Rashtreeya Sikshana Samithi Trust

R.V COLLEGE OF ENGINEERING

(Autonomous Institution affiliated to VTU, Belagavi)

R.V. Vidyaniketan Post, Mysore Road
Bengaluru – 560 059

SCHEME & SYLLABUS

III & IV Semester

B.E-AEROSPACE ENGINEERING

(2015 Scheme)

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)

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

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

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

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

PROGRAM OBJECTIVES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet t h e specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with t h e society at large, such as, being able to comprehend and write effective reports and design

documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of t h e engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

- Utilization of the fundamental knowledge and skills of Aerospace Engineering to develop pragmatic solutions for complex Aerospace Engineering problems.

- Apply Professional Engineering practices and strategies in the development of systems and subsystems for Aerospace Applications.

- Exhibit Effective Communication skills and a Zeal to function with multi-disciplinary teams

- Demonstrate Professional Ethics and Responsibilities in Engineering practices towards the achievement of societal symbiosis.

R. V. COLLEGE OF ENGINEERING, BANGALORE – 59.

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DEPARTMENT OF AEROSPACE ENGINEERING

THIRD SEMESTER CREDIT SCHEME								
Sl.No	**Course code**	**Course**	**BoS**	**Credit Allocation**				**Total Credits**
				L	**P**	**T**	**S**	
1	12MA31	Applied Mathematics-III	Maths	3	0	1	0	4
2	12EB32	Environmental science and Biology for Engineers	ME	3	0	0	1	4
3	15AS33	Basics of Aerospace Engg	AS	4	0	0	0	4
4	15AS34	Thermodynamics (Theory & Practice)	AS	3	1	0	1	5
5	15AS35	Fluid Mechanics (Theory & Practice)	AS	3	1	0	1	5
6	15AS36	Structural Mechanics	AS	4	0	0	1	5
7	12DMA37	Bridge course Mathematics-I*	Maths					
		Credits		**20**	**2**	**1**	**4**	**27**
		No. of. Hrs		**20**	**4**	**2**	**16**	**42**

*** Mandatory Audit course for Lateral entry (Diploma students)**

FOURTH SEMESTER CREDIT SCHEME								
Sl.No	**Course code**	**Course**	**BoS**	**Credit Allocation**				**Total Credits**
				L	**P**	**T**	**S**	
1	12MA41	Applied Mathematics-IV	Maths	3	0	1	0	4
2	12EM42	Engineering Materials	ME	3	0	0	0	3
3	15AS43	Aerodynamics (Theory & Practice)	AS	3	1	0	1	5
4	15AS44	Aerospace Structures (Theory & Practice)	AS	3	1	0	1	5
5	15AS45	Design of Machine Elements	AS	4	0	0	1	5
6	15AS46	Manufacturing Technology (Theory & Practice)	AS	3	1	0	1	5
7	12HSS47	Innovation and Social Skills	AS	0	1	0	0	1
8	12DMA47	Bridge course Mathematics-II**	Maths					
		Credits		**19**	**4**	**1**	**4**	**28**
		No. of. Hrs		**19**	**08**	**02**	**16**	**45**

**** Mandatory Audit course for Lateral entry (Diploma students)**

III SEMESTER

APPLIED MATHEMATICS-III

(Common to all Programs)

Course Code: **12MA31** **CIE marks: 100**
Hours/Week: L:P:T:S : 3:0:1:0 **SEE Marks :100**
Credits: 04 **SEE: 3 Hours**

Course Learning Objectives:

1. The student should be able to analyze periodic phenomena using concept of Fourier series.
2. Understand the basics of matrix theory and its applications for finding solution of system of linear equations.
3. Finding the approximate solutions using numerical methods, for problems which do not have analytical solutions.
4. Approximating functional values with different curves.
5. Optimizing real functional with various applications.

UNIT 1 **8 Hrs**

Fourier series and Fourier Transforms:

Introduction, periodic functions, Even and odd functions, properties. Special waveforms - Square wave, half wave rectifier, saw-tooth wave and triangular wave. Euler's formula for Fourier series, Fourier series for functions of period 2L (particular cases), Dirichlet's conditions - problems. Half Range Fourier series- Construction of Half range cosine and sine series, Complex form of Fourier series. Complex Fourier Transforms –Properties & simple problems.

UNIT 2 **7 Hrs**

Matrices and Linear Equations:

Elementary transformation, rank of matrix by using Echelon form, consistency of system of linear equations and solutions, solution of system of linear equations using Gauss elimination method, Gauss Jordan method, Gauss Seidel method, Eigen values and Eigenvectors, finding largest Eigen value by using Power method.

UNIT 3 **7 Hrs**

Curve Fitting and Interpolation:

Method of Least squares - fitting of the curves of the form $y = ax + b$, $y = ae^{bx}$, $y = ax^b$ and $y = ax^2 + bx + c$, Correlation and Regression analysis. Finite differences-forward and backward differences, Interpolation-Newton's forward and backward interpolation formulae, Lagrange's interpolation formula.

UNIT 4 **7 Hrs**

Numerical Methods:

Numerical integration– Simpson's rules, Weddle's rule and Gaussian quadrature (two point & three point formula). Numerical methods for first order ODE – Single step & Multistep

methods-Taylor's series method, Runge-Kutta fourth order method, Adam-Bash forth's method, BVP for ODE – Shooting methods for second order ODE (All methods without proof).

UNIT 5 **7 Hrs**

Calculus of Variation: Introduction, Variation of functions and functional, extremal of a functional, variational problem, Euler's equation and special cases. Examples - Geodesics, Hanging cable, and Brachistochrome problem.

Reference Books:

1. B.S. Grewal - Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007, ISBN: 81-7409-195-5, Chapters 2, 10, 24, 28, 29, 31, 34.
2. N.P Bali & Manish Goyal - A Text Book of Engineering Mathematics, Lakshmi Publications, 7thEdition, 2010, ISBN: 978-81-7008-992-6, Chapters: 3(3.34-3.40,3.46, 3.47), 10 (10.1-10.7-10.10), 2 (2.24 -2.26).
3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 9th Edition, 2007, ISBN: 978-81-265-3135-6, Chapters: 6, 7.1, 7.2,10(10.1-10.5,10.9-10.11),17, 18,19.
4. Murray R Spiegel - Theory & problems of Fourier Analysis with Applications to Boundary Value Problems, Schaum's Outline Series. ISBN-10: 0070602190

Course outcomes:

At the end of this course the student will be able to:

1. Apply knowledge of linear algebra for finding the solution of system of linear equations.
2. Analyze and interpret physical phenomena which are periodic in nature by applying Fourier series.

Solve Algebraic and transcendental equations using effective numerical methods

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	H	H	H	L	L	H	M	M				L
CO2	M	H	H	H	L	L	L	L				M
CO3	L		H	H								M

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			X
Semester End Examination			X

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

ENVIRONMENTAL SCIENCE AND BIOLOGY FOR ENGINEERS

(Common to all programs)

Course Code: **12EB32** **CIE marks: 100**
Hours/Week:L:P:T:S : 3:0:0:1 **SEE Marks :100**
Credits: 04 **SEE: 3 Hours**

Course Learning Objectives:

1. To inculcate awareness on environmental, societal, ethical, health and safety issues and their relevance in engineering.
2. To encourage for optimal recourse utilization and sustainable life styles.
3. To promote environmental design and simulation concept.
4. To understand different biomolecules, components of cells and various physiological systems.
5. To trigger innovative thinking at the interface of biological phenomena.

UNIT 1 **6 Hrs**

Principles of ecosystem, impact of human being on environment: pollution, resource depletion and global environmental issues, Ecosystem health and environmental changes and human health. Procedure to assess ecosystem's health. Standards- ISO14000 and Environmental Impact Assessment – definition, objectives, and types. Rapid and Comprehensive Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS) and Finding Of No Significant Impact (FONSI). Some EIA examples –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Airport, Water and Wastewater Treatment Plants.

UNIT 2 **10 Hrs**

Environment quality objectives and 'Waste challenge' in modern society - types of waste: municipal, agricultural, medicinal, E-waste, industrial. Engineering ethics, 3 R's – Reduce, Reuse & Recycle, Sustainable waste management: Compacting, drying, dewatering, bio-drying, composting, bioremediation, biodegradation (chemicals and oil spillage). Waste to energy – energy recovery by incineration, bio-gasification, Waste to energy –gasification and pyrolysis, bioconversion to clean energy (biofuels). Some examples: Upflow anaerobic sludge blanket (UASB) digestion for waste water treatment and biogas production. Technology to reduce pollution: SO2/CO2 reduction by smoke-scrubber in coal thermal plants, chlorofluorocarbon (CFC) and incandescent bulb replacement, Renewable energy sources – wind, solar, tidal waves and biomass.

UNIT 3 **6 Hrs**

Environmental Design: principles, benefits and motivation. Environmental design for manufactured products, building and for developmental planning. Systems Engineering – Analysis - Design – synthesis - applications to environmental Engineering Systems. Environmental Modelling: introduction, forecast modelling and growth modelling, sensitivity

analysis. Application of remote-sensing and geographic information systems (GIS) in environmental modelling.

UNIT 4 **6 Hrs**

Cell Types, Structure of plant, animal and microbial cell and Specialized cells like stem cells and nerve cells. Biological macromolecules: Carbohydrates, proteins and nucleic acids, Special biomolecules – hormones, enzymes, vitamins and antibiotics. Introduction to organ systems: digestive, respiratory, excretory, nervous and circulatory. Nervous Control and coordination, sensory organs: Auditory, vision, olfactory, touch and taste.

UNIT 5 **6 Hrs**

Biological phenomena and innovative engineering. Introduction to Bioelectronics, Biocomputing, biophotonics and biomechatronics. Locomotion and Bio-inspired Robotics, Prosthesis and biomedical implants, Aerodynamics and flight muscle functioning (birds & Drosophila). Signaling: Enzymes and recognition receptors in biosensors; Neurotransmission and neural networks (artificial intelligence, signal processing and imaging); Bioelectric signals and cardiac generator. Sound: Ultrasonics in biology (echolocation in bats, sonar in whales & dolphins) and instrumentation (medical ultrasonography - ultrasound imaging). Light: Photosynthesis and photovoltaic cells.

Reference Books

1. Vijay Kulkarni and T. V. Ramachandra 2009. ***Environment Management.*** TERI Press; ISBN: 8179931846, 9788179931844
2. Gerald Kiely 1997. ***Environmental Engineering.*** McGraw-Hill; ISBN: 9780077091279
3. Sven Erik Jørgensen 2002. ***Integration of Ecosystem Theories: A Pattern Ecology & Environment;*** Edition 3, Springer; ISBN: 1402007558, 9781402007552
4. Linvil Gene Rich 2003. ***Environmental Systems Engineering,*** McGraw-Hill; ISBN: 9780070522503
5. Ni-Bin Chang: ***Systems Analysis for Sustainable Engineering: Theory and Applications (Green Manufacturing & Systems Engineering)***. McGraw-Hill Professional, 2011, ISBN: 0071630058, 9780071630054
6. Larry Canter 1995. ***"Environmental Impact Assessment",*** McGraw-Hill. ISBN: 0070097674.

Course Outcomes

1. Comprehend the principles of biology and environment.
2. Analyze the environmental, societal, ethical, health and safety issues of anthropogenic activities on human health and environment.
3. Appraise the elements of environmental designs and models and examine their significance in sustainable development.
4. Evaluate the technical solution at the interface of engineering and biology.

CO-PO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	**H**	**M**	**H**	**M**	**L**	**H**	**L**					**L**
CO2	**H**	**H**	**H**	**H**	**L**	**H**	**H**					**M**
CO3	**H**	**M**	**H**	**H**		**H**	**H**	**H**				**L**
CO4	**H**	**L**	**H**	**H**	**L**	**H**	**H**	**H**				**L**

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			
Semester End Examination			X

Evaluation Scheme

CIE Scheme

CIE consists of Three Tests each for 40 marks (15 marks for short answers + 25 marks for descriptive answers) out of which best two will be considered. In addition there will be one assignment on self study component for 20 marks which is to be evaluated in different phases by a committee during the semester.

Assessment	% Weightage in Marks
2 short answers	15X2
2 descriptive answers	25X2
self study	20
Total	**80+20**

Course Unitization for Internals and Semester End Examination

Sl. No.	Chapter	Teaching Hours	No. of Questions in		
			First Internals	Second Internals	Third Internals
1	Unit I	06	3	--	--
2	Unit II	10	--	3	--
3	Unit III	06	--	--	3
4	Unit IV	06	2	1	--
5	Unit V	08	--	1	2

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions carrying 08 marks each. All ten from Part B will have internal choice and one of the two have to be answered compulsorily.

Sl. No.	Chapter	Teaching Hours	No. of Questions in SEE	
			Part A	Part B
1	Unit I	06	3	2
2	Unit II	10	7	2
3	Unit III	06	3	2
4	Unit IV	06	3	2
5	Unit V	08	4	2

BASICS OF AEROSPACE ENGINEERING

Course Code: **15AS33** **CIE marks: 100**
Hours/Week:L:P:T:S:4:0:0:0 **SEE Marks :100**
Credits: 04 **SEE: 3 Hours**

Course Learning Objectives:
To enable the students to:

1. Understand the history and basic principles of aviation
2. Demonstrate and explain foundation of flight, aircraft structures, material, aircraft propulsion
3. Explain the working of each component of an aircraft
4. Assess the stability of an aircraft along with its different systems

UNIT 1 **8 Hrs**

Introduction to Aircrafts : History of aviation, Evolution of Aviation in India, International Standard atmosphere, Atmosphere and its properties, Temperature, pressure and altitude relationships, Classification of aircrafts, Anatomy of an aircraft & Helicopters, Basic components and their functions, V/STOL machines, Modern developments in Aviation.

Introduction to Space Flight : Evolution of spacecraft technologies, History of Indian Space Technology, The upper atmosphere, Introduction to basic orbital mechanics, Orbit equation, Space vehicle trajectories, some basic concepts, Kepler's Laws of planetary motion.

UNIT 2 **9 Hrs**

Basic principles of flight : Significance of speed of sound, Propagation of sound, Mach number, subsonic, transonic, supersonic, hypersonic flows, Bernoulli's theorem, Aerodynamic forces and moments on an Airfoil, Lift and drag components, lift curve, drag curve, types of drag, factors affecting lift and drag; Centre of pressure and its significance, Aerodynamic centre, Aspect ratio, Airfoil nomenclature, Basic characteristics of airfoils, NACA nomenclature, Simple problems on lift and drag.

UNIT 3 **9 Hrs**

Aircraft Propulsion : Introduction, Classification, Piston Engine & its application, Brayton cycle, Principle of operation of Turboprop, turbojet and turbofan engines, Introduction to ramjets and scramjets; performance characteristics, Comparative merits and demerits of different types Engines.

Rocket Propulsion : Principles of operation of rocket, Classification of Rockets, Types of rockets and typical applications, Introduction to Space Exploration

UNIT 4 **9 Hrs**

Aircraft Structures and Materials : Introduction, General types of construction, Monocoque, Semi-Monocoque and Geodesic structures, Typical wing and fuselage structure;

Metallic and non-metallic materials for aircraft application. Use of aluminum alloy, titanium, stainless steel and composite materials.

Aircraft Stability : Airplane Stability and Control, Airplane axis system, Forces and Moments about longitudinal, lateral and vertical axes, Equilibrium of forces developed on wing and horizontal tail, Centre of gravity, Its importance in stability and control, Control surfaces elevators, ailerons and rudder.

UNIT 5 **9 Hrs**

Aircraft Instruments : Instrument Displays, Introduction to Navigation Instruments, Basic Air data systems & Probes, Mach meter, Air speed indicator, Vertical speed indicator. Altimeter. Gyro based instruments.

Aircraft Systems : Introduction to Hydraulic and pneumatic systems, Air Conditioning and Cockpit pressurization system, Generation and distribution of Electricity on board the airplane, Aircraft Fuel System, Fire Protection, Ice and Rain Protection System.

Reference Books

1. John D. Anderson, *"Introduction to Flight",* McGraw-Hill Education, 2011. ISBN 9780071086059.

   A.C. Kermode, *"Flight without formulae",* Pearson Education India, 1989. ISBN - 9788131713891
2. Nelson R.C., *"Flight stability and automatic control",* McGraw-Hill International Editions, 1998. ISBN 9780071158381.
3. Ian Moir, Allan Seabridge, *"Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration",* John Wiley & Sons, 2011. ISBN 978111965006.
4. Sutton G.P., "Rocket Propulsion Elements", John Wiley, New York, 8th Ed., 2011; ISBH:1118174208, 9781118174203.
5. Lalit Gupta and O P Sharma, Fundamentals of Flight Vol-I to Vol-IV, Himalayan Books. 2006 ISBN: 706

Course Outcomes:

At the end of this course the student will be able to :

1. Appreciate and apply the basic principles of aviation
2. Apply the concepts of fundaments of flight, basics of aircraft structures, aircraft propulsion and aircraft materials during the development of an aircraft
3. Comprehend the complexities involved during development of flight vehicles.
4. Evaluate and criticize the design strategy involved in the development of airplanes

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	**H**	**H**	**H**	**L**	**L**	**H**	**M**	**M**				**L**
CO2	**M**	**H**	**H**	**H**	**L**	**L**	**L**	**L**				**M**
CO3	**L**		**H**	**H**								**M**
CO4	**H**	**H**	**H**	**H**		**M**	**L**	**M**				**M**

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 45 marks (15 marks quiz+30 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 10 marks to be earned through assignments.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.

THERMODYNAMICS

Course Code: **15AS34** **CIE marks: 100+50**
Hours/Week: L:P:T:S :3:2:0:1 **SEE Marks :100+50**
Credits : 05 **SEE: 3 Hours+3Hours**

Course Learning Objectives:
To enable the students to:

1. Understand the influence of thermodynamic properties on processes.
2. Apply the thermodynamic laws in practical applications.
3. Evaluate the efficiencies and properties of thermodynamic systems.
4. Appreciate the practical applications of thermodynamics
5. Build thermodynamic solutions for newly emerging technologies.

PART A

UNIT 1 **8 Hrs**

Fundamental Concepts : Introduction to Thermodynamics, Macroscopic and Microscopic Approach - Thermodynamic System, surroundings and boundary- Thermodynamic state, path, process, Thermodynamic Property, Intensive and Extensive properties, Path and Point Function, Quasi Equilibrium process.

Concept of Temperature: Zeroth Law of thermodynamics and temperature measurement, definition of work and its limitations, Thermodynamic definition of Heat and work. Heat and work transfer, expressions for displacement work in various processes through P-V diagrams.

UNIT 2 **7 Hrs**

Fist Law Thermodynamic: First Law of thermodynamics for Closed System, Perpetual motion machine kind-I, Concept of Internal Energy, Enthalpy, First Law of Thermodynamics for a closed system – Steady flow process, steady flow energy equation and applications

Second law of Thermodynamics: Limitations of First Law of thermodynamics, Heat engine, Heat pump, Carnot's principle, Carnot cycle and its specialties, Clausius and Kelvin Planck statement, Perpetual motion machine kind-II, Entropy, Entropy change in non-flow processes. Gibbs and Helmholtz Functions, Maxwell Relations, Clapeyron Equations

UNIT 3 **8 Hrs**

Pure Substance: Steam and its properties-two property rule-Formation of steam, Introduction to steam tables and charts-vapour processes- Measurement of Dryness Fraction.

Perfect Gas Laws: Equation of State, specific and Universal Gas constant, Mass and Mole Fraction, Properties of Gas Mixtures, Throttling and Free Expansion Processes, Deviations from perfect Gas

Gas Mixtures: Gas Model, Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, Vander Waal's Equation of State –compressibility factor, use of compressibility charts.

UNIT 4 **7 Hrs**

Gas Cycles: Efficiency of air-Standard cycles-Carnot cycle, Otto, Diesel, Dual and Brayton cycle, Mean effective pressure, Representation of cycles on P-V and T-s diagrams,

Performance of I.C. Engines: Air and Fuel measurement- Introduction to Dynamometer , Calculation of IP BP & FP, Heat Balance sheet calculations.

Air Compressors: Classification of Air Compressors, Reciprocating air compressor, working of reciprocating air compressors, calculation of work of compression in single stage and multi-stage, Efficiency of Compressor, Intercooler, Volumetric Efficiency, Effects of clearance volume.

UNIT 5 **6 Hrs**

Refrigeration and Air Conditioning: Principles of refrigeration, Air conditioning, Heat pumps, Ideal & Actual Vapour compression Refrigeration cycle, Vapour absorption Refrigeration, Types, Coefficient of performance, Properties of refrigerants.

Psycrhometrics: Properties of atmospheric air, Construction and use of psycrhometric chart, Analysis of various processes, heating, cooling, dehumidifying and humidifying, Adiabatic mixing of moist air, Analysis of various Air conditioning processes .

PART B
LABORATORY COMPONENT

1. Determination of flash point and fire point of the given fuels/lubricating oils using Abel Pensky and Pensky Martin's apparatus
2. Determination of Calorific Value of Solid & Liquid Fuels using Bomb calorimeter
3. Determination of Calorific Value of gaseous fuel using Junker gas calorimeter
4. Determination of viscosity of various lubricating oils using Redwood, Saybolts Viscometers
5. Determination of viscosity of various lubricating oils using Brookfield Viscometer
6. Study of characteristics and performance of a 4 stroke Diesel Piston engine under various conditions
7. Determination of thermal conductivity of metals & Insulators
8. Determination of thermal resistance of a composite wall.
9. Determination of effectiveness of a parallel and counter flow heat exchangers
10. Radiation heat transfer
11. Natural & forced convection heat transfer through pin-fin
12. Determination of constituents of a gas mixture using Orsat apparatus
13. Study the performance of vapor compression air conditioning system
14. Study the performance of vapor compression refrigeration system

REFERENCE BOOKS:

1. Thermodynamics, An Engineering Approach, Yunus A.Cenegal and Michael A.Boles, TataMcGraw Hill publications, 2002 ISBN: 9780070495036
2. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons. ISBN: 978-0471812029
3. Fundamentals of Classical Thermodynamics, G.J.Van Wylen and R.E.Sonntag, Wiley Eastern.
4. P.K.Nag, Basic and Applied Thermodynamics,2nd Ed., Tata McGraw Hill Pub. 2002

Course Outcomes:

At the end of this course the student will be able to :

1. Understand the concepts and definitions of thermodynamics.
2. Differentiate thermodynamic work and heat and apply I law and II law of thermodynamics to different processes.
3. Comprehend and utilize the principles of Refrigeration and air conditioning
4. Design and Analyze the functioning of various Thermodynamic cycles

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	H	H	H	H	L	H	L					M
CO2	H	H	H	H	L							M
CO3	M	M	H	H								L
CO4	H	H	H	H		L	M					L

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			X
Self Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+25 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 marks to be earned through self study.
- **Scheme for Continuous Internal Evaluation (CIE- Practicals):** The record is evaluated for 40 marks and one test is considered for 10 marks.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.
- **Scheme for semester end examination (SEE-Practicals):** Laboratory examination is conducted for 50 marks:

GROUP EXPERIMENT	-	25 MARKS
INDIVIDUAL EXPERIMENT	-	15 MARKS
VIVA-VOCE	-	10 MARKS

FLUID MECHANICS

Course Code: **15AS35** **CIE marks: 100+50**
Hours/Week: L:P:T:S :3:2:0:1 **SEE Marks :100+50**
Credits : 05 **SEE: 3 Hours+3 Hours**

Course Learning Objectives

To enable the students to:

1. Understand the influence of properties of fluid on flow characteristics
2. Analyze the forces responsible for the behavior of fluid flows
3. Apply different basic equations in achieving solutions to practical flows
4. Apply Dimensional analysis and similarity laws for conducting model tests

PART A

UNIT 1 **8 Hrs**

Properties Of Fluids: Introduction, Definition of Fluid, Continuum, Density, Specific Weight, Specific Volume, Relative Density, (Specific Gravity), Viscosity, Shear Stress & Shear Force, Newton's Law of Viscosity, Types of Fluids, Vapour Pressure & Cavitation, Energy & Specific Heats, Compressibility & Bulk Modulus, Co-efficient of Volume Expansion, Surface Tension & Capillary Effect, Numerical Problems.

Fluid Statics: Introduction, Definition of Pressure, Pressure at a point, Pascal's Law, Types of pressures, Variation of pressure with Depth, Pressure Measuring Devices, Hydrostatic forces on plane and curved surfaces, Buoyancy & Stability of immersed and floating bodies, Fluids in Rigid Body Motion, Numerical Problems.

UNIT 2 **8 Hrs**

Fluid Kinematics: Introduction, Lagrangian & Eulerian Description of Fluids, Flow Patterns, Types of Fluid Flows, Types of Fluid Motion or Deformation of Fluid Elements, Continuity Equation, Velocity Potential Function & Stream Function, Source Flow, Sink Flow & Doublet Flow, Numerical Problems.

Basic Governing Equations For Fluid Flows: Basic laws for a system in integral form, Conservation of mass, Newton’s Second law, Application of the basic laws for a control volume, Kinematics, Motion of a fluid particle, Fluid deformation, Differential analysis of fluid motion, Continuity equation, Differential momentum equation, The Navier Stokes equations.

UNIT 3 **8 Hrs**

Dimensional Analysis & Modelling: Introduction, Dimensions & Units, Dimensional Homogeneity, Methods of Dimensional Analysis-Rayleigh's Method, Buckingham's π-Theorem, The Method of Repeating Variables, Model Analysis, Types of Similarities and Similitude, Dimensionless Numbers, Similarity Laws, Numerical Problems.

Incompressible Inviscid Flow: Introduction, Equations Of Motion, Euler's equation of motion, Bernoulli's equation, Bernoulli's equation for Real Fluids, Flow measurement, Orifice plate, Venturi meter, Notches, Pitot Tubes, Numerical Problems.

UNIT 4 **6 Hrs**

Incompressible Viscous Flow: Introduction to laminar and turbulent flow, Boundary layer concept, Wall shear and boundary layer thickness, Displacement thickness and Momentum thickness, Separation, Flow around circular cylinder & Airfoil, Development of lift & Drag on Airfoil, Flow of viscous fluids through parallel plates, Pipes, Kinetic energy correction factor, Calculation of head loss in flow through pipes, Numerical problems.

UNIT 5 **6 Hrs**

Introduction to Compressible Flows: Stagnation Properties, One-Dimensional Isentropic Flow, Propagation of Pressure Waves in a Compressible Medium, Velocity of Sound, Mach Number, Mach Cone, Variation of Fluid Velocity with Flow Area, Bernoulli's equation for isentropic flow, Introduction to Normal and Oblique shock waves, Numerical Problems.

PART B
LABORATORY COMPONENT

1. Determination of major and minor losses in fluids flowing through pipes.
2. Measurement of flow of liquids from a tank through rectangular and V-notch
3. Determination of force generated by the impact of water jet on the vanes
4. Determination of Co-efficient of discharge of a venturimeter and orifice meter
5. Determination of hydraulic Co-efficients of a vertical orifice
6. Verification of Bernoulli's theorem
7. Determination of critical Reynolds number for a pipe flow
8. Determination of characteristics of a centrifugal blower
9. Measurement of pressure using various manometers like micro manometer, digital manometer, inverted manometer
10. Study of performance characteristics of a single and multi stage centrifugal pump
11. Study of performance characteristics of a gear pump
12. Study of performance characteristics of a piston pump
13. Study of performance characteristics of a Pelton & Kaplan turbine
14. Flow visualization using a Water Tunnel

REFERENCE BOOKS:

1. Yunus A. Cengel& John M Cimbala, Fluid Mechanics and Applications, TataMcGraw- Hill Publishers , 2009 . ISBN: 9780070700345
2. John F. Douglas, Janusz M. Gasiorek, John A. Swaffield, Lynne B. Jack, "Fluid Mechanics", Fifth Edition, Pearson Education, ISBN-13: 978-0-13-129293-2, 200
3. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983 ISBN: 007115600
4. Frank M White, "Fluid Mechanics", Seventh Edition, Mc Graw Hill, ISBN 9780073529349
5. B S Massey, Mechanics of Fluids, ELBS Edition. ISBN-10: 0748740430
6. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai& Sons, Delhi, 1988.ISBN: 978-93-84378-27-1

Course Outcomes

By the end of the course students should be able to :

1. Appreciate the influence of properties of fluid on flow characteristics
2. Evaluate and Analyze the forces responsible for the behavior of the fluid flow
3. Evaluate the fluid forces on the solid bodies and behavior of body due to fluid interaction
4. Derive the expressions related to the flow and quantify the parameters

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	L	M	H	M		L						M
CO2	M	M	M	H								L
CO3	H	H	H	L								M
CO4	H	M	H	H		L	L	L				L

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			X
Self Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+20 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 marks to be earned through self study.
- **Scheme for Continuous Internal Evaluation (CIE- Practicals):** The record is evaluated for 40 marks and one test is considered for 10 marks.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.
- **Scheme for semester end examination (SEE-Practicals):** Laboratory examination is conducted for 50 marks:

GROUP EXPERIMENT	-	25 MARKS
INDIVIDUAL EXPERIMENT	-	15 MARKS
VIVA-VOCE	-	10 MARKS

STRUCTURAL MECHANICS

Course Code: **15AS36** **CIE marks: 100**
Hours/Week:L:P:T:S:4:0:0:1 **SEE Marks :100**
Credits : 05 **SEE: 3 Hours**

Course Learning Objectives:
To enable the students to:

1. Comprehend the basic concepts of strength of materials.
2. Acquire the knowledge of stress, strain under different loadings.
3. Understand the behavior of various structural members under the action of different types of loads
4. Analyze and Interpret the ability of different structures under the action of combined loading
5. Apply the different theories of failures on members

UNIT 1 **10 Hrs**

Basic equations of linear elasticity: The concept of stress and strain, Hooke's Law, Generalized Hooke's Law, Analysis of the state of stress at a point, The state of plane stress and plane strain, Analysis of the state of strain at a point, Relationship between Elastic Constants.

Constitutive behaviour of materials: Constitutive laws for isotropic materials, Allowable stress, Material selection for structural performance, Constitutive laws for anisotropic materials. Bar under constant axial force, Hyper static systems

UNIT 2 **10 Hrs**

Euler-Bernoulli beam theory: The Euler-Bernoulli assumptions , Implications of the Euler-Bernoulli assumptions, Stress resultants Beams subjected to axial loads, Beams subjected to transverse loads, Beams subjected to combined axial and transverse loads.

Deflection of Beams: Equation of Elastic curve, Deflection of Beams, Statically indeterminate beams, Method of Superposition, Method of Integration.

UNIT 3 **10 Hrs**

Torsion: Torsion of circular cylinders, Torsion combined with axial force and bending moments, Torsion of bars with arbitrary cross-sections, Torsion of a thin rectangular cross-section, Torsion of thin-walled open sections.

Columns: Stability of Structures, Euler's formula for pin ended columns, Extensions of Euler's formula to columns with other end loadings, Design of columns under centric and eccentric loading

UNIT 4 **9 Hrs**

Trusses: Introduction, Perfect, Deficient and Redundant Trusses, Principle of virtual work, Principle of virtual work applied to truss structures, Method of Joints and method of Section.

Strain Energy methods: Impact loading, Modulus of Resilience and Toughness, Strain Energy in Axial, shear, torsion and bending, Castigliano's Theorem.

UNIT 5 **9 Hrs**

Failure Theories: Maximum Principal Stress Theory, Maximum Shear Stress theory, Strain Energy Theory, Shear strain Energy theory, Maximum principal strain theory.

Shells: Thin cylindrical shell of circular cross section, Thin spherical shell, Cylindrical shell with hemispherical ends, Bending stresses in thin-walled circular cylinders.

REFERENCE BOOKS:

1. Timoshenko and Young "Elements of Strength of Mateials', East-West Press, 1976. ISBN: 978-93-84378-27-1
2. Beer.F.P. and Johnston.R, 'Mechanics of Materials', McGraw Hill Publishers, 2006. ISBN: 978-0073398235
3. Structural Mechanics, Bao Shihua, Gong Yaoqing, Wuhan University of Technology Press, 2005.
4. Aircraft structural Analysis, T.H.G Megson, Butterworth-Heinemann Publications, 2007. ISBN: 978-1-85617-932-4
5. S.Ramamrutham, R Narayanan, "Strength of Materials', Dhanapath Rai Publishing Company, New Delhi, 2012. ISBN: 978-93-84378-26-4

Course Outcomes:

At the end of this course the student will be able to :

1. Understand the nature of different types of loads
2. Describe the behavior of structures under various loads
3. Apply various principles to ascertain the character of materials under different loads
4. Evaluate the stability of various structures under different loading environments

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	M	L	H	L		M	M	L				L
CO2	H	M	H	H		M	L	H				H
CO3	L	M	H	H		H	L					H
CO4	H	M	H	H	H	H	H	H				M

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 45 marks (15 marks quiz+30 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 10 marks to be earned through assignments.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.

BRIDGE COURSE MATHEMATICS- I

(Common to all programs)

Course Code: 12DMA37 **CIE Marks: 100**
Audit Course **SEE Marks: 100**
SEE : 3 Hrs

Course Learning Objectives:

To enable the students to:

- Apply the knowledge of ordinary and partial differentiation in engineering and real life problems;
- Learn how to formulate and interpret a Taylor series approximation of a function.
- Make the student to learn the concepts of vector analysis.
- Recognize and model differential equations, apply analytic techniques to compute solution for engineering problems.

UNIT 1 **06 Hrs**

Differential Calculus: Successive differentiation, nth derivatives of standard functions, Leibnitz's theorem.Taylor's series and Maclaurin's series for function of single variable (all results without proof).

UNIT II **06 Hrs**

Partial Differentiation: Introduction-partial derivatives, total derivative, differentiation of composite and implicit functions. Jacobiansand problems.

UNIT III **08 Hrs**

Ordinary Differential Equations: Solution of first order and first degree differential equations - variable separable methods homogeneous, linear, Bernoulli, exact equations (without integrating factor).

UNIT IV **06 Hrs**

Linear Ordinary Differential Equations of Second and Higher Order: Linear differential equations of higher order with constant coefficients. Solution by inverse differential operator method. Solution by method of variation of parameters.

UNIT V **06 Hrs**

Vector Analysis: Vector Algebra - Vector addition, Multiplication (dot, cross & triple products), Vector differentiation – velocity, acceleration of a vector point function.

Course Outcomes:

At the end of this course, the student will be able to:

- Use the concept of functions of several variables and their partial derivatives for computing the areas, volumes using multiple integrals.
- Ability to apply concept of differential equations to handle physical problems.

Reference Books:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 40thEdition 2007. ISBN: 81-7409-195-5
2. N. P. Bali, Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, 7th Edition, 2007. ISBN: 978-81-7008-992-6,
3. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 2007. ISBN-10: 007063419X
4. E- Kreyszig "Advanced Engineering Mathematics", John Wiley &Sons Publications, 8thEdition, 2007. ISBN: 978-81-265-3135-6

Scheme of Continuous Internal Evaluation:

CIE consists of Two Tests each for 50 marks (20 marks for Quiz + 30 marks for descriptive).

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

FOURTH SEMESTER

AEROSPACE ENGINEERING PROGRAM

2015 SCHEME

IV SEMESTER

APPLIED MATHEMATICS IV

(Common to all programs)

Course Code: **12MA41** **CIE Marks: 100**
Hours/Week:L:P:T:S:3:0:1:0 **SEE Marks :100**
Credits : 04 **SEE: 3 Hours**

Course Learning Objectives:

To enable the students to:

1. Provide basic definitions and theorems of the calculus of complex functions which are involved in any field problems of Engineering.
2. Use of Bessel functions and Legendre polynomials and their properties in Heat, wave and Laplace equations with cylindrical and spherical symmetry.
3. The theory of probability in study of random phenomena, analyzing and interpreting data that involves uncertainties.
4. Apply linear programming techniques for optimization problems subject to linear constraints in the various areas of Engineering & Science.
5. A student will be able to find the solution of partial differential equations which arise in physical situations.

UNIT 1 **7 Hrs**

Complex Analysis: Complex variables - Function of a complex variable, analytic functions-Cauchy-Riemann equations in Cartesian and polar forms (without proof), properties of analytic functions, construction of analytic functions by Milne-Thomson method.

Complex integration - Complex line integrals-Cauchy's theorem and corollaries (without proof), Taylor's and Laurent's series (statements only), singularities, poles, residues, residue theorem (without proof) - problems

UNIT 2 **7 Hrs**

Special Functions: Introduction of Bessel's and Legendre's differential equation using the solution of Laplace equation in cylindrical and spherical system. Series solution of Bessel's differential equation leading to Bessel function of first kind, recurrence relations, generating functions, Bessel's integral formula, orthogonality of Bessel function. Legendre's differential equation, Legendre polynomials, Rodrigue's formula.

UNIT 3 **7 Hrs**

Linear Programming Problem: Mathematical formulation of Linear Programming Problem, Graphical method, Simplex method and Big M method.

UNIT 4 **6 Hrs**

Probability and Distributions: Basics of Probability: Sample Space, events, probability of an event, addition theorem. Conditional probability, Multiplication theorem, Baye's rule. Random Variables: Discrete and continuous, Probability mass function, Probability density function, Cumulative density function, Mean, Variance, standard deviation Binomial, Poisson, Exponential and Normal Distributions.

UNIT 5 **7 Hrs**

Partial Differential Equations: Classification of second order Partial differential equations - Elliptic, Parabolic and Hyperbolic. Solution of two dimensional Laplace equation in polar coordinates by the method of separation of variables. Solution of two dimensional heat flow in transient state and steady state. Solution of two dimensional wave equation by the method of separation of variables. Vibrating membrane, solution in the case of rectangular and circular membrane - Simple problems.

Reference Books:

1. B.S. Grewal - Higher Engineering Mathematics, Khanna Publishers, 40th Edition, 2007, ISBN: 81-7409-195-5, Chapters: 16, 17, 19, 20, 26 and 33.
2. N.P Bali & Manish Goyal - A Text Book of Engineering Mathematics, Lakshmi Publications, 7thEdition, 2010, ISBN: 978-81-7008-992-6,Chapters: 15, 16, 21.
3. Erwin Kreyszig - Advanced Engineering Mathematics, John Wiley & Sons, 9th Edition, 2007, ISBN: 978-81-265-3135-6, Chapters: 4, 11, 12, 20 and 22.
4. Seymour Lipschutz& Marc Lars Lipson- Theory and Problems of Probability, Schaum's Outline Series, 2nd Edition, ISBN: 0-07—118356-6, Chapters: 1, 2, 3, 4,5and 6.

Course outcomes:

At the end of the course student will be able to:

- Provide basic definitions and theorems of the calculus of complex functions which are involved in any field problems of Engineering.
- Use Bessel functions, Legendre polynomials and their properties in heat, wave and Laplace equations with cylindrical and spherical symmetry.
- Study of random phenomena, analyzing and interpreting data that involves uncertainty, using theory of probability.
- Interpret the models of probability distributions for real life and engineering problems.

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	H	H	H	M	L	L	L	L			M	L
CO2	H	H	H	H		L	L				M	M
CO3	H	H	H	L								
CO4	H	H	H	H	L	M					H	M

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			X
Semester End Examination			X

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

ENGINEERING MATERIALS

(Common to all programs)

Course Code: **12EM42** **CIE marks: 100**
Hours/Week :L:P:T:S : 3:0:0:0 **SEE Marks :100**
Credits: 03 **SEE: 3 Hours**

Course Learning Objectives:
To enable the students to:

1. Compare materials based on their properties
2. Identify appropriate materials for specific engineering applications
3. Identify the phases and structure-property relations in alloys based on the phase diagrams
4. Apply Define and differentiate thermodynamic work and heat.
5. Select materials and process parameters for Flexible Electronics Technology
6. Identify appropriate nano materials for engineering applications and their characterization
7. Identify materials and property requirements for advanced engineering applications

UNIT 1 **6 Hrs**

Introduction: Classification of Materials - Metals, Ceramics, Polymers, composites, Advanced Materials- semiconductors, biomaterials, smart materials, nanostructured materials and their applications Material properties - Mechanical properties, thermal properties - Heat capacity, CTE, thermal conductivity, Electrical and Electronic conductivity, Magnetic properties - dia, para, ferro, ferri, antiferro, domains and hysteresis. Optical properties- Luminescence and photoconductivity.

UNIT 2 **8 Hrs**

Ferrous Materials and Alloys: Binary phase diagrams. Phase Rule, Lever Rule, Solidification, Nucleation and Grain Growth.
Cast Iron, Chromium steels, Nickel steels, Silicon Steels, Tungsten and Molybdenum Steels & Stainless Steels; Tool Steels, structural steels, Corrosion and Heat Treatment.
Non-ferrous Materials and Alloy: Aluminum, Copper and Titanium, their alloys, properties and applications.

UNIT 3 **8 Hrs**

Overview of Flexible Electronics Technology: History of Flexible Electronics, Materials for Flexible Electronics, Fabrication Technology for Flexible Electronics Fabrication on Sheets by Batch Processing, Fabrication on Web by Roll-to-Roll Processing, Additive Printing, Low- temperature Amorphous and Nanocrystalline Silicon Materials, Low-temperature Dielectrics, Low- temperature Thin-film Transistor Devices
Ceramic Materials: Definition, Classification of Ceramic Materials, Processing Methods, Properties and Industrial, Medical and Commercial Applications

Polymers: Definition, Classification of Polymers, Properties and their applications, intrinsically conductive material

UNIT 4 **8 Hrs**

Composites: Types of Matrix Materials and Reinforcements, Selection of Composites, Properties, Applications, Rule of Mixture for density, elastic modulus and tensile strength.

Nanomaterials: Definition, classification and synthesis - physical and chemical processes, Characterization of nanomaterials - Electron microscope, X-Ray Diffraction, particle size analyzer

UNIT 5 **6 Hrs**

Advanced materials for - Construction Applications, Biomedical applications, High temperature Applications, Sensors and Actuators - Shape Memory Alloys and Composites, Thin films and coatings.

Reference Books:

1. William D. Callister; "Materials Science & Engineering- An Introduction"; Wiley India Pvt. Ltd.; 6th Edition; 2006; New Delhi; ISBN:9814-12-669-l; 1,4,6,7,8,9
2. Fred W. Billmeyer, Jr; "Text Book Of Polymer Science"; Wiley-Interscience Publication; 2lld Edition; 1984; ISBN:0-471-82834-3; 8
3. Donald R. Askland, Pradeep P. Phule, ''Essentials of Materials Science and Engineering", Thomas Canada Learning India Edition, ISBN:81-315-0233-3
4. William Smith, "Foundation of Materials Science and Engineering", 3rd Edition, McGraw Hill, 1997. ISBN:9780073529240
5. Flexible Electronics: Materials and Applications, William S. Wong and Alberto Salleo, eds. ISBN 978-0-387-74362-2, 2009

Course Outcome:

After successful completion of the course the students will be able to:

1. Classify materials based on properties
2. Compute the properties of composites based on the properties of the constituents
3. Draw Binary phase diagrams and identify the phases
4. Identify characterization techniques for nanomaterials, thin films, flexible electronics, biomedical applications, high temperature applications, sensors and actuators

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	H	H	H	L	L	M	L	L	L	L		L
CO2	H	M	H	L	L		L					
CO3	H	H	H	H	L							M
CO4	H	H	H	H	L	L						M

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			X
Semester End Examination			X

Scheme of Continuous Internal Evaluation:

CIE consists of Three Tests each for 45 marks (15 marks for Quiz + 30 marks for descriptive) out of which best of two will be considered. In addition there will be one seminar on new topics / model presentation etc. for 10 marks.

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

AERODYNAMICS

Course Code: **15AS43** **CIE marks: 100+50**
Hours/Week:L:P:T:S:3:2:0:1 **SEE Marks :100+50**
Credits : 05 **SEE: 3 Hours+3Hours**

Course Learning Objectives:
To enable the students to :

1. Extend the fundamentals of fluid mechanics to analyze different aerodynamic problems
2. Understand the behavior of various airfoils and wings subjected to incompressible flows
3. Compute and analyze the aerodynamic characteristics of finite wings for incompressible and compressible flows
4. Familiarize with different the types of wind tunnels, its instrumentation and measurement techniques

PART A

UNIT I

Introduction to Aerodynamics **8 Hrs**

Fundamental properties of fluids, Types of Flows, Basic Governing Equations: Continuity, Momentum, Energy and Navier-Stokes equation, Pathlines, Streamlines & Streaklines, Angular velocity, Vorticity, Strain, Circulation, Stream Function, Velocity Potential.

Airfoil Characteristics

Wing planform geometry, Airfoil nomenclature, Airfoil characteristics, Aerodynamic Forces & Moments, Centre of Pressure, Aerodynamic Coefficients, Pressure Distribution on Airfoil, typical airfoil aerodynamic characteristics.

UNIT II **8 Hrs**

Fundamentals of Potential Flows

Uniform flow, Source flow, Sink flow, Combination of a uniform flow with source and sink, Doublet flow, Non-lifting flow over a circular cylinder, Vortex flow, Lifting flow over a circular cylinder, Kutta-Joukowski theorem and generation of Lift, D'Alembert's paradox, Numericals.

Incompressible Flow Over Airfoils

Kelvin's circulation theorem and the starting vortex, vortex sheet, Kutta condition, Classical thin airfoil theory for symmetric and cambered airfoils. Numericals.

UNIT III **8 Hrs**

Incompressible Flow Over Finite Wings

Biot-Savart law and Helmholtz's theorems, Vortex filament, Infinite and semi-infinite vortex filament, Induced velocity, Prandtl's classical lifting line theory: Downwash and induced drag, Elliptical and modified elliptical lift distribution, Lift distribution on wings, Limitations of Prandtl's lifting line theory, Extended lifting line theory, Lifting surface theory, Vortex Panel Method, Vortex lattice method for wings.

UNIT IV **8 Hrs**

Finite Wing Theory & Characteristics of High Lift Devices

Simplified horse-shoe vortex model, Formation flight, Influence of downwash on tail plane, Ground effects, Swept wings: Introduction to sweep effects, Swept wings, Pressure coefficient, Typical aerodynamic characteristics, Subsonic and Supersonic leading edges, Introduction to high-lift systems, flaps, leading-edge slats and typical high lift characteristics, critical Mach numbers, Lift and drag divergence, Shock induced separation, Effects of thickness, Camber and aspect ratio of wings, Transonic area rule, Tip effects.

UNIT V **6 Hrs**

Introduction to Aerodynamic Testing

Principles of wind tunnel operation: Open and closed circuit wind tunnels, Working of low speed, Transonic and supersonic wind tunnels, Smoke and tuft flow visualization techniques, Pressure and Aerodynamic load measurements techniques, Total drag determination of two-dimensional bodies using wake survey at low speeds.

PART B
LABORATORY COMPONENT

1. Types of wind tunnel and their principles of operation
2. Calibration of a subsonic wind tunnel
3. Smoke flow visualization studies on a two-dimensional circular cylinder at low speeds.
4. Smoke flow visualization studies on a two dimensional airfoil at different angles of incidence at low speeds.
5. Tuft flow visualization on a wing model at different angles of incidence at low speeds.
6. Surface pressure distributions on a two-dimensional circular cylinder at low speeds and calculation of pressure drag
7. Surface pressure distributions on a two-dimensional symmetric airfoil at zero incidences at low speeds
8. Surface pressure distributions on a two-dimensional cambered airfoil at different angles of incidence and calculation of lift and pressure drag.
9. Calculation of total drag of a two-dimensional circular cylinder at low speeds using pitot-static probe wake survey technique
10. Calculation of total drag of a two-dimensional cambered airfoil at low speeds at incidence using wake survey technique
11. Pressure distribution over a smooth and rough circular cylinder.
12. Measurement of a typical boundary layer velocity profile on the tunnel wall (at low speeds) using a pitot probe and calculation of boundary layer displacement and momentum thickness.

Reference Books:

1. Anderson J .D., **"Fundamentals of Aerodynamics",** 5th edition, McGraw-Hill International Edition, New York **(**2011) ISBN:9780073398105
2. E. L. Houghton, P.W., Carpenter **" Aerodynamics for Engineering Students",** 5th edition, Elsevier, New York. (2010) ISBN: 9780080493855
3. Clancy L. J., **"Aerodynamics",** Sterling book house, New Delhi. (2006) ISBN: 9788175980570
4. Louis M. Milne-Thomson, **"Theoretical Aerodynamics",** Imported Edition, Dover Publications, USA (2011) ISBN: 080-0759619801
5. Jewel B Barlow, William H Rae, Alan Pope.**"Low-Speed Wind Tunnel Testing",** 3rd Edition, John Wiley & Sons, 3rd Revised edition (3 March 1999) ISBN-10: 0471557749 ISBN-13: 978-0471557746

Course outcomes:

At the end of the course student will be able to:

1. Apply the principles of Fluid Mechanics in designing & developing highly efficient aerodynamic bodies
2. Evaluate the Aerodynamic characteristics of different airfoils subjected to incompressible flows
3. Estimate the Aerodynamic characteristics using finite wing theory
4. Evaluate aerodynamic performance characteristics of various aerodynamic bodies using wind tunnel measurement techniques

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	**M**	**M**	**H**	**H**		**M**	**M**					**M**
CO2	**H**	**H**	**H**	**H**		**M**	**M**					**M**
CO3	**H**	**H**	**H**	**H**			**H**					**M**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**L**					**L**

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			X
Self Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+25 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 marks to be earned through self study.
- **Scheme for Continuous Internal Evaluation (CIE- Practicals):** The record is evaluated for 40 marks and one test is considered for 10 marks.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.
- **Scheme for semester end examination (SEE-Practicals):** Laboratory examination is conducted for 50 marks:

GROUP EXPERIMENT	-	25 MARKS
INDIVIDUAL EXPERIMENT	-	15 MARKS
VIVA-VOCE	-	10 MARKS

AEROSPACE STRUCTURES

Course Code: **15AS44** **CIE marks: 100+50**
Hours/Week L:P:T:S:3:2:0:1 **SEE Marks :100+50**
Credits : 05 **SEE: 3 Hours+3 Hours**

Course Learning Objectives:
To enable the students to:

1. Assess load characteristics on different aerospace structures and suggest suitable design considerations
2. Understand and comprehend behavior of aerospace structures under different loading conditions
3. Quantitatively analyze the loads acting on the fuselage and the wings
4. Design effective solutions for practical problems

PART A

UNIT 1 **6 Hrs**

Loads On Aircraft : Structural nomenclature, Load Factors, Wing Design Loads, Empennage Loads, Fuselage loads, Propulsion Loads, landing gear loads, Miscellaneous loads, Velocity diagram V-n diagram for the loads acting on the aircraft, salient features of the V-n diagram. Flight envelope for different flying conditions.

UNIT 2 **8 Hrs**

Shear Flow in Open & Closed Sections

Open Sections: Concept of shear flow, Shear Flow in Thin walled beams, the shear centre and Elastic axis.

Closed Sections: Bredt - Batho theory, shear centre of closed sections, Torsion of closed section box beams, shear flow in closed section box beams, Spanwise taper effect, Airy's Stress Function.

UNIT 3 **8 Hrs**

Buckling of Plates

Rectangular sheets under compression, local buckling stress of thin walled section - Crippling stresses by Needham's and Gerard's methods, Thin walled column strength- sheet stiffener panels-Effective width.

UNIT 4 **7 Hrs**

Design of Aircraft Structures

Design criteria, Safety Factor, Life Assessment procedures, Widespread Fatigue damage, Damage tolerance and Fail safe Design, Weight Prediction Methods, Balance and load-ability.

UNIT 5 **8 Hrs**

Bolted Riveted And Welded Connections

Failure of single bolt fitting, Lug strength analysis under Axial, Transverse and Oblique Loading, Riveted Connections, Welded Connections.

PART B
LABORATORY COMPONENT

1. Determination of hardness of a given specimen using Rockwell, Vickers and Brinell hardness formulation.
2. Determination of impact toughness of a given specimen.
3. Determination of Tensile strengths of different class of materials. (Including Titanium based Alloys)
4. Determination of Compressive strengths of different class of materials. (Including Titanium based Alloys)
5. Determination of Shear Strength for Different Class of Materials. (Including Titanium based Alloys)
6. Determination of Torsional Strength for different Materials.
7. Verification of the Bending Equation.
8. Determination of forces and deflections in a truss.
9. Study of Variation of Shear forces for various loading conditions.
10. Verification of Euler's Buckling Equation.
11. Unsymmetrical Bending – Determination of Shear Center for Asymmetrical Sections.
12. Determination of Circumferential and Longitudinal Stress and Strains in a thin cylinder.
13. Determination of Fatigue strength of Aerospace Alloys.
14. Fatigue crack propagation in Aerospace Alloys.
15. Photo-elasticity: Stress Concentration Factor.(DEMO)

Course Outcomes:

At the end of the course, the students will be able to:

1. Understand and comprehend the loading behavior on aircrafts.
2. Develop solutions to analyze the structures response to load.
3. Assess the influence of shear flow in open and closed sections
4. Quantitatively analyze the loads acting on the fuselage and the wings

Reference Books

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

4. C. T. Sun, “Mechanics of Aircraft Structures” Wiley-Interscience, March 1998, ISBN-13: 9780471178774

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	**L**	**M**	**H**	**M**		**M**	**M**	**H**	**L**			**H**
CO2	**H**	**M**	**H**	**H**		**M**	**M**	**M**				**M**
CO3	**H**	**H**	**H**	**H**		**H**						**H**
CO4	**H**	**H**	**H**	**H**	**H**	**L**	**H**	**L**				**M**

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	**2**	**3**
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			X
Self Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+25 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 marks to be earned through self study.
- **Scheme for Continuous Internal Evaluation (CIE- Practicals):** The record is evaluated for 40 marks and one test is considered for 10 marks.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.
- **Scheme for semester end examination (SEE-Practicals):** Laboratory examination is conducted for 50 marks:

GROUP EXPERIMENT	-	25 MARKS
INDIVIDUAL EXPERIMENT	-	15 MARKS
VIVA-VOCE	-	10 MARKS

DESIGN OF MACHINE ELEMENTS

Course Code: **15AS45** **CIE marks: 100**
Hours/Week L: P: T: S: 4:0:0:1 **SEE Marks: 100**
Credits: 05 **SEE: 3 Hours**

Course Learning Objectives:
To enable the students to:

1. Comprehend the fundamental aspect of design and failure theories.
2. Understand comprehensively the factors influencing the fatigue life of the component.
3. Design of critical mechanical elements viz. Bearing, Gears, Springs and Shafts.
4. Identify the application of machine elements based on the loading environment.

UNIT I **9 Hours**

Design for Strength and Stiffness: Axial Loads, Bending Moments and Torsional Moments, Combined Loads, Steady and Fluctuating Loads, ASME & BIS codes for design of power transmission shafts, Processes of Creep and Impact

UNIT II **10 Hours**

Design for Fatigue Strength: Introduction- S-N Diagram, Low Cycle Fatigue, High Cycle Fatigue, Endurance limit.

Factors Influencing Fatigue Life: Size effect, surface effect, Stress concentration effects, Types of Fluctuating Stresses, Stresses due to Combined Loading, Goodman and Soderberg relationship, Cumulative Fatigue Damage.

Introduction to fracture mechanics: Modes of fracture, stress intensity factors (Problems), crack propagation, Griffith's Law, Paris law.

UNIT- III **10 Hours**

Lubrication and Bearings:

Lubrication: Types of lubrication, Petroff's Equation, Sommerfeld Number, Stable Lubrication, Thick Film Lubrication.

Bearings: Types of bearings, Bearing life, Selection of Ball and Roller Bearing for Radial and Thrust Loads, Failures of Antifriction Bearing, Design of Journal Bearings for Radial and Thrust Loads, Design of Hydrostatic Pocket Type Thrust Bearing.

UNIT- IV **10 Hours**

Design of Gears: Law of Gearing, Gear Nomenclature, Contact Ratio, Interference, Introduction to Spur, Helical & Bevel gears. Design of Spur, Helical Gears and Bevel Gears, stresses in gear tooth, Lewis equation, Form factor - Dynamic and Wear Load.

UNIT V **9 Hours**

Design of springs: Types of springs, Stability, Design of Helical Springs and Leaf Springs against Static and Fluctuating loads

Design of Power Screws: Mechanics of Power Screw, Stresses in power Screws, Efficiency and Self-Locking, Design of Power Screw

Course outcomes:

At the end of the course student will be able to:

1. Define the critical aspects of design and list the failure theories.
2. Evaluate the factors affecting the fatigue life of a component.
3. Apply the fundamental aspects in designing machine elements such as Bearings, Gears, Springs and Shafts.
4. Justify the use of machine elements based on the loads.

Design Data Hand Books:

1. K. Mahadevan and Balaveera Reddy, Design Data Hand Book, Fourth Edition, 2013, CBS Publication.
2. Dr. K. Lingaiah, Design Data Hand Book Vol. l & Vol.2, 2006, Suma Publications, Belagavi, Bengaluru. ISBN-13:1234567142681 and ISBN-13: 5551234001940

Reference Books:

1. Joseph Edward Shigley - Mechanical Engineering Design, Tata McGraw Hill, New Delhi 1986 ISBN: 9780195155983
2. VL. Maleev and Hartman - Machine Design, CBS Publishers &Distribution, Delhi, 1983. ISBN: 9788186985151
3. Robert .L .Norton - Machine design –Pearson Education Asia, New Delhi, 2001 ISBN-10: 8131705331
4. Hall, Holowinko, Laughlin - Theory and Problems of Machine Design - Schaums Outline Series, 2002, ISBN: 9780070843523

PO & CO MAPPING

CO/PO	AS PO1	AS PO2	AS PO3	AS PO4	AS PO5	AS PO6	AS PO7	AS PO8	AS PO9	AS PO10	AS PO11	AS PO12
CO1	H	H	H	L	L	H	M	M				L
CO2	M	H	H	H	L	L	L	L				M
CO3	L		H	H								M
CO4	H	H	H	H		M	L	M				M

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			
Self Study			
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+25 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 marks to be earned through assignments.
- **Scheme for semester end examination (SEE-Theory):** The question paper consists of part A and part B. Part A will be for 20 marks covering the complete syllabus and Part B will be for 80 marks and shall consists for FIVE questions carrying 16 marks each. All FIVE from part B will have internal choices and one of the two have to be answered compulsorily.

MANUFACTURING TECHNOLOGY

Course Code: **15AS46** **CIE marks: 100+50**
Hours/Week L: P: T: S: 3:2:0:1 **SEE Marks: 100+50**
Credits: 05 **SEE: 3 Hours+3 Hours**

Course Learning Objectives

To enable the students to:

1. Acquire the knowledge of limits, fits and tolerance
2. Understand the processes of casting and heat treatment of metals
3. Outline the different types of composites processing
4. Identify and utilize suitable fabrication technique for a given application

PART -A

UNIT 1 **8 Hrs**

Limits, Fits and Tolerances: Introduction, Concept of interchangeability, Selective assembly, System Assembly, System Terminologies, Limits and Tolerances, Systems of Fit, Geometrical Tolerances, Limit Gauges and Design of Limit Gauges.

Casting Processes : Metal Casting, Casting Terms, Types of Pattern, Moulding Material and Properties, Sand moulding, Centrifugal casting, Pressure casting, Continuous casting; Advantages, Die Casting, Investment Casting, Evaporative Pattern Casting.

UNIT 2 **7 Hrs**

Forging Processes: Classification of forging processes, forging machines, Expressions for forging pressure and load in Open die forging, Flow lines, Effect of Forging on Microstructure.

Extrusion Processes: Types of extrusions, Cold and hot Extrusion, Extrusion Presses.

UNIT 3 **7 Hrs**

Metal Cutting : Machine tools and cutting tools; Engine- lathe parts and functions, Single point cutting tool – Nomenclature; Orthogonal and Oblique cutting, Mechanism of chip formation, Types of chips, Machining Forces and Merchant's Circle Diagram, Failure of cutting tools and tool life , Advanced Cutting Tool Materials.

UNIT 4 **7 Hrs**

Milling Machines: Classification and constructional features of Milling machine, Milling cutter nomenclature, Milling operations, Simple, Compound, Differential and Angular indexing.

Grinding Machines: Types of abrasives, classification of grinding machines – internal, external and centerless grinding.

UNIT 5 **7 Hrs**

Sheet Metal Processes: Rolling process, Classification of Sheet metal, Processes – Shearing, Punching, Blanking, Bending machines – Manual, Hydraulic, Electric, Turret punch, Laser cutting, Sheet metal calculations, Layouts and case studies

Welding & Joining Technologies: Introduction to Welding, Classification of Welding Process, Brazing & Soldering, Selection of material for Welding, Process parameters and its effect on Microstructure and Weld quality, Welding Defects

PART-B
LABORATORY COMPONENT

PART-I SAND TESTING, FOUNDRY & FORGING

1. Preparation of Green Sand Mould specimen and determination of Mechanical Properties using Universal Sand Testing Machine.
2. Determination of Permeability of Green Sand.
3. Forging and Microstructural analysis of mild steel.
4. Composite Preparation using Hand Lay-up Process.
5. Preparation of moulds using two moulding boxes.
    a. With Patterns.
    b. Without Patterns.

PART –II MACHINING PROCESS

6. Preparation of Model Involving different lathe operations.
    a. Thread Cutting.
    b. Knurling.
    c. Measurement of Cutting Forces using Lathe Tool Dynamometer.
7. Surface Milling & Step Milling in Vertical Milling Machine.

PART-III METROLOGY

8. Measurement of Angle using Sine Bar, Sine Centre and Bevel Protractor.
9. Measurement of Gear Tooth Profile using Profile Projector.
10. Calibration of LVDT and Thermocouple.
11. Calibration of Load Cell and Pressure Gauge.

DEMONSTRATION EXERCISES

12. Electric Discharge Machining &Rapid Prototyping Process. (Demonstration Only)
13. Tungsten Inert-Gas Welding. (Demonstration Only)
14. Preparation of Casting. (Aluminum or Cast iron-Demonstration only)

Reference Books:

1. Roy A Lindberg, 'Manufacturing Process and Materials of Manufacture', Prentice Hall of India, ISBN: 8120306635 4th 2005 Edition
2. G.Boothroyd "Fundamental of Metal Machining", McGraw Hill, ISBN:824778529 2nd 1975 Edition
3. S.K.Hajra Choudhury, 'Elements of Workshop Technology', Media Promoters, 2009. ISBN: 9788185099149 2nd 1990 Edition

4. Serope Kalpakjian, "Manufacturing Engineering & Technology", Pearson. ISBN-10: 8177581708 11th 2013 Edition.
5. F.C. Campbell, "Manufacturing Technology for Aerospace Structural Materials", Elsevier. ISBN-10: 1-85-617495-6 2006 1st Edition
6. Anand K Bewoor, Vinay A Kulkarni "Metrology & Measurement", McGraw-Hill. ISBN 10-0-07-014000-6 2009 4th Edition

Course Outcomes

By the end of the course students should be able to:

1. Comprehend the concept of Limits, Fits and tolerances and their influence in manufacturing processes.
2. List and Demonstrate the methodologies adopted in different manufacturing processes.
3. Design and examine the influence of stresses developed during the metal cutting.
4. Classify and categorize metal addition and metal removal processes.

PO & CO MAPPING

CO/PO	ASPO1	ASPO2	ASPO3	ASPO4	ASPO5	ASPO6	ASPO7	ASPO8	ASPO9	ASPO10	ASPO11	ASPO12
CO1	**H**	**L**	**H**	**L**		**M**	**M**					**M**
CO2	**L**	**L**	**H**	**H**		**L**	**L**					**M**
CO3	**H**	**M**	**H**	**L**		**L**	**L**					**L**
CO4	**H**	**M**	**H**	**L**		**M**	**M**					**L**

COURSE ASSESSMENT METHOD	ASSESSMENT INTERVALS		
	1	2	3
Quiz	X	X	X
Tests	X	X	X
Seminar/ Presentation			
Lab			X
Self-Study			X
Semester End Examination			X

- **Scheme for Continuous Internal Evaluation (CIE-Theory):** CIE consists of THREE tests for 40 marks (15 marks quiz+25 marks descriptive) out of which best TWO (as a set) will be considered. In addition, 20 mark to be earned through self-study.
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- **Scheme for semester end examination (SEE-Practicals):** Laboratory examination is conducted for 50 marks:

GROUP EXPERIMENT	-	25 MARKS
INDIVIDUAL EXPERIMENT	-	15 MARKS
VIVA-VOCE	-	10 MARKS

BRIDGE COURSE MATHEMATICS- II

(Common to all programs)

Course Code: 12DMA48 **CIE Marks: 100**
Audit Course **SEE Marks: 100**
SEE : 3 Hrs

Course Learning Objectives:

To enable the students to:

- Recognize partial differential equations and apply analytic techniques to compute solution for engineering problems.
- Apply the significance of vector differentiation and their theoretical importance in engineering problems.
- Apply the significance of Laplace transforms and inverse Laplace transforms and their theoretical importance in engineering problems.
- Identify and solve initial value problems, physically interpret the solutions using the Laplace transforms.

UNIT 1 **06 Hrs**

Laplace Transforms: Definition, transforms of elementary functions, properties, derivatives and integrals,unit step function.

UNIT 2 **06 Hrs**

Inverse Laplace Transforms: Inverse Laplace transforms- properties, convolution theorem (statement only) - problems. Solution of linear differential equations with constant coefficients

UNIT 3 **06 Hrs**

Integral Calculus: Multiple integrals - Double and Triple integrals. Area enclosed by plane curves, Volume of solids. Definition of beta and gamma functions and problems.

UNIT 4 **06 Hrs**

Partial Differential Equations (PDE): Formation of Partial differential equations by elimination of arbitrary constants/functions. Solution of Lagrange's linear PDE. Solution of PDE by the Method of separation of variables (first and second order equations).

UNIT 5 **06 Hrs**

Vector Analysis: Vector Differentiation - Scalar and vector point functions, gradient, directional derivative, divergence and curl. Solenoidal and Irrotational fields, Vector identities.

Reference Books:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 40th Edition 2007. ISBN: 81-7409-195-5
2. N. P. Bali, Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, 7th Edition, 2007. ISBN: 978-81-7008-992-6,
3. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publications, 2007. ISBN-10: 007063419X
4. E- Kreyszig "Advanced Engineering Mathematics", John Wiley &Sons Publications, 8th Edition, 2007. ISBN: 978-81-265-3135-6

Course Outcomes:

At the end of this course, the student will be able to:

- The student will be able to solve problems arising in signal processing and various systems using Laplace transforms techniques for problems arising in signals and systems.
- The student will be able to apply vector integration to different Engineering applications.

Scheme of Continuous Internal Evaluation:

CIE consists of Two Tests each for 50 marks (20 marks for Quiz + 30 marks for descriptive).

Scheme of Semester End Examination:

The question paper consists of Part A and Part B. Part A will be for 20 marks covering the complete syllabus and is compulsory. Part B will be for 80 marks and shall consist of five questions (descriptive, analytical, problems or/and design) carrying 16 marks each. All five from Part B will have internal choice and one of the two have to be answered compulsorily.

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