde Hampson system, Linde dual pressure system; Liquefaction systems for Neon, Hydrogen, Helium; Pre cooled Linde Hampson system for Neon and Hydrogen, Claude system, Simon helium liquefaction system. **Gas Purification Systems:** Gas Purification methods, Physical adsorption, Refrigeration purification, chemical purification	
Unit –III	**10 Hrs**
Gas Separation systems: Thermodynamically ideal gas separation system, properties of mixtures, principles of gas separation, Air separation systems, Hydrogen & Helium separation systems. **Cryogenic measurement systems:** Temperature, Pressure, Flow-rate and liquid-level measurement.	
Unit –IV	**08 Hrs**
Cryogenic fluid storage Systems: Introduction, Basic storage vessels, Dewar vessel, Inner vessel, outer vessel design, Piping, safety devices **Vacuum Technology:** Importance of Vacuum technology in cryogenics, Degree of Vacuum, components of Vacuum system, mechanical vacuum pumps, Diffusion pumps, Ion pumps, Cryopumping.	
Unit –V	**07 Hrs**
Cryogenic insulations: Expanded Foam Insulations, Gas Filled Powders & Fibrous Insulations, Vacuum Insulations, Multilayer Insulations, Liquid Shielded Vessels, Vapour Shielded Vessels. **Applications of Cryogenics in Propulsion & Space Technology:** Cryogenic Propulsion, Cryogenic Aircraft Development, Cryogenic Propellants, Cryogenic injections, Cryogenic Engine, Cryogenics for space Applications.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Summarize the important parameters required in achieving low temperature environment addressing certain areas of engineering applications
CO2	Identify technically suitable thermodynamic cycles to liquefy and separate gas such as hydrogen, helium, neon etc
CO3	Adopt feasible techniques for technically and economically producing cryogenic materials
CO4	Explain the importance of storing and insulating cryogenic materials

Reference Books	
1	Cryogenics Systems, Randall F. Barron, 2nd Edition, 1985, Oxford University Press, New York ISBN-978-0195035674.
2	Cryogenic Engineering, Thomas M. Flynn, 2nd Edition, 2005 CRC press, New York, ISBN-978-8126504985
3	Cryogenics: Applications and Progress, A Bose and P. Sengupta, 1987, Tata McGraw Hill, ISBN- 978-0074600368
4	Cryogenic Process Engineering, Timmerhaus, Flynn, 1989Plenum Press, New York, ISBN- 978-1-4684-8756-5
5	Randall F. Barron, Cryogenics Systems, 2nd Edition, 1985, Oxford University Press, New York ISBN-978-0195035674.

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: VI						
PRODUCT DESIGN AND DEVELOPMENT FOR AEROSPACE APPLICATIONS **Category: PROFESSIONAL CORE ELECTIVE-III (GROUP-D)** **(Theory)**						
Course Code	**:**	AS365TDF		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Design and Development Process & Systems Engineering Overview: - Overview of current industry trends, Overview of MBE and Significance of Digital Twin - Fundamentals of Systems Engineering, Common Technical Processes - Overview of the general design and development process, Release processes, Configuration Management, ChangeManagement	
Unit – II	**10 Hrs**
Requirements Management & System Safety Assessment: - Need for requirements, Writing good requirements, , Kano model, Context Diagram, Mind Map - Industry Standards, General requirements, Functional requirements, Design specific requirements, Performancerequirements - Requirement Tier, Validation & Verification, Compliance Matrix - System Safety Overview, FHA, FTA, FMEA, PRA, CMA	
Unit –III	**09 Hrs**
Design & Development: - Design conceptualization, Preparation of conceptual layouts, Guidelines from Industrial-standards pertaining tothe design requirements - Finalizing a layout design, Sizing of components from the finalized layout design, Material Selection, heattreatment and finishes, Types of fits - Preparation of detail and assembly drawings, GD&T, Tolerance stack up - Design review, Uploading in PLM database, Release of drawings for production	
Unit –IV	**08 Hrs**
Analysis: - Understanding the Structure and Its Design Requirements, Structural Reduction, Understanding Material - Structural Parameters, Load Calculations and Load Path, Analysis Requirements, Initial Sizing, Performing DetailedAnalysis Process, Structural Changes Using Analysis Outputs - Structural Analysis Reports/ Strength Check Notes, Structural Tests / Analysis Validation	
Unit –V	**08 Hrs**
Verification: - Qualification Plan, Qualification Procedure, Analysis & Significance, Qualification Report – Test, Similarity, Analysis,Inspection - Certification and its significance - In-service Issues	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Apply Modern Engineering Practices and Digital Technologies
CO2	Develop and Manage Comprehensive System Requirements
CO3	Execute Comprehensive Design and Development Processes
CO4	Ensure System Safety and Compliance Through Analysis and Verification

Reference Books	
1	"Systems Engineering Handbook", NASA, 2019
2	"Systems Engineering Fundamentals", Defense Acquisition University Press, 2001
3	SAE ARP4754A - (R) Guidelines for Development of of Civil Aircraft and Systems, SAE International
4	"Strategic Systems Engineering for Functional and Logical Structures", Take Control, Whitepaper, Dassault Systèmes, 2012
5	SAE ARP5580 - Recommended Failure Modes and Effects Analysis (FMEA) Practices for Non-Automobile Applications, SAE International
6	SAE ARP4761 - Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, SAE International
7	"Materials Selection in Mechanical Design", Michael F. Ashby, Elsevier Science
8	ASME Y14.5.2, Certification of Geometric Dimensioning and Tolerancing Professionals, 2000
9	"Shigley's Mechanical Engineering Design", J. Keith Nisbeth & Richard G. Budynas, McGraw Hill LLC
10	"Finite Element Procedures", Klaus-Jürgen Bathe, Prentice Hall
11	"An Introduction to the Finite Element Method", J.N. Reddy, McGraw-Hill Education
12	Completing the Certification Process, FAA

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. **Total Mark will be reduced to 40 MARKS**.	**40**

Project Step:
Form groups of 3 - having mixed skills
Select a common medium complex product for redesign/reverse engineer
Develop requirements for the product
Design the product to meet the requirements
Verify if product meets the requirement
System integration (as needed)
Submit report having Compliance Matrix, Detail Design with BoM and Supporting Documentations & Verification Artifacts

Evaluation Criteria:		*Marks*
Minor Submission		
After Concept Design Selection (Before Mid-Sem)		
1	- 3 levels of requirements - T1, T2, T3 - 3 Concept & concept selection criteria	15
After Layout Drawing		

		Creation (After Mid-Sem before End-Sem)			
		2	- Compliance Matrix and verification methods established - Layout drawing with GD&T and stackup - Analysis approach defined	15	
		Major Submission			
		Preliminary Design Review - PDR (Mid-Sem)			
		1	- Problem definition - System / Sub-system definition - Compliance Matrix with 3 tiers and validation completed - Concept Selection - Preliminary Design proposal - Preliminary analysis/hand-calculation to show compliance	20	
		Critical Design Review - CDR (End-Sem)			
		2	- Compliance Matrix with verification plan - System / Sub-system definition - Detail design - Analysis report - Qualification test plan and procedure for atleast 1 - Certification plan	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: VI						
FUNDAMENTALS OF AEROSPACE ENGINEERING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	AS266TEA		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	45L		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Basics of Flight Vehicles: History of aviation, International Standard atmosphere (ISA), Temperature, pressure and altitude relationships, Simple Problems on Standard Atmospheric Properties, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions.	
Unit – II	**10 Hrs**
Aircraft Aerodynamics: Bernoulli's theorem, Centre of Pressure, Lift and Drag, Types of Drag, Aerodynamic Coefficients, Aerodynamic Centre, Wing Planform Geometry, Airfoil Nomenclature, Basic Aerodynamic characteristics of Airfoil, Simple Numericals on Lift and Drag.	
Unit –III	**12 Hrs**
Aerospace Propulsion: Introduction, Turbine Engines: Brayton Cycle, Operation of Turbojet, Turboprop, Turbofan, Turboshaft, RAMJET and SCRAMJET Engines, Rocket Engines: Principles of operation of Solid, Liquid, Hybrid, Nuclear and Electric Rockets. Introduction to Space Mechanics: Basic Orbital Mechanics-Types of Trajectories, Escape and Orbital Velocities, Kepler's Laws of Planetary Motion, Simple Numericals.	
Unit –IV	**06 Hrs**
Aerospace Structures and Materials: General types of construction-Monocoque, Semi-Monocoque & Geodesic, Structure of Wing and Fuselage, Metallic and Composite Materials.	
Unit –V	**08 Hrs**
Aircraft Systems & Instruments: Instrument Displays, Basic Air data systems & Pitot Probes- Mach meter, Air speed indicator, Vertical speed indicator, Altimeter. **Basics of Aircraft Systems:** Hydraulic and pneumatic systems, Electrical System, Aircraft Fuel System, Environmental Control System.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Identify the fundamental nuances of Aerospace Engineering and appreciate their significance on the Flight Vehicles design and performance
CO2:	Interpret the design parameters that influence the design of the Aerospace Vehicles systems and its sub-systems
CO3:	Evaluate critically the design strategy involved in the development of Aerospace vehicles
CO4:	Categorically appraise the operation of the Aerospace Vehicles for different operating conditions

Reference Books	
1	Introduction to Flight, John D. Anderson, 7th Edition, 2011, McGraw-Hill Education, ISBN 9780071086059.
2	Fundamentals of Aerodynamics, Anderson J .D, 5th Edition, 2011, McGraw-Hill International Edition, New York ISBN:9780073398105.
3	Rocket Propulsion Elements, Sutton G.P., 8th Edition, 2011, John Wiley, New York, ISBN: 1118174208, 9781118174203.
4	Aircraft structural Analysis, T.H.G Megson, 2010, Butterworth-Heinemann Publications, ISBN: 978-1-85617-932-4
5	Ian Moir, Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", John Wiley & Sons, 3rd edition, 2011, ISBN: 9781119965206

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: VI						
BIOINFORMATICS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**BT266TEB**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**		**SEE Duration**	**:**	**3Hours**

Unit-I	**09 Hrs**
Introduction to tools and databases: Introduction to Bioinformatics, Goals, Scope, Applications, Sequence databases, Structure databases, Special databases – genome and microarray, Applications of these databases, examples, Database similarity search: Unique requirements of database searching, Heuristic Database Searching, Basic Local Alignment Search Tool (BLAST), FASTA, Comparison of FASTA and BLAST, Database Searching with Smith-Waterman Method	
Unit – II	**09 Hrs**
Sequence Analysis: Types of Sequence alignment -Pairwise and Multiple sequence alignment, Alignment algorithms, Scoring matrices, Statistical significance of sequence alignment. Multiple Sequence Alignment: Scoring function, Exhaustive algorithms, Heuristic algorithms, Profiles and Hidden Markov Models: Position-Specific scoring matrices, Profiles, Markov Model and Hidden Markov Model, Scoring matrices – BLOSSUM and PAM **Molecular Phylogenetics:** Introduction, Terminology, Forms of Tree Representation. Phylogenetic Tree Construction Methods - Distance-Based, Character-Based Methods and Phylogenetic Tree evaluation.	
Unit –III	**09 Hrs**
Introduction to Next-Generation Sequencing (NGS) analysis: Sanger sequencing principles - history and landmarks, of Sequencing Technology Platforms, A survey of next-generation sequencing technologies, A review of DNA enrichment technologies, Base calling algorithms, Base quality, phred values, Reads quality checks, Interpretations from quality checks. Adapter and primer contamination. Processing reads using clipping of reads-Advantages and disadvantages of processing of reads, automation in NGS analysis and advantages (shell scripting)	
Unit –IV	**09 Hrs**
Structural analysis & Systems Biology: Gene prediction programs – ab initio and homology-based approaches. ORFs for gene prediction. Detection of functional sites and codon bias in the DNA. Predicting RNA secondary structure, Protein structure basics, structure visualization, comparison and classification. Protein structure predictive methods using protein sequence, Protein identity based on composition. Structure prediction - Prediction of secondary structure, tertiary structure prediction methods, Scope, Applications. Concepts, implementation of systems biology, Mass spectrometry and Systems biology, Flux Balance analysis.	
Unit –V	**09 Hrs**
Drug Screening: Introduction to Computer-aided drug discovery, target selection, ligand preparation and enumeration, molecular docking, post-docking processing, molecular dynamics simulations, applications and test cases, AI/ML in Drug discovery	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Gain proficiency in utilizing a range of bioinformatics tools and databases for comprehensive sequence and structural analysis.
CO2	Investigate and apply innovative sequencing technologies and analytical methods to solve complex biological questions and advance research in genomics and molecular biology.
CO3	Demonstrate expertise in NGS technologies, including performing data quality assessments, read processing, and managing large-scale data.
CO4	Apply bioinformatics tools for modeling and simulating biological processes, with a focus on gene prediction using both ab initio and homology-based approaches.

Reference Books	
1.	Xiong J. Essential bioinformatics. Cambridge University Press; 2006 Mar 13.
2.	Buehler LK, Rashidi HH, editors. Bioinformatics basics: applications in biological science and medicine. CRC Press; 2005 Jun 23.
3.	Ghosh Z, Mallick BM. Bioinformatics principles and Applications. Oxford University Press; 2018 Jun 13.
4.	Low L, Tammi MT. Introduction to next generation sequencing technologies. Bioinformatics. WORLD SCIENTIFIC. 2017 Jul 26:1-21.
5.	Bioinformatics: Sequence and Genome Analysis; D W Mount; 2014; CSHL Press; 2nd edn; ISBN: 9780879697129.
6.	Computational Systems Biology; A Kriete and R Eils; 2006; Academic Press; Illustrated edn; ISBN: 978-01-208-87866.

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; wherein one sub division will be a caselet in the related topics)	
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: VI						
INDUSTRIAL SAFETY ENGINEERING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**CH266TEC**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3Hours**

Unit-I	**08 Hrs**
Introduction Safety: Introduction to industrial safety engineering, major industrial accidents, safety and health issues, key concepts and terminologies, Hazard theory, Hazard triangle, Hazard actuation, Actuation transition, Causal factors, problems on OSHA	
Unit – II	**08 Hrs**
Risk assessment and control: Risk assessment, Risk perception, acceptable risk, problems on net present value, internal rate of return, payback period concepts including real life examples. **Hazard Identification Methods:** Preliminary Hazard List (PHL), worksheets, case study. Preliminary Hazard Analysis (PHA), Fault tree and Event tree analysis. Design and development of fault tree and event tree for high pressure reactor system.	
Unit –III	**08 Hrs**
Hazard analysis: Hazard and Operability Study (HAZOP): Guide words, HAZOP matrix, Procedure, HAZOP studies on reactors, heat exchanger, design of HAZOP table, Failure Modes and Effects Analysis (FMEA) concept, methodology, problems of FMEA, examples.	
Unit –IV	**08 Hrs**
Risk analysis on capital budgeting: Risk adjusted discount rate (RADAR) method, certainty equivalent approach, scenario analysis, probability distribution, quantification of risk using statistical parameters and associated problems.	
Unit –V	**08 Hrs**
Safety in process industries and case studies: Personnel Protection Equipment (PPE): Safety glasses, face shields, welding helmets, absorptive lenses, hard hats, types of hand PPE, types of foot PPE, types of body PPE. Bhopal gas tragedy, Chernobyl nuclear disaster, Chemical plant explosion and fire.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the risk assessment techniques used in process industry
CO2	Interpret the various risk assessment tools.
CO3	Use hazard identification tools for safety management.
CO4	Analyze tools and safety procedures for protection in process industries.

Reference Books	
1.	Functional Safety in the Process Industry: A Handbook of practical Guidance in the application of IEC61511 and ANSI/ISA-84, Kirkcaldy K.J.D Chauhan, 2012, North corolina,Lulu publication, ISBN:1291187235.
2.	Safety Instrumented Systems Verification Practical probabilistic calculations, Goble and William M., 2005, Pensulvania ISA publication, ISBN:155617909X.
3.	Industrial safety and risk Management, Laird Wilson and Doug Mc Cutche, 1st Edition, 2003,The University of alberta press,Canada, ISBN: 0888643942.
4.	ndustrial Safety, Health and Environment Management Systems, R K Jain, Sunil S Rao, 4th Edition, 2005, Khanna Publishers, New Delhi, ISBN: 8174092102.

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. Each test will be evaluated for 50 Marks, adding upto 150 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; wherein one sub division will be a caselet in the related topics)	
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: VI						
ROBOTOC PROCESS AUTOMATION **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**CS266TED**		**CIE**	**:**	**100**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100**
Total Duration	**:**	**36L**		**SEE Duration**	**:**	**3 Hrs**

Unit – I	**8 Hrs**
RPA Concepts: RPA Basics, History of Automation, what is RPA? RPA vs Automation, Processes & Flowcharts, Programming Constructs in RPA, What Processes can be Automated? Types of Bots, Workloads that can be automated. **RPA Advanced Concepts**: Standardization of processes, Setting up the Centre of Excellence, RPA Development methodologies, Difference from SDLC, RPA journey, RPA business case, RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.	
Unit – II	**7 Hrs**
RPA Tool Introduction: Introduction to UiPath - the User Interface, Types of Variables, Variables in UiPath, Managing Arguments, The Arguments Panel, Namespaces; Control flow statements in UiPath, Sequences and Flowcharts, Control Flow Activities Data Manipulation Introduction, Data Manipulation Operations, Types of data storing variables, Text Manipulation, main string methods. **UiPath Recording:** Basic, Desktop and Web Recording, Image and Native Citrix Recording, Input/output methods, Types of OCR, Data Scraping, Advanced Scraping techniques.	
Unit-III	**7 Hrs**
Advanced Automation Concepts: Selectors, Types of Selectors (Full, partial, dynamic), Defining and Assessing Selectors, Customization, Debugging. Image, Text & Advanced Citrix Automation – Introduction, Keyboard based automation, Information Retrieval, Best Practices Excel Data Tables & PDF, Data Tables in RPA, Excel and Data Table, Extracting Data from Data Table, Anchors, Using anchors in PDF	
Unit – IV	**7 Hrs**
Email Automation, Exceptions and Deploying Bots: Introduction to Email Automation, Key concepts of email, email protocols, email automation in UiPath, email as input and output. Debugging and Exception Handling, Types of exception, Debugging Tools, Strategies for solving issues, Catching errors. Overview of orchestration Server, orchestrator functionalities, Connecting Bot to orchestrator	
Unit – V	**7 Hrs**
Hyperautomation: Components and application ofHyperautomation, Automation versus hyperautomation, Benefits and challenges of hyperautomation, use cases,Phases (Integration, Discover, Orchestration and Governance), Trends in Hyperautomation (low-code/no-code platform, HaaS)	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand RPA principles, its features and applications
CO2	Demonstrate proficiency in handling variables and decision making inside a workflow and data manipulation techniques
CO3	Gain insights into recording, Email Automation and exception handling and orchestrator.
CO4	Analyze the trends in automation and chose business strategy to design a real-world automation workflow.

Reference Books:	
1.	Alok Mani Tripathi, "Learning Robotic Process Automation, Publisher: Packt Publishing, Release Date: March 2018 ISBN: 9781788470940
2.	PASCAL BORNET, Intelligent automation: Welcome to the world of hyperautomation, World Scientific Publishing Company, ISBN-13: 978-9811235481 December 2020
3.	UiPath pdf manuals
4.	https://www.uipath.com/rpa/robotic-process-automation
5.	https://www.ibm.com/topics/hyperautomation
6.	https://www.pega.com/hyperautomation

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. Each test will be evaluated for 50 Marks, adding upto 150 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 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: VI						
INTELLIGENT TRANSPORTATION SYSTEMS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**CV266TEE**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**40L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction to Intelligent Transportation Systems **(**ITS): Historical background, Urbanisation, Motorisation, Transport system characteristics, Transport problems and issues, Challenges and opportunities in ITS: ITS-Today and tomorrow, ITS training and education needs, Role and importance of ITS in context of Indian Transport system and opportunity for sector growth of ITS.	
Unit – II	**10 Hrs**
ITS Architecture: introduction, Functionalities required for User service, Logical architecture, Physical architecture, Equipment and Market packages, Need of ITS Architecture to solve problems in Urban area. Technology building blocks for ITS: Introduction, Data acquisition, Communication tools, Data analysis and Traveller information. Various detection, Identification and collection methods for ITS.	
Unit –III	**12 Hrs**
Traffic management system components and ITS: Introduction, objectives, traffic management measures, ITS for traffic management, Development of traffic management system, Traffic Management Centre, Advance Traffic Management System, Advanced Traveller Information System, Advance Vehicle Control Systems, Advance Public Transport System, Commercial Vehicle Operations, ITS For Intermodal Freight Transport.	
Unit –IV	**06 Hrs**
ITS Evaluation – Project selection at the planning level, Deployment Tracking, Impact Assessment, Benefits by ITS components, Evaluation Guidelines. ITS for Law Enforcement: Introduction, Enhance and support the enforcement traffic rules and regulations, ITS Funding options.	
Unit –V	**08 Hrs**
ITS Standards-Standard development process, National ITS architecture and standards, ITS standards application areas, National Transportation Communications for ITS Protocol, Standards testing. ITS for smart cities and Case studies.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Identify and apply ITS applications at different levels
CO2:	Illustrate ITS architecture for planning process
CO3:	Examine the significance of ITS for various levels
CO4:	Compose the importance of ITS in implementations

Reference Books	
1	Pradip Kumar Sarkar and Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Private Limited, Delhi,2018, ISBN-9789387472068
2	Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning" Artech House publishers (31 March 2003); ISBN-10: 1580531601
3	Bob Williams, "Intelligent transportation systems standards", Artech House, London, 2008. ISBN-13: 978-1-59693-291-3
4	Asier Perallos, Unai Hernandez-Jayo, Enrique Onieva, Ignacio Julio García Zuazola "Intelligent Transport Systems: Technologies and Applications" Wiley Publishing ©2015, ISBN:1118894782 9781118894781,
5	R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Third Edition, 2004, ISBN-13: 978-0-13-459971-7.

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: VI						
INTEGRATED HEALTH MONITORING OF STRUCTURES **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**CV266TEF**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance, Importance of maintenance **Structural Health Monitoring**: Concepts, Various Measures, Analysis of behavior of structures using remote structural health monitoring, Structural Safety in Alteration.	
Unit – II	**10 Hrs**
Materials: Piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique, Sensor technologies used in SHM **Structural Audit**: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures, SHM using Artificial Intelligence	
Unit –III	**12 Hrs**
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.	
Unit –IV	**06 Hrs**
Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.	
Unit –V	**08 Hrs**
Remote Structural Health Monitoring: Introduction, Hardware for Remote Data Acquisition Systems, Advantages, Case studies on conventional and Remote structural health monitoring **Case studies:** Structural Health Monitoring of Bridges, Buildings, Dams, Applications of SHM in offshore Structures- Methods used for non-destructive evaluation (NDE) and health monitoring of structural components	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Diagnose the distress in the structure understanding the causes and factors.
CO2:	Understand safety aspects, components and materials used in Structural Health Monitoring.
CO3:	Assess the health of structure using static field methods and dynamic field tests.
CO4:	Analyse behavior of structures using remote structural health monitoring

Reference Books	
1	Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes,2006, John Wiley and Sons, ISBN: 978-1905209019
2	Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, 2007,John Wiley and Sons, ISBN:9780470033135
3	Structural Health Monitoring and Intelligent Infrastructure, J. P. Ou, H. Li and Z. D. Duan, Vol1,2006,Taylor and Francis Group, London, UK. ISBN: **978-0415396523**
4	Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, 2007,Academic Press Inc, ISBN: 9780128101612

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: VI						
ADVANCED ENERGY STORAGE FOR E-MOBILITY **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**			**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	3:0:0		**SEE**	**:**	**100 Marks**
Total Hours	**:**	42L		**SEE Duration**	**:**	**3.00 Hours**

Course Learning Objectives: The students will be able to

1	Understand the fundamentals and technologies of energy storage in electric vehicles
2	Analyze and compare advanced battery technologies for e-mobility
3	Impart the principles of electrochemistry for analyzing issues in electric/hybrid vehicles.
4	Develop solutions for battery management systems and recycling of advanced storage devices.

Unit-I	**07 Hrs**
Energy storage in electric vehicles Introduction to E-mobility, background of alternative energy sources and sustainability. Types of electric vehicles and their salient features along with their energy requirement. Fundamentals of advanced battery technology. Battery characteristics. Specification of advanced battery for e mobility.	
Unit – II	**08 Hrs**
Advanced lithium-ion batteries Basic concepts of lithium batteries. Types of advanced cathode and anode materials employed in lithium batteries. Construction, working and future applications of lithium cobalt oxide, lithium iron phosphate, Lithium air, lithium sulfur and lithium polymer batteries with their advancement in vehicle electrification.	
Unit –III	**09 Hrs**
Non lithium batteries for e mobility Limitations of lithium batteries. Overview of non-lithium battery technology. Construction and working of advanced non-Lithium batteries such as Lead acid, Nickel Metal Hydride, Redox flow, Zebra, Sodium and Magnesium batteries. Electrode materials and electrolyte considerations in non lithium batteries. Performance comparison with lithium-ion batteries. Battery requirement in charging infrastructure.	
Unit –IV	**09 Hrs**
Chemistry of alternative storage devices Introduction to super capacitor. Construction, working and applications of supercapacitors along with the materials used in electrodes. Types of advanced supercapacitors. Application of supercapacitors in regenerative braking. Advancement in battery-supercapacitor hybrid, Battery-fuel cell hybrid, and Battery-solar cell hybrid electric vehicles with their advantages and limitations.	
Unit –V	**09 Hrs**
Battery management and recycling: Battery management systems (BMS): Fundamentals of battery management systems and controls, State-of-charge (SoC), state-of-health (SoH) and Cell balancing techniques. Battery Thermal Management: Passive and active cooling systems. Safety mechanisms, thermal runaway and thermal management. Battery recycling: Economic aspects, environmental safety and process of recycling of advanced batteries.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Implement the fundamentals of chemistry in advanced energy storage and conversion devices.
CO2:	Apply the chemistry knowledge used for hybridization of various energy storage and conversion devices.
CO3:	Analyze the different battery system for achieving maximum energy storage for vehicle electrification
CO4:	Evaluation of efficiency of a battery with respect to cost, environmental safety, material, energy consumption and recycling.

Reference Books	
1	Battery reference book, T. R. Crompton., 3rd edition, NEWNES Reed Educational and Professional Publishing Ltd 2000, ISBN: 07506 4625 X.
2	Batteries for Electric Vehicles, D. A. J. Rand, R. Woods, and R. M. Dell, Society of Automotive Engineers, Warrendale PA, 2003. ISBN 10: 0768001277.
3	Lithium Batteries, Science and Technology, GA. Nazri and G. Pistoa, Kluwer Academic Publisher, 2003, ISBN 978-0-387-92675-9.
4	Battery Technology Handbook, H. A. Kiehne, Marcel Dekker, NYC, 2003. ISBN: 0824742494 9780824742492.
5	Electric Vehicle Technology Explained, James Larminie and John Lowry. 2nd Edition, Wiley, ISBN-13: 978-1118505429.
6	Electric Vehicle Technology and Design, Antoni Gandia. CRC Press, ISBN-13: 978-1138551912.
7	Sustainable Transportation: Problems and Solutions. William R. Black, The Guilford Press, ISBN-13: 978-1462532072.

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: VI						
HUMAN MACHINE INTERFACE (HMI) **Category: Institutional Electives-I GROUP-E** **(Theory)** **Industry Assisted Elective-BOSCH**						
Course Code	**:**	**EC266TEH**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**03 Hrs**

Unit-I	**09 Hrs**
Foundations of HMI: The Human: History of User Interface Designing, I/O channels, Hardware, Software and Operating environments, The Psychopathology of everyday Things, Psychology of everyday actions, Reasoning and problem solving. The computer: Devices, Memory, Processing and networks. Interaction: Models, frameworks, Ergonomics, styles, elements, interactivity, Paradigms. **Introduction to HMI and Domains**: Automotive, Industrial, CE, Medical, ECUs within car and their functionalities. Interaction between ECUs. Communication protocols for ECUs(CAN, LIN, Most, FlexRay, Ethernet etc)	
Unit – II	**09 Hrs**
Automotive Human-Machine Interfaces: Automotive infotainment system - Evolution road map, Feature sets, System architecture, Trends, Human factors and ergonomics in automotive design, Automotive User Experience (UX) Design Principles, In-Vehicle Information Systems (IVIS), Driver-Assistance Systems (DAS) Interfaces, HMI design for adaptive cruise control, Voice and Gesture Recognition in Automotive HMIs, Touchscreen Interfaces and Controls, Usability Testing and Evaluation in Automotive HMIs, Safety Considerations and Regulations in Automotive HMIs, Emerging Technologies in Automotive HMIs, Human-Machine Interfaces for Autonomous Vehicles	
Unit –III	**09 Hrs**
UX and Guidelines: Introduction to UX design - stages, theory, Design thinking, UX Study, Interaction concepts, Graphic design tools - Adobe Photoshop, Adobe XD, Blender, GIMP, Asset Design - Overview, Guidelines and norms, 2D/3D rendering, OpenGL, OSG.	
Unit –IV	**09 Hrs**
HMI User Interface: User-centered HMI development process, Basics of Web-Server. Web-based HMI: Basics of TwinCAT and HTML, CSS, JavaScript. **HMI on Mobile**: Four Principles of Mobile UI Design, Benefits of Mobile HMIs, Mobile HMI Development Suites.	
Unit –V	**09 Hrs**
HMI Control Systems: Introduction to Voice-Based HMI, Gesture-Based HMI, Sensor-Based UI controls. **Haptics in Automotive HMI**: Kinesthetic Feedback Systems, Tactile Feedback Systems, Haptics in Multimodal HMI, Automotive Use-Cases **HMI Testing**: Limitations of Traditional Test Solutions, Case - Study: Bosch's HMI validation tool - Graphics Test Systems (GTS). **UI analytics**: Usage patterns, Debugging, Performance Profiling, Use Cases.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understanding the application of HMIs in various domain.
CO2	Comparison of various communication protocols used in HMI development.
CO3	Apply and analyse the car multimedia system free software and hardware evolution.
CO4	Design and evaluate the graphic tools and advanced techniques for creating car dashboard multimedia systems.

Reference Books	
1.	Touch based HMI; Principles and Applications, Shuo gao, Shuo Yan, Hang Zhao, Arokia Nathan, Springer Nature Switzerland AG, 1st Edition.
2.	Unity 2020 by Example: A Project based guide to building 2D, 3D augmented reality and Virtual reality games from sratch, Robert Wells, Packt Publishing ltd, 2020.
3.	GUI Design and Android Apps, Ryan Cohen, Tao Wang, Apress, Berkley, CA,2014.

RUBRIC FOR THE CONTINUOUS INTERNAL EVALUATION (THEORY)		
#	COMPONENTS	MARKS
1.	**QUIZZES:** Quizzes will be conducted in online/offline mode. TWO QUIZZES will be conducted & Each Quiz will be evaluated for 10 Marks. **THE SUM OF TWO QUIZZES WILL BE THE FINAL QUIZ MARKS.**	**20**
2.	**TESTS:** Students will be evaluated in test, descriptive questions with different complexity levels (Revised Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating). TWO tests will be conducted. Each test will be evaluated for 50 Marks, adding up to 100 Marks. **FINAL TEST MARKS WILL BE REDUCED TO 40 MARKS.**	**40**
3.	**EXPERIENTIAL LEARNING:** Students will be evaluated for their creativity and practical implementation of the problem. Case study-based teaching learning (10), Program specific requirements (10), Video based seminar/presentation/demonstration (20**) Phase 2 will be done in the exhibition mode (Demo/Prototype/any outcome). ADDING UPTO 40 MARKS**.	**40**
	MAXIMUM MARKS FOR THE CIE	**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: VI						
ENERGY AUDITING & STANDARDS **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	**EE266TEJ**		**CIE**	**:**	50 Marks
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	50 Marks
Total Hours	**:**	**45 L**		**SEE Duration**	**:**	2 Hours

Unit-I	**06 Hrs**
Types of Energy Audit and Energy-Audit Methodology: Definition of Energy Audit, Place of Audit, Energy – Audit Methodology, Financial Analysis, Sensitivity Analysis, Project Financing Options, Energy Monitoring and Training. **Survey Instrumentation:** Electrical Measurement, Thermal Measurement, Light Measurement, Speed Measurement, Data Logger and Data Acquisition System, **Energy Audit of a Power Plant:** Indian Power Plant Scenario, Benefit of Audit, Types of Power Plants, Energy Audit of Power Plant.	
Unit – II	**10 Hrs**
Electrical-Load Management: Electrical Basics, Electrical Load Management, Variable Frequency Drives, Harmonics and its Effects, Electricity Tariff, Power Factor, Transmission and Distribution Losses. **Energy Audit of Motors:** Classification of Motors, Parameters related to Motors, Efficiency of a Motor, Energy Conservation in Motors, BEE Star Rating and Labelling. **Energy Audit of Pumps, Blowers and Cooling Towers:** Pumps, Fans and Blowers, Cooling Towers	
Unit –III	**09 Hrs**
Communication & Standards: **Wireless technologies:** WPANs, LAN, Wireless metropolitan area network, cellular network, satellite communication, Zigbee, Bluetooth, LAN, NAN **Wireline communication:** Phone line technology, powerline technology, coaxial cable technology; Optical communication, TCP/IP networks	
Unit –IV	**09 Hrs**
Energy Audit of Boilers: Classification of Boilers, Parts of Boiler, Efficiency of a Boiler, Role of excess Air in Boiler Efficiency, Energy Saving Methods. **Energy Audit of Furnaces:** Parts of a Furnace, classification of Furnaces, Energy saving Measures in Furnaces, Furnace Efficiency **Energy Audit of Steam-Distribution Systems :** S team as Heating Fluid, Steam Basics, Requirement of Steam, Pressure, Piping, Losses in Steam Distribution Systems, Energy Conservation Methods	
Unit-V	**09 Hrs**
Energy Audit of Lighting Systems: Fundamentals of Lighting, Different Lighting Systems, Ballasts, Fixtures (Luminaries), Reflectors, Lenses and Louvres, Lighting Control Systems, Lighting System Audit, Energy Saving Opportunities. **Energy Audit Applied to Buildings:** Energy – Saving Measures in New Buildings, Water Audit, Method of Audit, General Energy – Savings Tips Applicable to New as well as Existing Buildings.	

Course Outcomes: After completing the course, the students will be able to: -	
CO 1	Explain the need for energy audit, prepare a flow for audit and identify the instruments needed.
CO 2	Design and perform the energy audit process for electrical systems.
CO 3	Design and perform the energy audit process for mechanical systems
CO 4	Propose energy management scheme for a building

Reference Books	
1.	Handbook of energy audit, Sonal Desai, Kindle Edition, 2015, McGraw Hill Education, ISBN: 9339221346, 9789339221348.
2.	Energy management handbook, Wayne C Turner and Steve Doty, 6th Edition, 2015, CRC Press, ISBN: 0-88173-542-6.
3.	Energy management, Sanjeev Singh and Umesh Rathore, 1st Edition, 2016, Katson Books, ISBN 10: 9350141019, ISBN 13: 9789350141014.
4.	Energy audit of building systems, Moncef Krarti, 2nd Edition, 2010, CRC Press ISBN: 9781439828717

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

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

Semester: VI						
BIOMEDICAL INSTRUMENTATION **Category: Institutional Elective** **(Theory)**						
Course Code	**:**	**EI266TEK**		**CIE**	:	100 Marks
Credits: L:T:P	**:**	**3:0:0**		**SEE**	:	100 Marks
Total Hours	**:**	**45L**		**SEE Duration**	:	03 Hrs

Unit-I	**09 Hrs**
Fundamentals: Sources of Biomedical signals, Basic medical instrumentation system, General constraints in design of medical instrumentation systems. **Bioelectric Signals and Electrodes**: Origin of bioelectric signals, Types of bioelectric signals, Recording electrodes, Electrode-tissue interface, Polarization, Skin contact impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.	
Unit – II	**09 Hrs**
Electrocardiograph: Electrical activity of heart, Genesis and characteristics of Electrocardiograph (ECG), Block diagram description of an Electrocardiograph, ECG lead systems, Multi-channel ECG machine. **Electroencephalograph:** Genesis of EEG, Block diagram description of an EEG, 10-20 Electrode system, Computerized analysis of EEG.	
Unit –III	**09 Hrs**
Patient Monitoring System: Bedside monitors, Central Monitors, Measurement of Heart Rate, Average Heart Rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Blood Pressure measurement, Direct and indirect method, Automatic blood pressure measuring apparatus using Korotkoff's method. **Oximeters:** Oximetry, ear oximeter, pulse oximeter, skin reflectance oximeter and intravascular oximeter.	
Unit –IV	**09 Hrs**
Blood Flow Meters: Electromagnetic blood flow meter, Types of electromagnetic blood flow meters, Ultrasonic blood flow meters, NMR blood flow meters, Laser Doppler blood flow meters. **Cardiac Pacemakers and Defibrillators:** Need for Cardiac pacemaker, External Pacemaker, Implantable Pacemaker, Types of Implantable Pacemaker, Ventricular Synchronous Demand Pacemaker and Programmable Pacemaker. Need for a defibrillator, DC defibrillator, Defibrillator electrodes, DC defibrillator with synchronizer.	
Unit –V	**09 Hrs**
Advances in Radiological Imaging: X-rays-principles of generation, Conventional X-ray radiography, Fluoroscopy, Angiography, Digital radiography, Digital subtraction angiography (DSA). Basic principle of computed tomography, magnetic resonance imaging system and Ultrasonic imaging system.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Understand the sources of biomedical signals and basic biomedical instruments.
CO2	Apply concepts for the design of biomedical devices
CO3	Analyze the methods of acquisition and signal conditioning to be applied to the physiological parameters.
CO4	Develop instrumentation for measuring and monitoring biomedical parameters.

Reference Books	
1.	Handbook of Biomedical Instrumentation, R. S. Khandpur,3rd Edition, Reprint 2016, Tata McGraw-Hill, ISBN: 9780070473553.
2.	Biomedical Instrumentation and Measurements, Leslie Cromwell & others, 2nd Edition, Reprint 2015, ISBN: 9780130771315.
3.	Medical instrumentation: Application and Design, J. G. Webster, 3rd Edition, Reprint 2015, Wiley Publications, ISBN: 9788126511068.
4.	Principles of Medical Imaging, K.Kirk Shung, Michael B. Smith and Banjamin Tsui, Academic Press, 2016, ISBN: 978-0126409703.

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: VI						
TELECOMMUNICATION SYSTEMS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ET266TEM**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**08 Hrs**
Introduction to Electronic Communication: The Significance of Human Communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, Electromagnetic Spectrum, Bandwidth, A Survey of Communication Applications. **The Fundamentals of Electronics:** Gain, Attenuation, and Decibels. **Radio Receivers:** Super heterodyne receiver.	
Unit – II	**10 Hrs**
Modulation Schemes: Analog Modulation: AM, FM and PM- brief review. **Digital Modulation:** PCM, Line Codes, ASK, FSK, PSK & QAM (Architecture). **Wideband Modulation:** Spread spectrum, FHSS, DSSS. **Multiple Access:** FDMA, TDMA, CDMA.	
Unit –III	**10 Hrs**
Satellite Communication: Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Positioning System.	
Unit –IV	**09 Hrs**
Optical Communication: Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers, Wavelength-Division Multiplexing, Passive Optical Networks.	
Unit –V	**08 Hrs**
Cell Phone Technologies: Cellular concepts, Frequency allocation, Frequency reuse, Internet Telephony. **Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee, Mesh Wireless Networks, WiMax, and Wireless Metropolitan Area Networks.	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Describe the basics of communication systems.
CO2:	Analyze the importance of modulation and multiple access schemes for communication systems.
CO3:	Analyze the operational concept of cell phone and other wireless technologies.
CO4:	Justify the use of different components and sub-system in advanced communication systems.

Reference Books	
1	Principles of Electronic Communication Systems, Louis E. Frenzel, 4th Edition, 2016, Tata McGraw Hill, ISBN: 978-0-07-337385-0.
2	Electronic Communication Systems, George Kennedy,3rd Edition, 2008, Tata McGraw Hill, ISBN: 0-02-800592-9.
3	Introduction to Telecommunications, Anu A. Gokhale, 2nd Edition, 2008, Cengage Learning ISBN: 981-240-081-8

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: VI						
MOBILE COMMUNICATION NETWORKS AND STANDARDS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ET266TEN**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Principle of Cellular Communication: Cellular Terminology, Cell Structure and Cluster, Frequency Reuse Concept, Cluster size and System Capacity, Method of Locating Co-channel cells, Frequency Reuse distance, Co-channel Interference and Signal Quality, Co-channel interference Reduction Methods.	
Unit – II	**09 Hrs**
Basic Cellular system: Consideration of components of a cellular system- A basic cellular system connected to PSTN, Main parts of a basic cellular system, Operation of a Cellular system, Performance criteria- Voice quality, Trunking and Grade of Service, Spectral Efficiency of FDMA and TDMA systems	
Unit –III	**09 Hrs**
Second generation Cellular Technology: GSM: GSM Network Architecture, Identifiers used in GSM System, GSM channels, Authentication and Security in GSM, GSM Call Procedure, GSM Hand-off Procedures.	
Unit –IV	**09 Hrs**
3G Digital Cellular Technology: GPRS: GPRS technology, GPRS NetworkArchitecture, GPRS signalling, Mobility Management in GPRS. **UMTS:** UMTS Network Architecture, UMTS Interfaces, UMTS Air Interface Specifications, UMTS Channels**.**	
Unit –V	**09 Hrs**
Wireless Personal Area Networks: Network architecture, components, Bluetooth, Zigbee, Applications. **Wireless Local Area networks:** Network Architecture, Standards, Applications. Wireless Metropolitan Area Networks: IEEE 802.16 standards, advantages, WMAN Network architecture, Protocol stack	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Describe the concepts and terminologies for Cellular Communication.
CO2:	Analyze the Architecture, Hand-off and Security aspects in 2G and 3G Networks.
CO3:	Compare the performance features of 2G and 3G Cellular Technologies.
CO4:	Analyze and Compare the architectures of various Wireless technologies and standards.

Reference Books	
1	Wireless Communications, T.L. Singal, 2nd Reprint 2011,Tata McGraw Hill Education Private Limited, ISBN: 978-0-07-068178-1
2	Wireless and Mobile Networks Concepts and Protocols, Dr.Sunil Kumar SManvi, 2010, Willey India Pvt. Ltd., ISBN: 978-81-265-2069-5.
3	Wireless Communication, Upena Dalal, 1st Edition, 2009, Oxford higher Education, ISBN-13:978-0-19-806066-6.
4	Wireless Communications Principles and practice, Theodore S Rappaport, 2nd Edition, Pearson, ISBN 97881-317-3186-4

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: VI						
MOBILE APPLICATION DEVELOPMENT **Category: INSTITUTIONAL ELECTIVE** **GROUP E**						
Course Code	**:**	**IS266TEO**		**CIE**	**:**	100 Marks
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	100 Marks
TotalHours	**:**	**45L**		**SEE Duration**	**:**	03 Hours

Prerequisite: - Programming in Java.

Unit-I	**09 Hrs**
Introduction: Smart phone operating systems and smart phones applications. Introduction to Android, Installing Android Studio, creating an Android app project, deploying the app to the emulator and a device. UI Design: Building a layout with UI elements, Layouts, Views and Resources, Text and Scrolling Views. Activities and Intents, The Activity Lifecycle, Managing State, Activities and Implicit Intents, The Android Studio Debugger, Testing the Android app, The Android Support Library.	
Unit–II	**09 Hrs**
User experience: User interaction, User Input Controls, Menus, Screen Navigation, Recycler View, Delightful user experience, Drawables, Styles, and Themes, Material Design, Testing app UI, Testing the User Interface	
Unit–III	**09 Hrs**
Working in the background: Async Task and Async Task Loader, Connect to the Internet, Broadcast Receivers and Services. Scheduling and optimizing background tasks – Notifications, Scheduling Alarms, and Transferring Data Efficiently	
Unit–IV	**09 Hrs**
All about data: Preferences and Settings, Storing Data, Shared Preferences. Storing data using SQLite, SQLite Database. Sharing data with content providers. Advanced Android Programming: Internet, Entertainment and Services. Displaying web pages and maps, communicating with SMS and emails, Sensors.	
Unit–V	**09 Hrs**
Hardware Support & devices: Permissions and Libraries, Performance and Security. Fire base and AdMob, Publish and Polish, Multiple Form Factors, Using Google Services.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Comprehend the basic features of android platform and the application development process. Acquirefamiliarity with basic building blocks of Android application and its architecture.
CO2:	Apply and explore the basic framework, usage of SDK to build Android applications incorporating Android features in developing mobile applications.
CO3:	Demonstrate proficiency in coding on a mobile programming platform using advanced Android technologies, handle security issues, rich graphics interfaces, using debugging and troubleshooting tools.
CO4:	Create innovative applications, understand the economics and features of the app marketplace by offering the applications for download.

Reference Books	
1	Android Programming, Phillips, Stewart, Hardyand Marsicano, Big Nerd Ranch Guide, 2nd Edition, 2015, ISBN-13 978-0134171494
2	AndroidStudioDevelopmentEssentials-Android6, NeilSmyth,2015, Create space Independent Publishing Platform, ISBN:9781519722089
3	Android Programming–Pushing the limits, EricHellman,2013, Wiley, ISBN-13:978-1118717370
4	Professional Android2ApplicationDevelopment, RetoMeier, Wiley India Pvt. Ltd, 1st Edition, 2012, ISBN-13:9788126525898
5	BeginningAndroid3, Mark Murphy, A press Springer India Pvt Ltd,1st Edition,2011, ISBN-13:978-1-4302-3297-1
6	AndroidDeveloperTraining-https://developers.google.com/training/android/ AndroidTestingSupportLibrary-https://google.github.io/android-testing-support-library/

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

Semester: VI						
ELEMENTS OF FINANCIAL MANAGEMENT **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**IM266TEQ**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**06 Hrs**
Financial Management-An overview: Financial Decisions in a firm, Goals of a firm, Fundamental principle of finance, Organization of finance function and its relation to other functions, Regulatory framework. **The financial System:** Functions, Assets, Markets, Market returns, Intermediaries, regulatory framework, Growth and trends in Indian financial system.	
Unit – II	**10 Hrs**
Financial statements, Taxes and cash flow: Balance sheet, statement of profit and loss, items in annual report, manipulation of bottom line, Profits vs Cash flows, Taxes. **(Conceptual treatment only)** **Time Value of Money:** Future value of a single amount, future value of an annuity, present value of a single amount, present value of an annuity. **Valuation of securities:** Basic valuation model, bond valuation, equity valuation-dividend capitalization approach and other approaches.	
Unit –III	**10 Hrs**
Risk and Return: Risk and Return of single assets and portfolios, measurement of market risk, relationship between risk and return, implications. **Techniques of Capital Budgeting:** Capital budgeting process, project classification, investment criteria, Net present value, Benefit-Cost ratio, Internal Rate of return, Payback period, Accounting rate of return. **(Conceptual and Numerical treatment)**	
Unit –IV	**10 Hrs**
Long term finance: Sources- Equity capital, Internal accruals, preference capital, term loans, debentures. Raising long term finance- Venture capital, Initial Public Offer, Follow on Public Offer, Rights Issue, Private Placement, Term Loans, Investment Banking **Securities Market:** Primary market vs Secondary market, Trading and Settlements, Stock market quotations and Indices, Govt. securities market, Corporate debt market.	
Unit –V	**09 Hrs**
Working Capital – Policy and Financing: Factors influencing working capital requirements, Current assets financing policy, operating cycle and cash cycle. Accruals, trade credit, banks, public deposits, inter-corporate deposits, short term loans, right debentures, commercial paper, Factoring **(Conceptual treatment only)**	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Explain the features and elements of a financial system.
CO2	Recognize the relevance basic principles of financial management in decision making.
CO3	Describe the processes and techniques of capital budgeting and working capital financing by organizations.
CO4	Demonstrate an understanding of various sources of finance.

Reference Books:	
1.	Fundamentals of Financial Management, Prasanna Chandra, 6th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 978-93-392-0313-9, 93-392-0313-5
2.	Financial Management ,I M Pandey, 12th edn, 2021, Pearson, ISBN-939057725X, 978-9390577255
3.	Financial Management-Text, Problems and Cases, Khan M Y & Jain P K, 8th Edition, 2018, McGraw Hill Education(India) Pvt. Ltd, ISBN: 9353162181 , 9789353162184
4.	Fundamentals of Financial Management, Eugene F Brigham, Joel F Houston, 8th Edition, 2014, Cengage Learning, ISBN : 9781285065137, 1285065131.

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: VI						
OPTIMIZATION TECHNIQUES (Institutional Elective) (Theory)						
Course Code	**:**	**IM266TER**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**03 Hours**

UNIT – I	**08 Hrs**
Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial problems, Features of OR models, Limitations of OR. **Linear Programming:** Definition, Mathematical Formulation, Standard Form, Solution Space, Types of solution – Feasible, Basic Feasible, Degenerate, Solution through Graphical Method. Problems on Product Mix, Blending, Marketing, Finance, Agriculture and Personnel. **Simplex methods:** Variants of Simplex Algorithm – Use of Artificial Variables.	
UNIT – II	**09 Hrs**
Simplex Algorithm: How to Convert an LP to Standard Form, Preview of the Simplex Algorithm, Direction of Unboundedness, Why Does an LP Have an Optimal basic feasible solution, The Simplex Algorithm, Using the Simplex Algorithm to Solve Minimization Problems, Alternative Optimal Solutions, Degeneracy and the Convergence of the Simplex Algorithm, The Big M Method, The Two-Phase Simplex Method.	
UNIT – III	**09 Hrs**
Transportation Problem: Formulation of Transportation Model, Basic Feasible Solution using North-West corner, Least Cost, Vogel's Approximation Method, Optimality Methods, Unbalanced Transportation Problem, Degeneracy in Transportation Problems, Variants in Transportation Problems. **Assignment Problem:** Formulation of the Assignment problem, solution method of assignment problem-Hungarian Method, Variants in assignment problem, Travelling Salesman Problem (TSP).	
UNIT – IV	**08 Hrs**
Project Management Using Network Analysis: Network construction, CPM & PERT, Determination of critical path and duration, floats. Crashing of Network. Usage of software tools to demonstrate N/W flow problems	
UNIT – V	**08 Hrs**
Game Theory: Introduction, Two person Zero Sum game, Pure strategies, Games without saddle point - Arithmetic method, Graphical Method, The rules of dominance	

Course Outcomes: After going through this course the student will be able to	
CO1	Understand the characteristics of different types of decision – making environments and the appropriate decision making approaches and tools to be used in each type.
CO2	Build and solve Transportation Models and Assignment Models.
CO3	Design new simple models, like: CPM, PERT to improve decision –making and develop critical thinking and objective analysis of decision problems.
CO4	Implement practical cases, by using TORA, WinQSB, Excel, GAMS.

Reference Books:	
1.	Operation Research An Introduction, Taha H A, 10th Global Edition, 2017, Pearson Education Limited, ISBN 13: 978-1-292-16554-7
2.	Principles of Operations Research – Theory and Practice, Philips, Ravindran and Solberg, 2nd Edition, 2007, John Wiley & Sons (Asia) Pvt Ltd, ISBN 13: 978-8126512560
3.	Introduction to Operation Research, Hiller, Liberman, Nag, Basu, 10th Edition, 2017, McGraw Hill Education, ISBN 13: 978-9339221850
4.	Operations Research Theory and Application, J K Sharma, 6th Edition, 2009, Trinity Press, ISBN : 978-93-85935-14-5

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 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: VI						
AUTOMOTIVE MECHATRONICS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**ME266TES**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Automobile Engines Classifications of Internal Combustion Engines**.** Engine nomenclature and mechanics. Mixture formation – External, internal, quality and quantity control – homogeneous and stratified injection. Thermodynamic principles of Otto and Diesel cycle. Characteristics – pressure curve and energy yield, engine speed, torque, and power	
Unit – II	**10 Hrs**
Engine Auxiliary Systems: Turbocharger, Intercooler, Exhaust manifold, 3-way catalytic convertor, Exhaust Gas Recirculation system. **Common Rail Fuel Injection system**- Low pressure and high pressure fuel systems, Return line, Quantity control valve and Injectors.	
Unit –III	**12 Hrs**
Vehicular Auxiliary Systems: Vehicle frame and body classification- Hatchback, Sedan, SUV, Coupe, Roadster. Adaptive Brakes - Disc and drum brakes, Antilock Braking Systems, ESP, TCS. Wheels and Tyres- Toe-In, Toe-Out, Caster and Camber angle. Classification of tyres, Radial, Tubeless. **Supplemental Restraint System**: Active and passive safety, Vehicle structure, Gas generator and air bags, Belt Tensioner, Acceleration sensor, Rollover sensor, Seat occupancy recognition.	
Unit –IV	**06 Hrs**
EV Technology: Types of EV's, ICE vs EV torque output, Architecture and Working of EV's. Battery Thermal Management System, Regenerative braking, Safety system and Impacts of EV on the environment.	
Unit –V	**08 Hrs**
Telematics in vehicles – Radio Transmission, Exchange of information, signal path & properties, Concept of radio waves. **Sensors:** Oxygen sensors, Crankshaft/Cam shaft Sensor, Boost Pressure Sensor, Coolant Temperature Sensor, Hot Film Air Mass flow Sensor, Throttle Position Sensor, Rain/Light sensor	

Course Outcomes: At the end of this course the student will be able to :	
CO1:	Describe the functions of Mechatronic systems in a modern automobile
CO2:	Evaluate the performance of an engine by its parameters
CO3:	Analyse the automotive exhaust pollutants as per emission norms
CO4:	Demonstrate communication of control modules using a On-Board Diagnostic kit

Reference Books	
1	Automotive Technology – A systems approach, Jack Erjavec, 5th Edition, Delamr Cengage Learning, ISBN-13: 978-1428311497
2	Automotive Engineering Fundamentals, Richard Stone and Jeffrey K. Ball, 2004, SAE International, ISBN: 0768009871
3	Bosch Automotive Handbook, Robert Bosch, 9th Edition, 2004, ISBN: 9780768081527
4	Understanding Automotive Electronics, William B Ribbens, 5th Edition, Butterworth–Heinemann, ISBN 0-7506-7008-8

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: VI						
MATHEMATICAL MODELLING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**MA266TEU**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction to Mathematical Modelling: Basic concepts, steps involved in modelling, classification of models, assorted simple mathematical models from diverse fields.	
Unit – II	**09 Hrs**
Mathematically Modelling Discrete Processes: Difference equations - first and second order, Introduction to Difference equations, Introduction to discrete models-simple examples, Mathematical modelling through difference equations in economics, finance, population dynamics, genetics and other real world problems.	
Unit –III	**09 Hrs**
Markov modelling: Mathematical foundations of Markov chains, application of Markov Modelling to problems.	
Unit –IV	**09 Hrs**
Modelling through graphs: Graph theory concepts, Modelling situations through different types of graphs.	
Unit –V	**09 Hrs**
Variational Problem and Dynamic Programming: Optimization principles and techniques, Mathematical models of variational problem and dynamic programming, Problems with applications.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamental concepts of mathematical models arising in various fields engineering.
CO2:	Apply the knowledge and skills of discrete and continuous models to understand various types of analysis.
CO3:	Analyze the appropriate mathematical model to solve the real world problem and to optimize the solution.
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	Mathematical Modeling, J. N. Kapur, 1st Edition, 1998, New Age International, New Delhi, ISBN: 81-224-0006-X.
2	Mathematical Modeling: Models, Analysis and Applications, Sandip Banerjee, 2014, Chapman and Hall/CRC Textbook, ISBN 9781439854518.
3	Case studies in mathematical modeling, D. J. G. James and J. J. Mcdonald, 1981, Stanly Thames, Cheltonham, ISBN: 0470271779, 9780470271773.
4	Modeling with difference equations, D. N. Burghes, M. S. Borrie, Ellis Harwood, 1981, ISBN 13: 9780853122869.

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; wherein one sub division will be a caselet in the related topics)	
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: VI						
MATHEMATICS FOR QUANTUM COMPUTING **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**MA266TEV**		**CIE**	**:**	**100 Marks**
Credits: L: T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**09 Hrs**
Introduction to Quantum Computing: Quantum superposition, Qubits, Linear algebra for quantum computing, Inner products and Tensor products of vector spaces, Quantum states in Hilbert space, The Bloch sphere, Generalized measurements, No-cloning theorem.	
Unit – II	**09 Hrs**
Quantum Gates: Universal set of gates, quantum circuits, Dirac formalism, superposition of states, entanglement Bits and Qubits. Qubit operations, Hadamard Gate, CNOT Gate, Phase Gate, Z-Y decomposition, Quantum Circuit Composition, Basic Quantum circuits.	
Unit –III	**09 Hrs**
Quantum Algorithm - I: Deutsch Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazarani Algorithm, Simon periodicity algorithm, Phase estimation algorithm, Quantum Fourier transform.	
Unit –IV	**09 Hrs**
Quantum Algorithm - II: Grover search algorithm, Shor quantum factoring algorithm, Harrow-Hassidim-Lloyd (HHL) algorithm for solving linear system problems.	
Unit –V	**09 Hrs**
Applications of Quantum Computing: Application to: order-finding, discrete logarithm, quantum counting, Boolean satisfiability problems(SAT), graph theory problems.	

Course Outcomes: After completing the course, the students will be able to	
CO1:	Explore the fundamental concepts of quantum computing.
CO2:	Apply the knowledge and skills of quantum computing to understand various types of problems arising in various fields engineering
CO3:	Analyze the appropriate quantum algorithm to solve the real-world problem and to optimize the solution.
CO4:	Distinguish the overall knowledge gained to demonstrate the problems arising in many practical situations.

Reference Books	
1	An introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, 2007, Oxford University press.
2	Quantum Computing for Everyone, Chris Bernhardt, 2020, The MIT Press, Cambridge.
3	Quantum Computation and Quantum Information, M. A. Nielsen & I. Chuang, 2013, Cambridge University Press.
4	Quantum Computing for the quantum curious, Cirian Hughes et. al., 2021, Springer, ISBN 978-3-030-61600-7.
5	Concise guide to quantum computing, Sergei Kurgalin, Sergei Borzunov, 2021, Springer, ISBN 978-3-030-65051-3, ISBN 978-3-030-65052-0 (eBook).

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; wherein one sub division will be a caselet in the related topics)	
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: VI						
APPLIED PSYCHOLOGY FOR ENGINEERS **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**HS266TEW**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**45 Hrs**		**SEE Duration**	**:**	**3 Hours**

Unit-I	**08 Hrs**
Introduction to Psychology: Definition and goals of Psychology: Role of a Psychologist in the Society: Today's Perspectives (Branches of psychology- Clinical, Industrial). Psychodynamic, Behavioristic, Cognitive, Humanistic, Psychological Research and Methods to study Human Behavior: Experimental, Observation, Questionnaire and Clinical Method.	
Unit – II	**08 Hrs**
Intelligence and Aptitude: Concept and definition of Intelligence and Aptitude, Nature of Intelligence. Theories of Intelligence – Spearman, Thurston, Guilford Vernon. Characteristics of Intelligence tests, Types of tests. Measurement of Intelligence and Aptitude, Concept of IQ, Measurement of Multiple Intelligence – Fluid and Crystallized Intelligence.	
Unit –III	**10 Hrs**
Personality: Concept and definition of personality, Approaches of personality- psychoanalytical, Socio- Cultural, Interpersonal and developmental, Humanistic, Behaviorist, Trait and type approaches. Assessment of Personality: Self- report measures of Personality, Questionnaires, Rating Scales and Projective techniques, its Characteristics, advantages & limitations, examples. Behavioral Assessment.	
Unit –IV	**10 Hrs**
Learning: Definition, Conditioning – Classical Conditioning, Basics of Classical Conditioning (Pavlov), the process of Extinction, Discrimination and Generalization. Operant Conditioning (Skinner expt). The basics of operant conditioning, Schedules of reinforcement. Cognitive – Social approaches to learning – Latent Learning, Observational Learning, Trial and Error Method, Insightful Learning.	
Unit –V	**09 Hrs**
Application of Psychology in Working Environment: The present scenario of information technology, the role of psychologist in the organization, Selection and Training of Psychology Professionals to work in the field of Information Technology. **Psychological Stress**: a. Stress- Definition, Symptoms of Stress, Extreme products of stress v s Burnout, Work Place Trauma. Causes of Stress – Job related causes of stress.Sources of Frustration, Stress and Job Performance, Stress Vulnerability-Stress threshold, perceived control. Type A and Type B.**Psychological Counseling** - Need for Counseling, Types – Directed, Non- Directed, Participative Counseling.	

Course Outcomes: After completing the course, the students will be able to:-	
CO1	Describe the basic theories, principles, and concepts of applied psychology as they relate to behaviors and mental processes.
CO2	Define learning and compare and contrast the factors that cognitive, behavioral, and Humanistic theorists believe influence the learning process.
CO3	Develop understanding of psychological attributes such as intelligence, aptitude, creativity, resulting in their enhancement and apply effective strategies for self-management and self-improvement.
CO4	Apply the theories into their own and others' lives in order to better understand their personalities and experiences.
CO5	Understand the application of psychology in engineering and technology and develop a route to accomplish goals in their work environment.

Reference Books	
1.	Understanding Psychology Feldman R. S, IV edition, (1996) McGraw Hill India
2.	Psychology Robert A. Baron, III edition (1995) Prentice Hall India.
3.	Organizational Behaviour , Stephen P Robbins Pearson Education Publications, 13th Edition, ISBN – 81-317 – 1132 – 3
4.	Organisational Behaviour : Human Behaviour at Work ,John W.Newstrem and Keith Davis. Tata McGraw Hill India, 10th Edition, ISBN 0-07-046504-5
5	Psychology-themes and variations , Wayne Weiten, IV edition, Brooks / Cole Publishing Co.

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; wherein one sub division will be a caselet in the related topics)	
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: VI						
Universal Human Values - II **Category: Institutional Electives-I GROUP-E** **(Theory)**						
Course Code	**:**	**HS266TEY**		**CIE**	**:**	**100 Marks**
Credits: L:T:P	**:**	**3:0:0**		**SEE**	**:**	**100 Marks**
Total Hours	**:**	**42L**		**SEE Duration**	**:**	**3.00 Hours**

Unit-I	**10 Hrs**
Introduction-Basic Human Aspiration, its fulfillment through All-encompassing Resolution. The basic human aspirations and their fulfillment through Right understanding and Resolution, Right understanding and Resolution are the activities of the Self, Self is central to Human Existence; All-encompassing Resolution for a Human Being, its details and solution of problems in the light of Resolution.	
Unit – II	**10 Hrs**
Right Understanding (Knowing)- Knower, Known & the Process. The domain of right understanding starts from understanding the human being (the knower, the experiencer and the doer); and extends up to understanding nature/existence – its interconnectedness and co-existence; and finally understanding the role of human being in existence (human conduct).	
Unit –III	**08 Hrs**
Understanding Existence (including Nature). A comprehensive understanding (knowledge) about the existence, which certainly includes the Nature. The need and the process of inner evolution (through self-exploration, self-awareness and self-evaluation)- particularly awakening to activities of the Self: Realization, Understanding and Contemplation in the Self (Realization of Co-Existence, Understanding of Harmony in Nature and Contemplation of Participation of Human in this harmony/ order leading to comprehensive knowledge about the existence).	
Unit –IV	**08 Hrs**
Understanding Human Being. Understanding the human being comprehensively is the first step and the core theme of this course; human being as co-existence of the self and the body, the activities and potentialities of the self, Reasons for harmony/contradiction in the self.	
Unit –V	**08 Hrs**
Understanding Human Conduct, All-encompassing Resolution & Holistic Way of Living. Understanding Human Conduct, Understanding different aspects of All-encompassing Resolution (understanding, wisdom, science etc.), Holistic way of living for Human Being with All-encompassing Resolution covering all four dimensions of human endeavour viz., realization, thought, behavior and work (participation in the larger order) leading to harmony at all levels from self to Nature and entire Existence.	

Course Outcomes: After completion of the course the students will be able to	
CO1	Understand the basic human aspiration with program of its fulfilment and meaning of resolution in the complete expanse of human living.
CO2	Understand human being in depth and see how self is central to human being
CO3	Understand existence in depth and see how coexistence is central to existence
CO4	Understand human conduct and the holistic way of living leading to human tradition

Reference Books	
1	A foundation course in human values and professional ethics, R. R. Gaur, R Asthana, G P Bagaria, 2nd revised Edition, excel books, New Delhi – 2019, ISN 978-93-87034-47-1
2	Avartansheel Arthshastra, A Nagraj, Divya Path Sansthan, Amarkantak, India, ISBN 978-8-174-46781-2
3	Economy of Performance- a quest for social order based on non – violence, J C Kumarappa, 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India
4	Energy and Equity, Ivan Illich, 1974, The Trinity Press, Worcester & Harper Collins, USA, ISBN, 0060803274, 9780060803278

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**

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. Each test will be evaluated for 50 Marks, adding upto 150 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**

Semester: VI						
INTERDISCIPLINARY PROJECT						
Course Code	**:**	**AS367P**		**CIE**	**:**	**50 Marks**
Credits: L:T:P	**:**	**0:0:3**		**SEE**	**:**	**50 Marks**
Total Hours	**:**	**15 P**		**SEE Duration**	**:**	**2 Hours**

Major Project Guidelines:

1. The project topic, title and synopsis have to be finalized and submitted to their respective internal guide(s) before the beginning of the VI semester.
2. The detailed Synopsis (approved by the department ***Project Review Committee***) has to be submitted during the 1st week after the commencement of VI semester.

Batch Formation:

- Students are free to choose their project partners from any other program.
- Each student in the team must contribute towards the successful completion of the project. The project may be carried out In-house only.
- ***The project work is to be carried out by a team of two to four students.***

Project Topic Selection:

The topics of the project work must be in the ***field of Sustainable Development goals areas or in line with CoE's(Centre of Excellence) identified by the college*** or **List of project areas as given by Faculty. The projects as far as possible should have societal relevance with focus on sustainability.**

Project Evaluation:

Continuous monitoring of project work will be carried out and cumulative evaluation will be done.

- The students are required to meet their guides once in a week to report their progress in project work.
- **Weekly Activity Report** (WAR) has to be maintained in the form of a diary by the project batch and the same has to be discussed with the Guide regularly.
- For CIE assessment the project groups must give a final presentation with the draft copy of the project report.
- The presentation by each group will be for 20-30 minutes and every member of the team needs to justify the contributions to the project.
- The project team is required to submit Hard copies of the detailed Project Report in the prescribed format to the department.
- For CIE 50% weightage should be given to the project guide and 50% weightage to the project evaluation committee.

Course Outcomes:	
1	Identifying critical thinking and problem-solving abilities by analyzing and addressing interdisciplinary challenges, utilizing creative approaches and innovative solutions.
2	Exhibit proficiency in conducting comprehensive research, including literature review, data collection, modelling, simulation, and analysis, to address significant technical challenges and propose innovative solutions.
3	Demonstrate the ability to do effective teamwork, leadership, project management, and communication skills, while adhering to ethical standards and professional responsibility in delivering the project outcomes within time and budget constraints.
4	Utilize appropriate engineering tools, technologies, and software to design, test, and implement project solutions, ensuring adherence to technical specifications, safety standards, and industry best practices.

CIE Assessment:

The following are the weightings given for the various stages of the project.

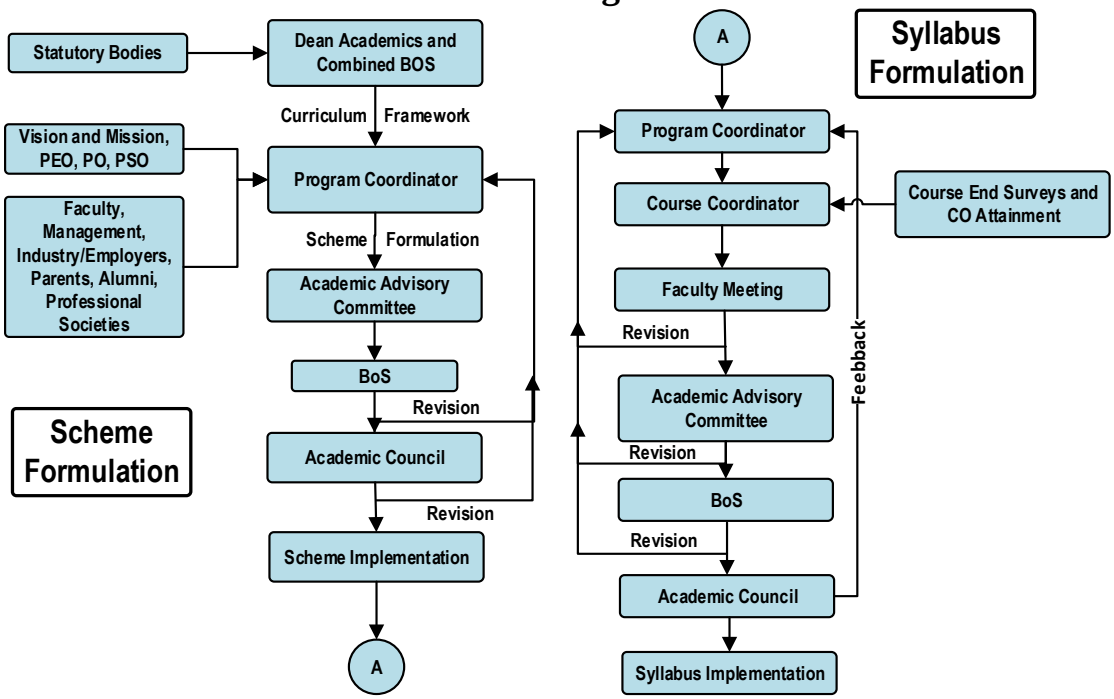
1.	Selection of the topic and formulation of objectives	10%
2.	Design and Development of Project methodology	25%
3.	Execution of Project	25%
4.	Presentation, Demonstration and Results Discussion	30%
5.	Report Writing & Publication	10%

SEE Assessment:

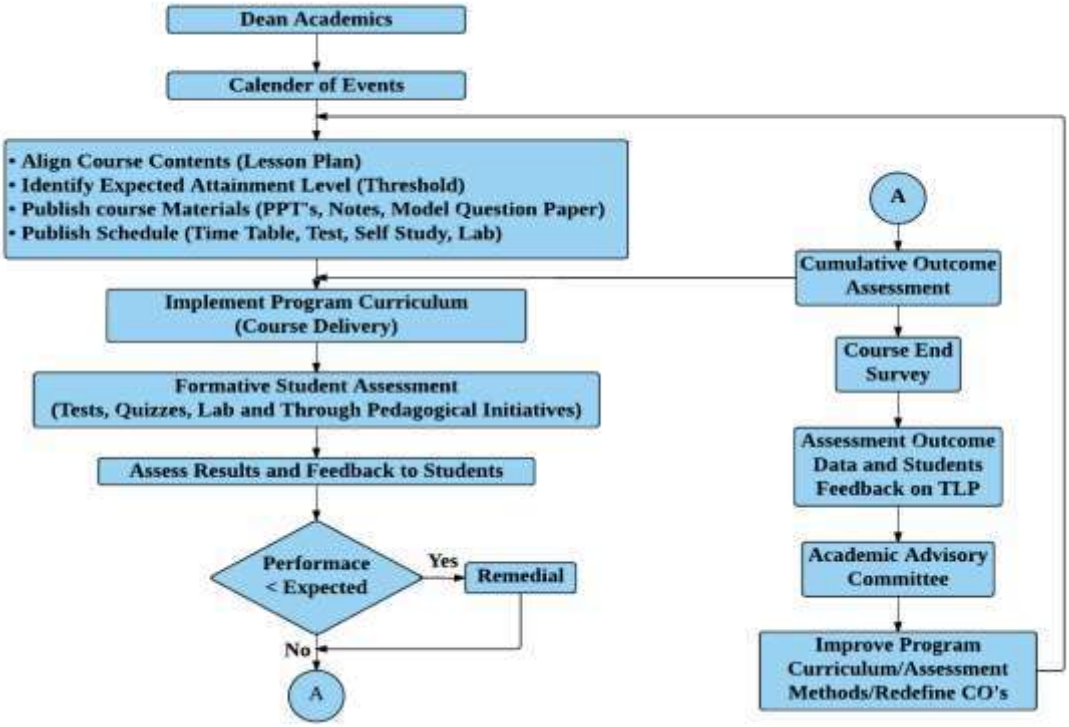
The following are the weightages given during Viva Examination.

1.	Written presentation of synopsis	10%
2.	Presentation/Demonstration of the project	30%
3.	Methodology and Experimental Results & Discussion	30%
4.	Report	10%
5.	Viva Voce	20%

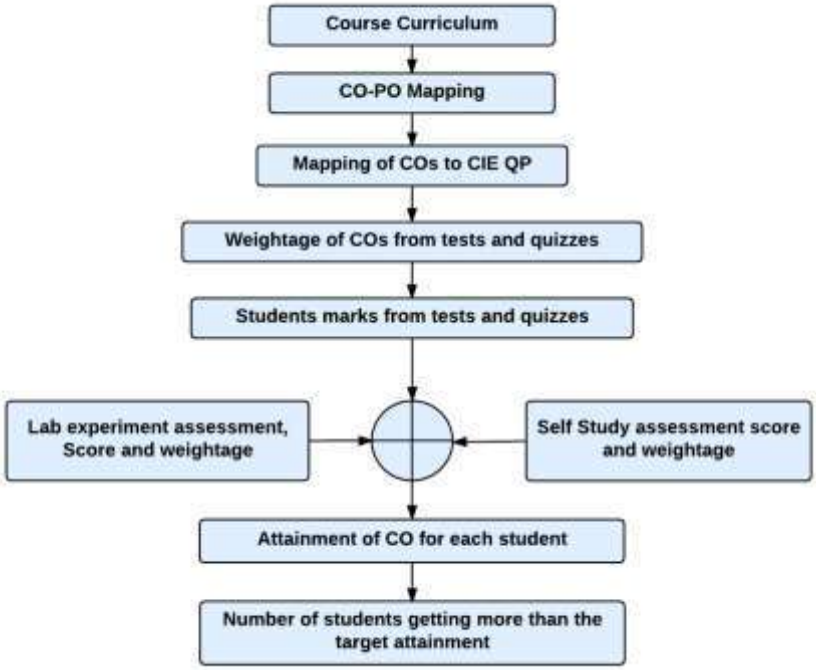
Curriculum Design Process



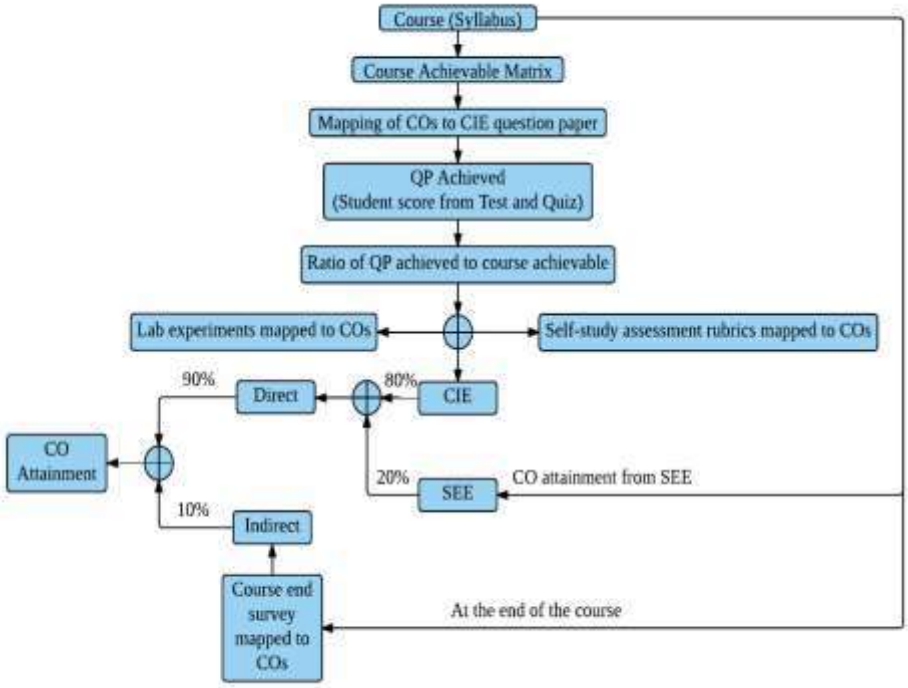
Academic Planning and Implementation



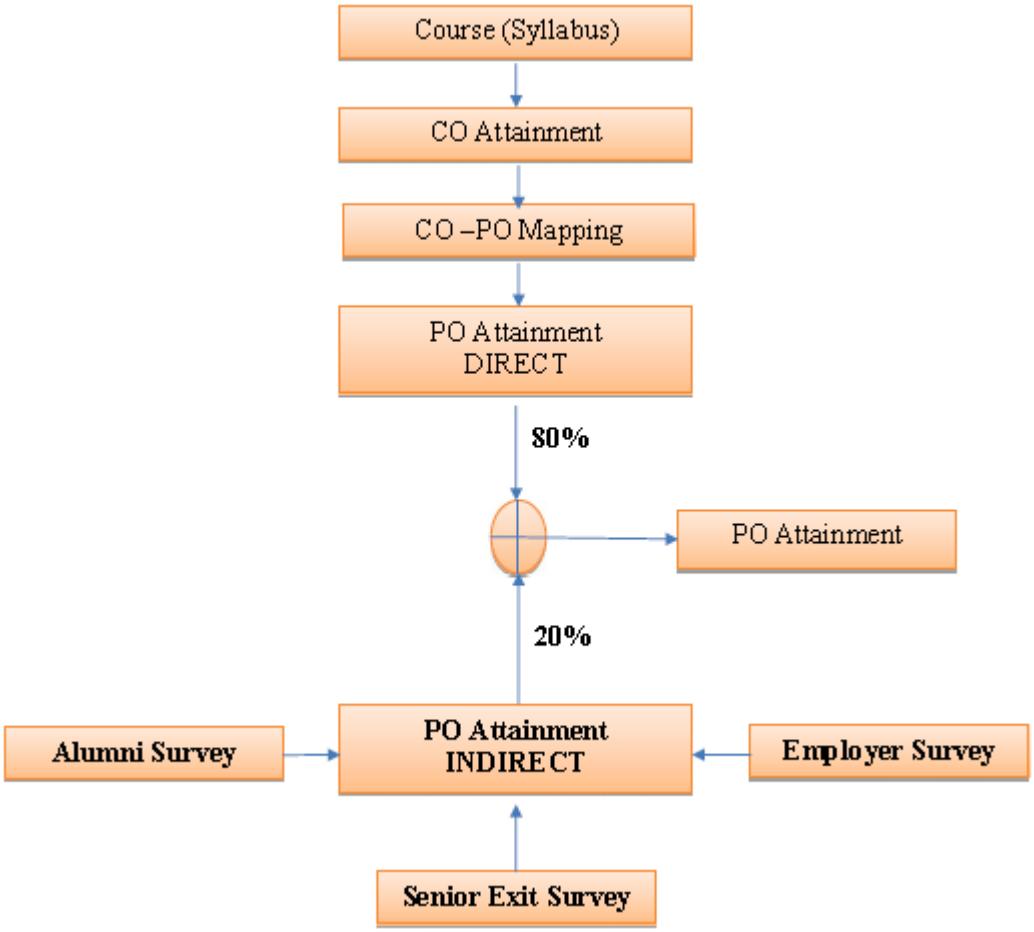
Process For Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Knowledge and Attitude Profile (WK)

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

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New Program Outcomes(PO)

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

INNOVATIVE TEAMS OF RVCE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cultural Activity Teams

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

NSS of RVCE

NCC of RVCE

VISION

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

MISSION

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

QUALITY POLICY

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

CORE VALUES

Professionalism, Commitment, Integrity, Team Work, Innovation