Annasaheb Dange College of Engineering and Technology

Ashta, Dist. Sangli-416301 (An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Department of Aeronautical Engineering

Vision & Mission of Institute

Vision: To be a Leader in preparing professionally competent engineers

Mission: **We, at Annasaheb Dange College of Engineering and Technology, Ashta, are committed to achieve our vision by**

- Imparting effective outcome based education.
- **Preparing students through skill oriented courses to excel in their profession with ethical values.**
- **Promoting research to benefit the society.**
- **Strengthening relationship with all stakeholders.**

Vision & Mission of Department

Vision: **To be a leader in preparing competent aeronautical engineers to meet the present and future needs of the aeronautical and allied industries**

Mission: **We, at the Department of Aeronautical Engineering, Annasaheb Dange College** of Engineering and Technology, Ashta are committed to achieve our vision by

- **Preparing the students with good fundamental knowledge of aeronautics through outcome-based education.**
- Imparting technical knowledge in tune with the current industry requirements **through skill-oriented courses.**
- **Promoting research culture among the faculty and students through sponsored and consultancy projects with industries and research establishments.**
- **Establishing relationships with all the stakeholders for the benefit of students.**

Head of Department

Annasaheb Dange College of Engg. & Tech. ASHTA 416 301

Annasaheb Dange College of Engineering and Technology

Ashta, Dist: Sangli-416301 (An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Department of Aeronautical Engineering

Program Educational Objectives (PEOs)

The graduates of the Department of Aeronautical Engineering at ADCET, Ashta will be able to,

PEO 1:	**Pursue successful career in technical profession, entrepreneurship, research and higher studies in the field of aeronautical and allied engineering.**
PEO 2:	**Demonstrate technical competency in aeronautical engineering by offering best possible engineering solutions.**
PEO 3:	**Work effectively as an individual and as a team member with professional ethics, social and environmental concern.**
PEO 4:	**Engage in lifelong learning and adapt to the changing professional requirements.**

Head of Department

Annasaheb Dange College of Engineering and Technology

Ashta, Dist: Sangli-416301 (An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Department of Aeronautical Engineering

Program Outcomes (POs)

PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 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.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 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.
PO 7	Environment and stainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with 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.
PO 11	Project management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Annasaheb Dange College of Engineering and Technology

Ashta, Dist: Sangli-416301 (An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

Department of Aeronautical Engineering

Program Specific Outcomes (PSOs)

PSO 1	Apply the knowledge of aeronautical engineering in the Design and Development, Operating, Maintaining and overhauling of the products enhancing the mobility in the society.
PSO 2	Develop aeronautical and aviation frameworks, and subsystems to overcome the challenges faced by the aviation industry through innovative solutions leading to employability and entrepreneurial development.

Head of Department

Annasaheb Dange College of Engg. & Tech. ASHTA 416 301

Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

Department of Aeronautical Engineering

Teaching and Evaluation Scheme
B. Tech: Semester III (Aeronautical Engineering)

Course code	Course	Teaching Scheme				Evaluation Scheme				
						Scheme	Theory (Marks)			Practical (Marks)	
		L	T	P	Credits		Max	Min. for Passing		Max	Min. for Passing
1AEBS201	Applied Mathematics - III	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEES202	Fluid Mechanics	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEES203	Mechanics of Materials	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEES204	Applied Thermodynamics	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC205	Introduction to Aerospace Engineering	2	-	-	2	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEPC206	Aircraft Production Technology	2	-	-	2	ISE	25	10		-	-
1AEPC251	Aircraft Production Technology Laboratory	-	-	2	1	ISE	-	-	-	25	10
1AEES254	Fluid Mechanics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
1AEES255	Mechanics of Materials Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
1AEES256	Applied Thermodynamics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
Total		**16**	**4**	**8**	**24**		525			200	
Total Contact Hours/Week= 28 hrs											

Course Category	HS	BS	ES	PC	PE	OE	PR
Credits	**0**	**4**	**15**	**5**	**0**	**0**	**0**
Cumulative Sum	**3**	**20**	**39**	**5**	**0**	**0**	**0**

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Teaching and Evaluation Scheme
B. Tech: Semester IV (Aeronautical Engineering)

Course Code	Course Name	Teaching Scheme				Evaluation Scheme					
							Theory (Marks)			Practical (Marks)	
		L	T	P	Credits	Scheme	Max	Min for Passing		Max	Min for Passing
1AEES207	Numerical Analysis with Programming Language	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC208	Low Speed Aerodynamics	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC209	Air Breathing Propulsion	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC210	Aerospace Materials and Structures	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC211	Aircraft Systems and Instruments	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEHS252	Professional Ethics	-	-	2	2	ISE	-	-	-	25	10
1AEMC253	Environmental Studies	2	-	-	-	ISE	-	-	-	25	10
1AEES257	Numerical Analysis with Programming Language Laboratory	-	-	2	1	ISE	-	-	-	25	10
1AEPC258	Low Speed Aerodynamics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
1AEPC259	Air Breathing Propulsion Laboratory	-	-	2	1	ISE	-	-	-	25	10

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1AEPC260	Aerospace Materials and Structures Laboratory	-	-	2	1		ISE	-	-	-	25	10
							ESE	-	-	POE	25	10
Totai		**17**	**2**	**10**	**23**			**500**			**200**	
Total Contact Hours/Week: 29 Hours												

Course Category	HS	BS	ES	PC	PE	OE	PW
Credits	2	0	4	17	0	0	0
Cumulative Sum	5	20	43	22	0	0	0

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEBS201 - Applied Mathematics - III**
Prerequisite/s	1AEBS101 - Applied Mathematics – I 1AEBS108 - Applied Mathematics - II
Teaching Scheme: Lecture/Tutorial/Practical	03/01/00
Credits	4
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEBS201_1	**Solve** the problems on Fourier Series and Laplace Transform.**(K^3)**
1AEBS201_2	Make use of Linear Differential Equation to **solve** the Aeronautical Engineering problems. **(K^3)**
1AEBS201_3	Make use of Partial Differential Equation to **solve** the Aeronautical Engineering problems. **(K^3)**
1AEBS201_4	**Solve** the problems of vector calculus. **(K^3)**
1AEBS201_5	**Demonstrate** Numerical ability to **solve** the problem. **(S^2)**

Course Contents:		
Unit 1	**Vector Calculus** Introduction, Scalar and vector point functions - vector operator del ,Del applied to scalar point functions - gradient, directional derivative, Del applied to vector point functions - Divergence and curl, Line integral, Green's theorem in the plane	**07 Hrs**
Unit 2	**Linear Differential Equations** Definitions, Complete solution., Operator D, Rules for finding Complementary function., Inverse operator, Rules for finding the Particular integral, Cauchy's homogeneous linear differential equations..	**07 Hrs**
Unit 3	**Applications of Linear Differential Equations** Introduction, Oscillations of a spring, Free oscillations, Damped Oscillations, Forced oscillations without damping, The Whirling of Shafts.	**07 Hrs**
Unit 4	**Laplace Transform** Introduction, Laplace transform of elementary functions, Properties of Laplace Transforms, Transforms of derivatives, Transforms of integrals, Multiplication by t, Division by t, Evaluation of integrals by Laplace Transforms, Inverse Laplace transforms - Method of Partial Fractions, convolution Theorem, Applications of Laplace transform to solve linear differential Equations	**07 Hrs**
Unit 5	**Fourier Series** *Introduction, Euler's Formulae, Conditions for a Fourier expansion,* Functions having points of discontinuity, Change of interval, Expansion of odd or even periodic functions, Half range series.	**07 Hrs**
Unit 6	**Partial Differential Equations and its Application** Introduction –Formation of partial differential equations, linear equation of	**07 Hrs**

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	the first order (Lagrange's equation), Method of separation of variables, Vibration of a stretched string, one dimensional wave equation (using separation of variables), One dimensional heat flow equation (using separation of variables).	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Higher Engineering Mathematics	Dr. B. S. Grewal	Khanna Publication	40th	2007
02	Higher Engineering Mathematics.	H. K. Das	S. Chand and company ltd., New Delhi.	1st	2011
03	Higher Engineering Mathematics.	B.V. Ramana	Tata McGraw Hill Education Private limited	1st	2007
04	A Text Book of Engineering Mathematics	N.P.Bali, Manish Goyal	Laxmi Publication New Delhi	7th	2007

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons,Inc.	9th	2007
02	Advanced Engineering Mathematics.	Potter Merle C.	Oxford University Press,	3rd	2005
03	Engineering Mathematics Volume I and II	ITL Education	Cengage Learning India Private limited	1st	2015
04	Advanced Engineering Mathematics.	ONeil Peter V	Cengage Learing India Pvt. Ltd. ,	1st	2012
05	Engineering Mathematics Vol- I.	Kandasamy P. , Thilagavathy K. and Gunavathy K.	S Chand & Company Ltd New Delhi	3rd	2000
06	Engineering Mathematics Vol- II.	Kandasamy P. , Thilagavathy K. and Gunavathy K.	S. Chand & Company Ltd, New Delhi	4th	1999

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES202 - Fluid Mechanics**
Prerequisite/s	1AEBS103 - Engineering Mechanics:Statics 0AEES110 - Engineering Mechanics:Dynamics 1AEBS101 - Applied Mathematics – I 1AEBS108 - Applied Mathematics - II
Teaching Scheme: Lecture/Tutorial/Practical	03/01/00
Credits	4
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES202_1	**Explain** the fluid properties, their definitions & SI units. **(K^2)**
1AEES202_2	**Apply** the basic laws of nature to derive the fluid flow governing equations & use them for solving the problems related to fluid mechanics. **(K^3)**
1AEES202_3	Apply the dimensional **analysis** technique to obtain the equations for the problems related to fluid mechanics and use the similarity laws for carrying out the prototype testing. **(K^3)**
1AEES202_4	**Explain** basic terminology & the working principle of various fluid machinery and will be able to draw the velocity triangle of the turbo machinery. **(K^3)**
1AEES202_5	Comment on the significance of the Governing equations of the fluid flow in **solving** the fluid mechanics problems using the computational methods and explain the basic terminology involved in computational fluid dynamics. **(K^3)**
1AEES202_6	Calculate the losses that occur when a fluid passes through closed conduits and **analyze** them to select the dimensions and material for the minimum loss. **(K^4)**
1AEES202_7	**Determine** the lift & drag forces on the bodies like flat plate, cylinder & airfoil and comment on the comparative study. **(K^4)**

Course Contents:		
Unit 1	**Introduction to Fluid Mechanics & Basic Concepts** **Introduction -** A Brief History of Fluid Mechanics, Application Areas of Fluid Mechanics, Dimensions & Units. **Properties of Fluids -** Density, Specific Volume, Specific Weight, Specific Gravity, Viscosity, Newton's Law of Viscosity, Coefficients of Kinematic & Dynamic Viscosity, Newtonian & Non-Newtonian Fluids, Surface Tension, Capillarity Effect & Vapor Pressure, Compressibility & Speed of Sound **Flow Characteristics -** Steady & Unsteady Flows, Viscous & Inviscid Flows, Compressible & Incompressible Flows, Laminar & Turbulent Flows, Natural & Forced Flows, One, Two & Three Dimensional Flows.	**06 Hrs**
Unit 2	**Fluid Statics & Fluid Kinematics** **Fluid Statics -** Pressure, Pressure at a Point, Hydrostatic Law & Variation of Pressure with depth, Pressure Measuring Devices, Forces on Submerged Plane & Curved Surfaces, Buoyancy, Stability of Immersed & Floating	**06 Hrs**

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	bodies. **Fluid Kinematics** - Lagrangian & Eulerian Description of Fluid Flow, Acceleration Field & Substantial Derivative, Continuity Equation, Mass & Volume Flow Rates, Flow Patterns (Stream Lines, Path Lines & Streak Lines), Flow Visualization Techniques.	
Unit 3	**Fluid Dynamics & Dimensional Analysis** **Fluid Dynamics** - The Linear Momentum Equation, Conservation of Energy – The Bernoulli Equation, Applications of the Bernoulli Equation, Static, Dynamic & Stagnation Pressures, General Energy Equation – Energy Transfer by Heat & Work. **Dimensional Analysis** - Dimensional Analysis, Non-Dimensional Parameters, Model & Similarity Laws, Wind Tunnel Testing.	**08 Hrs**
Unit 4	**Internal & External Fluid Flows** **Internal Fluid Flow** - The Developing & Fully Developed Flow, Laminar Flow between Flat Plates & Pipes, Turbulent Flows in Pipes, Frictional & Minor Losses, Piping Networks & Pump Selection, Flow Rate & Velocity Measurement. **External Fluid Flow** - Flow over a Flat Plate, Laminar & Turbulent Boundary Layer, The Boundary Layer Equations – Momentum Integral Equation, Wall Shear Stress, Skin Friction Coefficient, Pressure & Viscous Forces (Lift & Drag), Lift & Drag Coefficients, Flow over Flat Plates, Cylinder & Spheres, Flow over a Airfoil & Pressure distribution.	**08 Hrs**
Unit 5	**Turbo Machinery** Classifications & Terminology, Euler's Turbomachine Equation, Velocity Triangles, **Pumps –** Introduction, Positive-Displacement Pumps, Centrifugal Pumps, Axial Pumps **Turbines –** Introduction, Impulse & Reaction Turbines, Gas Turbines, Wind Turbines	**08 Hrs**
Unit 6	**Introduction to Computational Fluid Dynamics** **Introduction & Fundamentals of CFD**, The Governing Equations in PDE Form, Conservation of Mass, Conservation of Momentum, Conservation of Energy, Solution Procedure of CFD technique, Additional Governing Equations, Grid Generation & Grid Independence, Boundary Conditions **Laminar CFD Calculations** - Pipe Flow Entrance Region at Re = 500, Flow around a Cylinder at Re = 150,**Turbulent CFD Calculations** - Introduction to Turbulence Models, Flow around a cylinder at Re = 10,000, CFD Calculations with Heat Transfer	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Fluid Mechanics (SIE)	Yunus A. Cengel, John M. Cimbala	McGraw Hill Education (India) Private Limited, New Delhi	3rd	2016

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02	Introduction to Fluid Mechanics & Fluid Machines	S K Som, Gautam Biswas, Suman Chakraborthy	Tata McGraw-Hill, New Delhi	3rd	2012
03	Fluid Mechanics	Kumar, K.L	Tata McGraw-Hill, New Delhi	2nd	2000

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Fluid Mechanics	Robert W. Fox and Alan T. McDonald	Wiley and Sons, Inc	5th	1998
02	Textbook of Fluid Mechanics and Hydraulic Machines	R K Bansal	Laxmi Publications (P) Ltd.	9th	2017
03	Vectors, Tensors and the Basic Equations of Fluid Mechanics	Rutherford Aris	Dover Publications, Inc	New Edition	1990
04	Fluid Mechanics	Frank M. White	McGraw-Hill Professional	SIE	2011

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES203 - Mechanics of Materials**
Prerequisite/s	1AEBS103 - Engineering Mechanics:Statics 0AEES110 - Engineering Mechanics:Dynamics 1AEBS101 - Applied Mathematics – I 1AEBS101 - Applied Mathematics - I
Teaching Scheme: Lecture/Tutorial/Practical	03/01/00
Credits	4
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES203_1	**Explain** the basic concepts related to stress and strains in engineering components. **(K^2)**
1AEES203_2	**Construct a** Mohr's circle for given plane stress problem to calculate stress components.**(K^3)**
1AEES203_3	**Apply** the fundamental concepts of principle of superposition, equilibrium, force-deformation, and stress-strain relationships to the solid mechanics problems. **(K^3)**
1AEES203_4	**Calculate** the shear force, bending moment, stresses and deflections in a beam under given load conditions. **(K^3)**
1AEES203_5	**Calculate** the shear stresses in shafts subjected to torsion. **(K^3)**
1AEES203_6	Perform structural **analysis** by hand computations and design bars, shafts, beams and columns with the use of theories of failure. **(K^4)**

Course Contents:		
Unit 1	**Stress and strain** Concept of stress and strain, Normal stress and strain, Shear stress and strain, Bearing stress, Hooke's Law, Stress-strain diagrams: Elastic Limit, yield strength and ultimate tensile strength, Poisson's Ratio, Elastic constants: Modulus of elasticity, Bulk Modulus, Modulus of Rigidity, Composite Bars, Thermal Stresses, Stresses in thin-walled pressure vessel.	**08 Hrs**
Unit 2	**Analysis of Stress and Strain:** Stresses on inclined planes, Plane stress, Stress transformation, Principal planes and principal stresses, Maximum shear stress, Mohr circle for plane stress conditions. Strain energy stored in body when load is applied gradually, suddenly and with impact	**05 Hrs**
Unit 3	**Shearing Force and Bending Moment:** Diagram for simply supported Beam, Cantilevers, with concentrated, uniformly distributed and variable loads. Castigliano's theorems, unit load method. **Stresses in beams:** Pure Bending: Deformation in a transverse cross-section, derivation of formula for bending stresses. Section modulus of rectangular	**10 Hrs**

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	and circular sections (Solid and Hollow), I and T sections, Bending stresses in symmetric and un-symmetric sections, Bending stresses in composite sections. Shear stress formula, shear stress distribution in rectangular, circular, Triangular, I, T sections.	
Unit 4	**Deflection of Beams** Deflection in simply supported beams and cantilevers with concentrated loads, uniformly distributed loads and combination of these. Double integral Method, Macaulay's method, moment area method.	**05 Hrs**
Unit 5	**Buckling of columns & Torsion in Shafts** **Buckling of columns** : Buckling, Euler formula for pin-ended columns and its extension to columns with other end conditions. Rankine Gordon formula. **Torsion in shafts** : Torsion: Deformation in a circular shaft, angle of twist, stresses due to torsion, derivation of torsion formula, torsion in composite shafts.	**08 Hrs**
Unit 6	**Theories of failure** Theories of failure-Maximum principal stress theory, maximum shear stress theory, maximum strain theory, maximum strain energy theory and maximum shear strain energy theory.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Mechanics of Materials	Gere and Thimoshenko	CBS Publisher	2nd	2000
02	Strength of Materials	S. Ramamrutham R. Narayanan	Dhanpat Rai Publishing Co.	18th	2011
03	Mechanics of Materials	Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain	Laxmi Publications Pvt. Ltd.	Revised	2017
04	A Textbook of strength of materials	Dr. R. K. Bansal	Laxmi Publications Pvt. Ltd.	6th	2017

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
01	Mechanics of Materials	E P Papov	PHI Learning Pvt Ltd.	2nd	1999
02	Mechanics of Materials	F. B. Beer, E.R. Johnston & J T Dewolf	Tata McGraw Hill	-	2008
03	Aircraft Structures for Engineering Students	T H G Megson	Elsevier	5th	-
04	Advanced Mechanics of Solids	L S Srinath	Tata McGraw Hill	3rd	2011

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Reference Books:					
Sr.No	**Title**	**Author**	**Publisher**	**Edition**	**Year**
05	Elements of Strength of Materials	Timoshenko	East West	-	2003

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES204 - Applied Thermodynamics**
Prerequisite/s	1AEBS103 - Engineering Mechanics: Statics 0AEES110 - Engineering Mechanics: Dynamics 1AEBS101 - Applied Mathematics – I 0AEBS108 - Applied Mathematics - II
Teaching Scheme: Lecture/Tutorial/Practical	03/01/00
Credits	4
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES204_1	**Explain** the basic physical quantities & their Units, principles of thermodynamics such as systems, properties, and thermodynamics laws.**(K^2)**
1AEES204_2	**Explain** the concept of Entropy & its significance in the irreversible & reversible process. **(K^2)**
1AEES204_3	**Apply** the First Law of Thermodynamics to solve problems related to the Flow & Non Flow Processes. **(K^3)**
1AEES204_4	**Apply** the Second Law of Thermodynamics to solve problems related to thermodynamic cycles. **(K^3)**
1AEES204_5	**Solve** the problems based on the air standard cycles such as Otto cycle, Diesel and Brayton cycle, etc. **(K^3)**
1AEES204_6	Know definitions of fuel, oxidizer and combustion; concepts related to element conservation; **calculate** enthalpy of reaction, enthalpy of combustion and heating values; determine adiabatic flame temperature. **(K^3)**

Course Contents:		
Unit 1	**Definitions & Concepts** Thermodynamics and energy, Applications, Fundamentals units. Derived units (SI units), systems and control volume, properties of a system, continuum, state and equilibrium, state postulate, processes and cycles, Zeroth law of thermodynamics, temperature scale; energy, various forms of energy, energy transfer, pure substance, ideal gas law.	**06 Hrs**
Unit 2	**1st Law of Thermodynamics** Application of 1st law of thermodynamics for non-flow process, for flow process-steady state, steady flow processes, transient flow processes-charging & discharging of tank.	**07 Hrs**
Unit 3	**2nd Law of Thermodynamics & Its Application** Limitations of the 1st law of thermodynamics, heats engine, heat pump/refrigeration. 2nd law of Thermodynamic-Kelvin Planck &Clausius statement & their equivalence. Reversible & irreversible process, Carnot cycle & Carnot principles availability.	**08 Hrs**
Unit 4	**Entropy**	**06 Hrs**

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	The inequality of Clausius, entropy-A property of a system, entropy change in reversible process, entropy change of control mass during on irreversible process, entropy generation, entropy change of solid or liquid and an ideal gas, entropy as a rate equation.	
Unit 5	**Power Cycle & Refrigeration Cycle** Rankin's cycle- ideal reheat & regenerative. Gas power cycle – Otto cycle, diesel cycle, dual cycle &Brayton cycle. Refrigeration cycle, vapor compression refrigeration & gas refrigeration cycles. Numerical on power cycles.	**09 Hrs**
Unit 6	**Introduction to Combustion** Introduction, Definition of Fuel, Oxidizer, Ignition and Combustion, Kinds of Fuels and Oxidizer, Stoichiometry, Ideal Gas Mixture, Heat of Formation and Reaction, Adiabatic Flame Temperature, Entropy Change of a Reacting System.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Engineering Thermodynamics	P K Nag,	McGraw-Hill	5th	2013
02	Thermodynamics - an Engineering Approach	Yunus A. Cengel and Michael A. Boles	McGraw-Hill	5th	2006
03	Gas Turbine Combustion: Alternative Fuels and Emissions	Arthur H. Lefebvre, Dilip R. Ballal	CRC Press	3rd	2010

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	A Textbook of Refrigeration and Air Conditioning	R. K Rajput	S. K. Kataria and Sons,2012	2nd	2012
02	Fundamentals of combustion processes	Sara McAllister, Jyh-Yuan Chen, A. Carlos Fernandez-Pello,	Springer Science & Business Media	-	2011
03	Fundamentals of Engineering Thermodynamics	E. Radhakrishnan	PHI	2nd	-
04	Principles of Engineering Thermodynamics	Moran, Shapiro , Boettner , Bailey	Wiley	8th	2015

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Reference Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
05	Advanced Engineering Thermodynamics	Adrian Bejan	Wiley	3rd	2006

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEPC205 - Introduction to Aerospace Engineering**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	2
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC205_1	**Explain** the historical developments in the Aeronautical Engineering, Current Trends in the Aviation Industry **(K^2)**
1AEPC205_2	**Comment & Explain** in detail the basic components, systems & subsystems of the Aircraft and their functions**(K^2)**
1AEPC205_3	**Explain** the fundamentals of Aerodynamics, Propulsion, Structures & Their classifications**(K^2)**
1AEPC205_4	**Comment & Explain** in detail the basics of Air Transportation & Airport Operations **(K^2)**
1AEPC205_5	**Comment & Explain** on the material requirements for Aeronautical applications**(K^2)**
1AEPC205_6	**Identify & Comment** on the various configurations of the aircraft **(K^2)**

Course Contents:		
Unit 1	**Introduction & Basic Anatomy of Aerospace Vehicles** History of Aviation(Global & India Perspective), Early Concepts, Wright Brothers Era, First World War Period, Second World War Period, Modern Developments, Classification of Flying Vehicles, Anatomy of (Basic Parts & Their Function), Buoyancy Lift Vehicles(Airships, Aerostats, Hot Air Balloons), Dynamic Lift Vehicles(Aircrafts), Powered Static Lift Vehicles(Helicopters), Reaction Lift Vehicles(Launch & Re-entry Vehicles), Parachutes & Para gliders, Control Surfaces & Their Functions	**07 Hrs**
Unit 2	**Propulsion - Air Breathing and Non Air Breathing Engines** Air Breathing Propulsion - Principle of Operation , Components Piston Engines , Jet Engines, Turbo Jet, Turbo Fan, Turbo Prop, Turbo Shaft, Ramjet, Scramjet, Station Numbering - Flight Envelope - Non-Air Breathing Propulsion	**07 Hrs**
Unit 3	**Aircraft Maintenance and Repair** General Aircraft Repairs- A, B, C, D Checks - Starting procedures of Turbo Prop, Turbo Fan and Turbojet Engines- Flight Inspection Procedures - Tools used in Airrcraft Maintenance- MRO Sector - Indian MRO Sector - Various job roles involved in the maintenance sector.	**08 Hrs**
Unit 4	**Aviation - Air Transportation systems** History of Aviation - Regulatory bodies - ICAO, IATA, FAA, EASA, DGCA- Airlines Management in brief - Airport Operations - ARFF - Airport	**06 Hrs**

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	Nomenclature - Air Traffic Control Operations - Airline Ticketing- Job roles involved in the Aviation Sector - Flight Scheduling in brief.	
Unit 5	**Aerodynamics** International Standard Atmosphere, Introduction to Aerodynamic Forces(Lift & Drag), Types of Lift & Drag Forces, Types of Weight & Thrust Forces, Aerofoils – Nomenclature & Types, NACA Series, Pressure Distribution around a Typical Aerofoil, Centre of Pressure, Aerodynamics Centre, Wing – Nomenclature & Configuration Types, Rectangular Wings, Swept Back & Forward Wings, Delta Wings, High Wing, Mid Wing, & Low Wing, High Lift Devices in Wings, Slats & Slots, Flaps, Trim Tabs, Airbrakes.	**07 Hrs**
Unit 6	**Materials and Aircraft Structures** Materials, Typical Materials used in Aircraft Structures, Aluminum Alloys, Steel (Marging Steel), Nickel & Titanium Alloys, Glass & Carbon Composites, Aircraft Structures, Basic Loads acting on Aircraft Structures, Structural Members of Wing, Structural Members of Fuselage, Structural Members of Landing Gear, Structural Members of Engine Nacelle	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Flight	Anderson, J.D	McGraw-Hill	7th	2011
02	Aerodynamics, Aeronautics and Flight Mechanics	McCormick, B.W.	John Wiley	2nd	1995
03	Gas Turbines and Jet and Rocket Propulsion	Mathur M L and Sharma R P	Standard Publisher	3rd	2014
04	Aircraft Structures for Engineering Students	Megson, T.H.G	Elsevier	4th	2007

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Aerospace Engineering with a Flight Test Perspective	Stephen Corda	Wiley	1st	2011
02	Aviation. An Introduction to the Elements of Flight	Algernon Edward Berriman	Nabu Press	1st	2010
03	Aircraft Propulsion and Gas Turbine Engines	Ahmed F El-Sayed	Taylor and Francis	2nd	-
04	Experiments in Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2010
05	Aircraft Communication	Mike Tooley &	Routledge	1st	2007

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Reference Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
	& Navigation System	David Wyatt	(SIE)		

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Course Details:

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEPC206 - Aircraft Production Technology**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	2
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC206_1	**Describe** the technique of manufacturing different parts of aircraft like Casting, Joining, Machining, Shaping and Forming **(K^2)**
1AEPC206_2	**Interpret** the concept of conventional and unconventional manufacturing processes **(K^2)**
1AEPC206_3	**Take a decision** on manufacturing technique for manufacturing given component or a product**(K^3)**
1AEPC206_4	**Estimate** production cost, selling cost with profit margin for products with respect to the production methods**(K^3)**
1AEPC206_5	**Relate** the advance manufacturing method's implification in the Aircraft production line **(K^3)**

Course Contents:		
Unit 1	**Casting** Material properties and selection process - Working principles of sand casting and its types - types of pattern & core making - moulding tools - special moulding processes – Die-casting, Centrifugal casting, Investment casting, Shell moulding, continuous casting, casting defects.	**05 Hrs**
Unit 2	**Welding** Classification of welding processes - Principles of Oxy-acetylene gas welding, A.C metal arc welding, resistance welding, submerged arc welding, tungsten inert gas welding, metal inert gas welding, plasma arc welding, thermit welding, defects in welding, soldering and brazing.	**05 Hrs**
Unit 3	**Conventional Machining** General principles, parts, types, applications, advantages, limitations and working of Conventional machining: Lathe operations, Shaper machine, Planer Machine, Milling machine, Drilling machine, Grinding machine.	**04 Hrs**
Unit 4	**Unconventional Machining** General principles, parts, types, applications, advantages, limitations and working of Non-Conventional machining: Water Jet Machining, Abrasive jet machining, Ultrasonic machining, Plasma arc machining, Electron beam machining and Laser beam machining.	**05 Hrs**
Unit 5	**Forming and Shaping of Plastics** Types of plastics - Characteristics of the forming and shaping processes –	**05 Hrs**

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	Working principles and typical applications of Injection moulding - Plunger and screw machines – Blow moulding – Rotational moulding –Film blowing – Extrusion - Typical industrial applications – Thermoforming	
Unit 6	**Advanced Manufacturing Techniques** Computer Integrated Manufacturing - CNC machining, Electron beam welding, laser beam welding, Electric Discharge Machining, Electro chemical machining, 3D printing - Additive Manufacturing Techniques.	**04 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Production technology: Manufacturing Processes, Technology and Automation	R K Jain	Khanna publishers	17th	2014
02	Production Technology (Manufacturing Processes)	P. C. Sharma	Schand	-	2006

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Advanced Manufacturing Technology	David L. Goetsch	Delmar Cengage Learning	-	1989
02	Manufacturing Process	Rajeev Kumar, Maheshwar Dayal Gupta	PHI learning Private Limited	-	2014
03	Aircraft Maintenance and Repair	Michael J Kroes, William A Watkins, Frank Delp, Ronald Sterkenburg	Mc Graw Hill Education	7th	2014
04	Handbook of Advanced Composite & Polymers Manufacturing	Gerrard Brison	Auris Reference Limited	1st	2014

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Course Details

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEPC251 - Aircraft Production Technology Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC251_1	**Decide** the manufacturing method and techniques for the given design **(K^3)**
1AEPC251_2	**Illustrate** sample company certifications and IPR **(K^3)**
1AEPC251_3	**Perform** all the machining works on the given workpiece**(S^2)**
1AEPC251_4	**Make** use of production tools and equipment to manufacture given simple components**(S^2)**
1AEPC251_5	**Follow** professional ethics and virtue throughout the entire course and forth**(A^2)**

List of Experiments

Exp. No.	Title of Experiment
1	Prepare a demo company with intellectual property paper work on patents, trademarks, copyrights, and trade secrets
2	Make a product cost estimation for an aircraft component with current market price evaluation
3	Prepare paper work of all registration procedure for an aircraft component manufacturing industry start-up
4	Tool sharpening using grinding wheels/Abrasive sharpeners
5	Mild steel rod cutting and Facing
6	Lathe work - Turning, Step turning and Tapering
7	Conventional Machining by Shaper/Planer/Milling Machine
8	Unconventional material cutting by Laser beam/Electron Bean/Water jet cutting machines
9	Design and Manufacture an airfoil Pattern with 3D printing / advanced technology
10	Manufacture an airfoil with any of the manufacturing process

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Course Details

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES254 - Fluid Mechanics Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES254_1	**Apply** the basic fluid mechanics principles for determining the fluid & flow characteristics using the measuring instruments.**(K^3)**
1AEES254_2	**Determine** the forces acting on the bodies due to fluid flow over them using the Wind Tunnel **(K^3)**
1AEES254_3	**Verify** the fluid mechanics laws using the experimental methods **(K^3)**
1AEES254_4	**Carry out** the Performance study of the Fluid Machinery**(K^3)**
1AEES254_5	Effectively record the results and **analyze** them to provide a conclusion. **(S^3)**
1AEES254_6	**Learn** the best & effective practices for carrying out the experimentation. **(S^3)**
1AEES254_7	**Follow** the professional practices like mainlining a laboratory journal and completion of work on time. **(A^3)**

List of Experiments

Exp. No.	Title of Experiment
1	a. Determination of Density, Specific Volume, Specific Weight, & Specific Gravity of a Given Fluid. b. Determination of Viscosity coefficient of Oil using the Red Wood Viscometer & characterization of variation in viscosity with increase in temperature.
2	Pressure measurement using the U-Tube & Multi-Column Manometer
3	a. Measurement of Force acting on the submerged flat plate & study of the force variation with the depth b. Measuring the Buoyancy force using the spherical balloon
4	Flow Visualization using the Hele-Shaw apparatus
5	Verification of the Bernoulli's Equation
6	Calibration of the Wind Tunnel & Testing Flow over a Aerofoil (Model Preparation using Similarity Laws)
7	Determination of the Coefficient of Discharge of the given Venturi meter
8	Measurement of Velocity of Air using the Pitot-Static Tube
9	Lift & Drag Coefficient Measurement over the Flat Plates, Cylinder & Sphere Models.
10	Distribution of the Pressure over the Aerofoil
11	Performance Study of the Reciprocating & the Centrifugal Pumps
12	Performance Study of the Turbines (Kaplan & Francis Turbine)

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Course Details

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES255 - Mechanics of Materials Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES255_1	**Explain** the behavior of the materials under tension, compression, bending and torsion loading conditions. **(K^2)**
1AEES255_2	**Calculate** the stresses and strains induced in the bodies under the given loading condition. **(K^3)**
1AEES255_3	Effectively carry out the experiment and record the results, **analyze** them to provide a conclusion. **(S^3)**
1AEES255_4	**Learn** the best & effective practices for carrying out the experimentation. **(A^2)**

List of Experiments

Exp. No.	Title of Experiment (Any 12 experiment from the following list are to be performed)
1	To determine the properties like Young's modulus, ultimate strength, and the percentage elongation of mild steel using tension test
2	Compression Test to find compressive strength of the material
3	Test on Thin Walled Shells to calculate hoop stress
4	To find out stiffness of Spring in different loading condition
5	Bending test on simply supported beam
6	Bending test on cantilever beam
7	Buckling of Columns with Various End Supports
8	Torsion test : To measure the modulus of rigidity of material by using torsion test
9	Izod Impact test : To measure the amount of energy absorbed by the specimen during fracture
10	Charpy Impact test : To measure the amount of energy absorbed by the specimen during fracture
11	Brinell Hardness Test on Metal to find its hardness
12	Rockwell Hardness Test on Metal to find its hardness
13	Non Destructive Testing of the Material using Ultra Sound Waves
14	Demonstration of FEA software for static structural analysis

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Course Details

Class	S. Y. B. Tech (Semester - III)
Course Code and Course Title	**1AEES256 - Applied Thermodynamics Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES256_1	**Conduct** the experiment as per standard process to find properties of lubricants such as Aniline point, cloud and pour point, flash and fire point and grease penetration no., dropping point etc. **(K^3)**
1AEES256_2	**Evaluate** the isothermal efficiency and volumetric efficiency of an air compressor. **(K^3)**
1AEES256_3	**Evaluate** the calorific value of any given substance. **(K^3)**
1AEES256_4	**Perform** the experiments in a group as a leader as well as a member**(K^3)**
1AEES256_5	**Communicate** the results and write the report effectively**(S^3)**
1AEES256_6	**Pursue** professional and ethical principles during laboratory work**(S^3)**
1AEES256_7	**Follow** the professional practices like mainlining a laboratory journal and completion of work on time. **(A^3)**

List of Experiments

Exp. No.	Title of Experiment
1	Significance and relevance of lubrication properties
2	Test on grease penetrometer apparatus
3	Test on Aniline point apparatus
4	Determination of flash point and fire point of lubricant oil.
5	Test on Redwood viscometer apparatus
6	Test on dropping point apparatus
7	Test on carbon residue
8	Test on cloud and pour point apparatus
9	Study and demonstration of air compressor.
10	Test on Bomb calorimeter to find C.V.

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEES207 - Numerical Analysis with Programming Language**
Prerequisite/s	1AEBS201 - Applied Mathematics – III 1AEES151 - Computer Programing in C Laboratory
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES207_1	**Analyze** the various types of errors which are a part of scientific computing and perform the curve fitting & the statistical analysis of the experimental data generated. **(K^3)**
1AEES207_2	**Solve** the mathematical problems involving the algebraic, Transcendal equations and Lincar Equations. **(K^3)**
1AEES207_3	**Solve** the mathematical problems involving the Numerical Integration & Differentiation. **(K^3)**
1AEES207_4	**Obtain** the solutions of Ordinary & Partial Differential Equations with the given boundary conditions. **(K^3)**

Course Contents:		
Unit 1	**Errors, Curve Fitting & Statistical Analysis:** **Errors:** Introduction, Types of errors, Rules for estimate errors, Error propagation, Error in the approximation of function **Curve Fitting:** Least square regression – Linear regression, Polynomial regression, Interpolation – Newton's divided difference, Interpolating polynomial, Lagrangian interpolating polynomial **Statistics:** Mean and standard deviation, Addition and multiplication laws, Probabilities, Binomial, Poisson and normal distribution	**08 Hrs**
Unit 2	**Numerical Solutions to Algebraic & Transcendal Equations:** Bracketing method: Bisection method, False position method, Open method: Newton Raphson's, Multiple roots, Iteration system of non-linear equations, Secant method, Roots of polynomial: Muller's method	**08 Hrs**
Unit 3	**Numerical Solutions to Linear Simultaneous Equations:** **Direct Methods of Solution –** Eigen Value Extraction, Gauss Elimination Method, Gauss Jordan Method **Iterative Methods of Solution –** Jacobi's Iteration Method, Gauss Seidel Iteration Method	**05 Hrs**
Unit 4	**Numerical Integration & Differentiation:** Newton's cote's integration of equation: Trapezoidal rule, Simpson's rule, Integration unequal segments. Integration of equation: Romberg's integration and Gauss quadrature. Numerical differentiation, Differentiation formulae, Richardson extrapolation, Derivation of	**08 Hrs**

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	unequally spaced data, Forward difference, Central difference, Backward difference	
Unit 5	**Numerical Solution to Ordinary Differential Equations:** Taylor's series method, Picard's method, Runge-Kutta method, Euler's method, Improved polygon method, System of equation, Boundary value and Eigen value problem, shooting method, Finite Difference method, Eigen value problem based on polynomial method, Power method.	**08 Hrs**
Unit 6	**Numerical Solution to Partial Differential Equations:** Classification of Partial Differential Equations, Cramer rule and Eigen value method, Hyperbolic, Parabolic and Elliptic forms of equations, Finite Difference – Elliptical equation, Laplace's equation, Finite Difference- Parabolic equation.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	7th	2005
02	Numerical Methods	B.S. Grewal	Khanna Publishers	7th	2005

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Numerical Methods	E.Balguruswamy	Tata McGraw Hill	9th	2002
02	Computer Based Numerical Methods and Statistical Techniques	P. K. De	CBS Publisher	1st	2006
03	Numerical Methods for Engineering	Steven. C. Chapra	Tata McGraw Hill	5th	2007
04	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI Learning, 2012	5th	2012

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEPC208 - Low Speed Aerodynamics**
Prerequisite/s	1AEBS201 - Applied Mathematics – III 1AEES202 - Fluid Mechanics 1AEES204 - Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC208_1	**Explain** the Fluid properties, & their Governing Equations in various forms. **(K^2)**
1AEPC208_2	**Apply** the basics of Fluid Mechanics to derive the Lift & Drag equations acting over the bodies. **(K^3)**
1AEPC208_3	**Calculate** the Lift Force Coefficient & Lift Distribution over the Finite Wing of an Aircraft. **(K^3)**
1AEPC208_4	**Calculate** the Induced & Skin Friction Drag over the Finite Wings & explain the Flow control techniques to control the boundary layer. **(K^3)**
1AEPC208_5	**Explain & Determine** the Thrust & Thrust Coefficient acting on the Propellers applied to Aircraft, Helicopter & Hovercraft. **(K^3)**

Course Contents:		
Unit 1	**Introduction & Governing Equations of Fluid Mechanics:** Review of Fluid Mechanics & Potential Flow Theory, Governing Equations of Fluid Mechanics, The Continuity Equation, The Momentum Equation, and Energy equation, Angular Velocity, Vorticity & Circulation, Kelvin's Theorem of Circulation.	**07 Hrs**
Unit 2	**Potential Flow Theory:** The Stream Function & Stream Line, The Velocity Potential Function & Equi-potential Line, Relationship between the Stream Function & Velocity Potential Function, Fundamental Imaginary flows and their combinations. Non-lifting flow over circular cylinder, lifting flow over a circular cylinder, Kutta Joukowski Theorem, Real flow over cylinder.	**07 Hrs**
Unit 3	**Two-Dimensional Wing Theory:** Vortex Sheet Representation and The Kutta Condition, Starting Vortex, Conformal Mapping: Circle to flat plat, Circle to Ellipse and Circle to Aerofoil (Kutta Joukowski Transformation), Karman Trefftz profiles (Theoretical Treatment), Thin Aerofoil Theory: The Symmetrical Aerofoil, The Cambered Aerofoil, Normal Force & Pitching Moment Derivatives. Real flow over an aerofoil.	**07 Hrs**
Unit 4	**Finite Wing Theory:**	**07 Hrs**

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	Downwash & Induced Drag, The Vortex Filament & Horseshoe Vortex, Helmholtz's Theorem, The Biot-Savart Law, The Prandtl's Classical Lifting Line Theory, The Elliptical and General Lift Distribution.	
Unit 5	**Boundary Layer Theory & Flow Control Over Wings:** Introduction to development of Boundary Layer, The Boundary Layer Equation, Wall Shear Stress & Skin Friction Coefficient, Boundary Layer Separation, Laminar – Turbulent Transition, Conditions of Transition, The Physics of the Turbulent Boundary Layer, Boundary Layer Control Methods, Reduction in Skin Friction Drag, Form Drag & Induced Drag	**07 Hrs**
Unit 6	**Introduction to Propeller Theory:** Froude's Momentum Theory, Propeller Coefficients and efficiency, Flow factors, Blade Element Theory.	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Fundamentals of Aerodynamics	J D Anderson	McGraw Hill	5th	2010
02	Aerodynamics	L J Clancy	Shroff Pubs & Dists Pvt. Ltd.	1st	2006
03	Aerodynamics for Engineering Students	E. L.Houghton, P W Carpenter, S. H. Collicott, D. T. Valentile	"Butterworth – Heinemann	6th	2013

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aerodynamics, Aeronautics & Flight Mechanics	B W McCormick	Wiley	2nd	2015
02	Applied Aerodynamics	Leonard Bairstow	Nabu Press	-	2011
03	Aerodynamics of the Airplane	Schlichting, H., and Tuckenbroke, E	McGraw Hill	2nd	1979

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEPC209 - Air Breathing Propulsion**
Prerequisite/s	1AEBS201 - Applied Mathematics - III 1AEES202 - Fluid Mechanics 1AEES204 - Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC209_1	**Differentiate and explain** the working principle of air breathing and non-air breathing engines. **(K^2)**
1AEPC209_2	**Distinguish and explain** the intakes and exhaust systems and gas turbine combustions used in aircrafts. **(K^2)**
1AEPC209_3	**Apply** control volume analysis and the integral momentum equation to estimate the forces produced by Aircraft Propulsion systems. **(K^3)**
1AEPC209_4	Describe the principal design parameters and constraints that set the performance of gas turbine engines, and to **apply** ideal-cycle analysis to a gas turbine engine to relate thrust and air fuel ratio.**(K^3)**
1AEPC209_5	**Use** velocity triangles to estimate the performance of a compressor or turbine stage. **(K^3)**
1AEPC209_6	**Comment** of the factors that affect combustion process and design factors of combustion chamber. **(K^4)**

Course Contents:		
Unit 1	**FUNDAMENTALS OF GAS TURBINE ENGINES:** Illustration of working of gas turbine engine - Thrust equation - Factors affecting thrust. Effect of pressure, velocity and temperature changes of air entering compressor. Methods of thrust augmentation. Characteristics of turboprop, turbofan and turbojet - Performance characteristics.	**07 Hrs**
Unit 2	**SUBSONIC AND SUPERSONIC INLETS FOR JET ENGINES:** Internal flow and Stall in subsonic inlets - Boundary layer separation - Major features of external flow near a subsonic inlet - Relation between minimum area ratio and external deceleration ratio - Diffuser performance - Supersonic inlets - Starting problem on supersonic inlets - Shock swallowing by area variation - External deceleration - Modes of inlet operation.	**07 Hrs**
Unit 3	**COMPRESSORS:** Principle of operation of centrifugal compressor - Work done and pressure rise - Velocity diagrams - Diffuser vane design considerations - Concept of pre whirl - Rotation stall - Elementary theory of axial flow compressor - Velocity triangles - degree of reaction - Three dimensional - Air angle distributions for free vortex and constant reaction designs - Compressor	**08 Hrs**

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	blade design - Centrifugal and Axial compressor performance characteristics.	
Unit 4	**COMBUSTION CHAMBERS:** Classification of combustion chambers - Important factors affecting combustion chamber design - Combustion process - Combustion chamber performance - Effect of operating variables on performance - Flame tube cooling - Flame stabilization - Use of flame holders	**06 Hrs**
Unit 5	**NOZZLES:** Theory of flow in isentropic nozzles - Convergent nozzles and nozzle choking - Nozzle throat conditions - Nozzle efficiency - Losses in nozzles - Over expanded and under expanded nozzles - Ejector and variable area nozzles - Interaction of nozzle flow with adjacent surfaces - Thrust reversal	**08 Hrs**
Unit 6	**OTHER PROPULSION SYSTEMS:** Introduction to other propulsion systems Ram jet , Scram jet , Rocket propulsion Pulse detonation engine, LACE, turbo ramjet, Turbo Rocket configurations	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Propulsion and gas turbine engines	Ahmed F. El-Sayed	CRC press	-	2008
02	Gas turbine combustion	Aurtur H Lefebvre & Dilip R Ballal	CRC press	3rd	2010
03	Rocket Propulsion	K. Ramamurthi	Trinity	2nd	2016

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Elements of gas turbine propulsion	J D Mattingly	Mc Graw Hill Edu-Europe	3rd	2005
02	Gas Turbine Propulsion Systems	Bernie MacIsaac & Roy Langton	John Wiley & Sons	-	-
03	Gas Turbines and Jet Rocket Propulsion	V.M. Domkundwar	Dhanpat Rai & Co.	2nd	2013
04	The Jet Engine	Rolls Royce	Rolls Royce	5th	-

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEPC210 - Aerospace Materials and Structures**
Prerequisite/s	1AEBS102 - Applied Physics 1AEBS201 - Applied Mathematics - III 1AEES203 - Mechanics of Materials
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC210_1	**Understand** basics of the structure- properties relationship. **(K^2)**
1AEPC210_2	**Explain** composition, properties and use of different materials used in aircraft construction. **(K^2)**
1AEPC210_3	**Understand** the basic structure and loads acting on aircraft components. **(K^2)**
1AEPC210_4	**Explain** different phase diagrams, predict and calculate amount of phases using the phase diagram. **(K^3)**
1AEPC210_5	**Apply** principles of heat treatments of steels. **(K^3)**
1AEPC210_6	**Apply**ing the design considerations of aircraft structures. **(K^3)**

Course Contents:		
Unit 1	**Introduction To Materials Science and Engineering:** Materials classification, Atomic structure and bonding, Primary bonding - Ionic, covalent, metallic, Secondary bonding- hydrogen bonding, Van der Walls, Crystal structure - SC, FCC, BCC, HCP, Bravais lattice, Miller indices, Imperfections in crystals- point defects, line defects, surface defects.	**04 Hrs**
Unit 2	**Phase Diagrams:** Solidification of metals and alloys- Mechanism of crystallization, Nucleation and grain growth, Solid solution, Hume-Rothery rule of solid solubility, plotting of equilibrium diagrams, Gibbs Phase rule, Equilibrium diagram- Binary isomorphous alloy system, Eutectic System, Partially Eutectic system and also alloy with a peritectic transformation. Lever rule, Iron carbon Equilibrium diagram, Phase transformation in the iron carbon diagram, Solidification and microstructure of slowly cooled steel, Non equilibrium cooling of steel and property variation with microstructure.	**08 Hrs**
Unit 3	**Transformation Diagram and Heat treatment processes:** Formation of Austenite, Transformation of austenite into pearlite, Bainite and Martensite, Plotting of TTT diagrams, CCT diagrams, critical cooling rate and its significance in heat treatment processes. Heat treatment of steels- Annealing, Normalizing, Hardening, Tempering, Surface heat treatment- flame hardening and Induction hardening Chemical heat treatments- Carburizing, Nitriding, Carbo-nitriding, Cyaniding. Hardenability - Jominy test.	**06 Hrs**

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Unit 4	**Materials in Aircraft Construction:** **Aircraft steel:** Classification of steel, Effect of alloying element on steel, aircraft steel specifications, corrosion and heat resistant steels, Maraging Steels: Properties and Applications, selection and application of steel alloy to aircraft structure. **Light metal alloys:** Aluminum and its alloys their properties, types and identification. Castings - Heat treatment processes- Surface treatments. Magnesium and its alloys their properties, features, specification. fabrication problems, Special treatments. Application of these alloys in aircraft structures. **High strength and heat resistant alloy:** Titanium and its alloys: Applications, machining, forming, welding and heat treatment. Copper Alloys - Monel, K Monel. Super Alloys: Nickel base - Cobalt base - Iron base, Forging and Casting of Super alloys, welding, heat treatment.	**12 Hrs**
Unit 5	**Introduction to Aircraft Structures:** Structural components of aircrafts: Fuselage- Monocoque and Semi-monocoque, Wing, Landing Gears, Empennage- Loads on Structural Components-Function of structural components- Fabrication of structural components- Connections: Simple Lap Joint, Joint Efficiency, Group-Riveted Joints, Eccentrically Loaded Riveted Joints	**06 Hrs**
Unit 6	**Airworthiness and Fatigue:** Factors of Safety- Flight Envelope- Load Factor Determination: Limit Load, Uncertainties in Design and Structural Deterioration, Variation in Structural strength, Fatigue- Safe life and Fail safe structures, Designing against fatigue, Fatigue strength of components, Prediction of Aircraft Fatigue life-Crack Propagation.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Material Science and Metallurgy for Engineers	V.D.Kodgire	Everest Publishers,Pune	12th	2011
02	Material Science and Engineering	W.D.Callister	Wiley India Pvt. Ltd	5th	2014
03	Aircraft Structures for Engineering Students	T.H.G Megson	Elsevier Ltd.	5th	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Engineering Materials	V. B.John	ELBS.	6th	-
02	Aircraft Materials and Analysis	Tariq Siddiqui	McGraw-Hill Education	1st	2015

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Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
03	Airframe structural Design	Michael Niu	CONMILIT Press Ltd	1st	1995

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEPC211- Aircraft Systems and Instruments**
Prerequisite/s	1AEPC205- Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC211_1	**Describe** the principle and working of different aircraft systems. **(K^2)**
1AEPC211_2	**Distinguish** between the features and working of various flight control systems. **(K^3)**
1AEPC211_3	**Compare** the aircraft piston engine and jet engines fuel system components and its operational features. **(K^3)**
1AEPC211_4	**Illustrate** the need of cabin pressurization and auxiliary systems. **(K^3)**
1AEPC211_5	**Justify** the statement that "all the aircraft instrument are either Gyroscopic or Inertial" **(K^3)**
1AEPC211_6	**Trouble shoot** the snags detected in various aircraft systems and suggest methods to minimize the maintenance of various system components. **(K^4)**

Course Contents:		
Unit 1	**AIRPLANE CONTROL SYSTEMS ASSEMBLY AND RIGGING:** Aircraft assembly and Rigging- Conventional Systems – Power assisted and fully powered flight controls – Power actuated systems – Engine control systems – Push pull rod system – operating principles – Control surface Rigging Modern control systems – Digital fly by wire systems – Auto pilot system, Active Control Technology.	**07 Hrs**
Unit 2	**AIRCRAFT SYSTEMS:** Hydraulic systems – Study of typical systems – components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system – Brake system – Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.	**07 Hrs**
Unit 3	**ENGINE SYSTEMS:** Piston and Jet Engines- Fuel systems – Components - Multi-engine fuel systems, lubricating systems – Starting and Ignition systems.	**07 Hrs**
Unit 4	**AUXILLARY SYSTEMS:** Basic Air Cycle systems – Vapor Cycle Systems, Boot-strap air cycle system – Evaporative vapor cycle systems – Evaporation air cycle systems – Oxygen systems – Fire extinguishing system and smoke detection system, De-icing and anti-icing system	**07 Hrs**
Unit 5	**AIRCRAFT INSTRUMENTS:**	**07 Hrs**

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	Flight Instruments and Navigation Instruments – Accelerometers, Air speed Indicators – Mach Meters – Altimeters - Gyroscopic Instruments– Principles and operation – Study of various types of engine instruments – Tachometers – Temperature and Pressure gauges.	
Unit 6	**GENERAL MAINTENANCE AND TROUBLE SHOOTING:** Aircraft control system inspection and maintenance, Hydraulic and pneumatic system maintenance practices, Inspection and maintenance of landing gear and break maintenance, inspection, maintenance and repair of fuel systems, Installation and maintenance of instruments, troubleshooting theory and practices	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Maintenance and repair	Michael j. Kroes (etal)	McGraw Hill Publications	7th	2013
02	Handbooks of Airframe and Power plant Mechanics	US dept. of Transportation, Federal, Aviation Administration	The English Book Store, New Delhi,	-	1995

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Power Plants	Mekinley, J.L. and R.D. Bent	McGraw Hill	5th	1985
02	Aircraft Instruments & Principles	Pallet, E.H.J	Pearson Education	2nd	2009
03	Aircraft Gas Turbine technology	Teager, S	McGraw Hill	3rd	2017

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEHS252 - Professional Ethics**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	02
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEHS252_1	**Understand**ing basic purpose of profession, professional ethics and various moral and social issues. **(K^2)**
1AEHS252_2	**Aware**ness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer. **(K^2)**
1AEHS252_3	Acquiring knowledge of various roles of Engineer In applying ethical principles at various professional levels. **(K^3)**
1AEHS252_4	Professional Ethical values and contemporary issues. **(K^3)**
1AEHS252_5	Excelling in competitive and challenging environment to contribute to industrial growth. **(K^4)**
1AEHS252_6	**Identify** the essential qualities for progressing in career. **(K^4)**

Course Contents:		
Unit 1	**Introduction to Professional Ethics:** Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.	**05 Hrs**
Unit 2	**Basic Theories:** Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.	**05 Hrs**
Unit 3	**Professional Practices in Engineering:** Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession, Central Responsibilities of Engineers, The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk Away Collapse.	**05 Hrs**
Unit 4	**Work Place Safety, Rights & Responsibilities:** Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk, Respect for Authority, Collective Bargaining,	**05 Hrs**

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	Confidentiality, Conflicts of Interest., Occupational Crime, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination	
Unit 5	**Global issues in Professional Ethics:** Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisors, Moral Leadership, Code of Conduct, Corporate Social Responsibility.	**05 Hrs**
Unit 6	**Developing Career Trust:** Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.	**03 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Professional Ethics	R. Subramanian	Oxford University Press	-	2015
02	Ethics in Engineering	Mike W. Martin and Roland Schinzinger	"Tata McGraw Hill,	-	2003
03	Ethics in Engineering Practice & Research	Caroline Whitbeck	New Delhi"	2nd	2015

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Engineering Ethics, Concepts Cases	Charles E Harris Jr., Michael S Pritchard, Michael J Rabins	Cengage learning	4th	2015
02	Business Ethics concepts & Cases	Manuel G Velasquez	PHI	6th	2008

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Course Details:

Class	S. Y. B. Tech, Sem.-IV
Course Code and Course Title	**1AEMC253 - Environmental Studies**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	02/00
Credits	00
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEMC253_1	**Know** importance and scope of environmental studies. **(K^2)**
1AEMC253_2	**Explain** the importance of public awareness on environmental problems. **(K^2)**
1AEMC253_3	**Explain** about natural resources and biodiversity. **(K^2)**
1AEMC253_4	**Describe** scientific, technological and economic solutions to environmental problems. **(K^3)**
1AEMC253_5	**Explain** the pollution control and waste management. **(K^3)**

Course Contents:		
Unit 1	**Nature of Environmental Studies:** Definition, scope and importance. Multidisciplinary nature of environmental studies Need for public awareness.	**02 Hrs**
Unit 2	**Natural Resources:** Water resources, Mineral resources, Forest resources, Food resources, Land resources, Energy resources – Different types of energy, Conventional sources & non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Fossil Fuels, Hydrogen as an alternative energy.	**05 Hrs**
Unit 3	**Ecosystems:** Definition, Scope and Importance ecosystem. Classification, Structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Energy flow in the ecosystem, Bio-magnification, Bioaccumulation, ecosystem value.	**05 Hrs**
Unit 4	**Biodiversity and its conservation:** Introduction - Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India - Value of biodiversity, consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega diversity nation- Hot-spots of biodiversity, Threats to biodiversity, habitat loss, man wildlife conflicts; Conservation of biodiversity- In-situ and Ex-situ conservation. National biodiversity act.	**05 Hrs**
Unit 5	**Environmental Pollution:** Water Pollution, Noise pollution, Land Pollution, Public Health Aspects, Global Environmental Issues: Population Growth, Urbanization, Land Management, Water & Waste Water Management. Air Pollution: Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures.	**05 Hrs**

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Unit 6	**Social Issues and the Environment:** Disaster Management and Urban Problems, role of non-governmental organization, water conservation, rain water harvesting, Waste management and watershed management. Environmental ethics: Issues and possible solutions, Environmental Legislation and Acts.	**06 Hrs**
	Field Work: Visit to a local area to document environmental assets river/ forest/ grassland /hill /mountain. Visit to a local polluted site Urban/ Rural/ Industrial/ Agricultural. Study of common plants, insects, birds, Study of simple ecosystems-pond, river, hill slopes, etc. (Hand written field work Report is mandatory.)	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Environmental Studies	Dr. P. D. Raut	Shivaji University, Kolhapur.	5th	2013
02	Environmental Studies	Benny Joseph	Tata Mc- Graw Hill Publication	-	2005
03	Environmental Studies	R.J.Ranjit Daniels and Jagadish Krishnaswamy	Wiley India Private Ltd., New Delhi	-	2009
04	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford University Press	-	2005

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Principals of Environmental Science and Engineering	Raman Sivakumar	Cengage learning Singapore	2nd	2005
02	Elements of Environmental Science and Engineering	P. Meenakshi	Prentice Hall of India Private Limited, New Delhi	-	2006
03	Environmental Science – working with the Earth	G.Tyler Miller Jr	Thomson Brooks /Cole	11th	2006
04	Environmental Law	Dharmendra S Sengar	Prentice Hall of India PVT LTD, New Delhi	-	2007

Course Details

Class	S. Y. B. Tech (Semester - IV)
Course Code and Course Title	**1AEES257 - Numerical Analysis with Programming Language Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEES257_1	**Apply** Numerical Methods/Techniques to find the solutions of simple engineering problems using computer program **(K^3)**
1AEES257_2	**Implement** the numerical algorithm as a MATLAB script to compute the solution for the given problem **(K^3) (S^3)**
1AEES257_3	**Debug** the MATLAB script for any syntax or logical errors for proper execution**(S^3)**
1AEES257_4	**Follow professional** ethics and complete the laboratory work regularly along with the maintenance of lab journal **(A^2)**

List of Experiments

Exp. No.	Title of Experiment
1	Getting to the GUI of MATLAB and programming fundamentals using MATLAB (PART A)
2	Introduction to programming fundamentals using MATLAB (Part B)
3	Introduction to programming fundamentals using MATLAB (Part C)
4	Illustration of importance of Round off and Truncation Errors in scientific computations
5	Curve fitting using method of least squares
6	Statistical Analysis-Determination of Mean and Standard deviation
7	Solution of Algebraic and Transcended Equations-Bisection and Newton Raphson's Method
8	Numerical solution for system of Linear Algebraic Equations-Iterative Methods
9	Numerical Differentiation-First Order and Second Order FDA, CDA and BDA
10	Numerical solution to Ordinary Differential Equation, using RK-4 method
11	Numerical solution to Partial Differential Equation- IVP and BVP
12	Optimization of single and multivariable functions using gradient based approach

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Course Details

Class	S. Y. B. Tech (Semester - IV)
Course Code and Course Title	**1AEPC258 - Low Speed Aerodynamics Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
0AEPC258_1	Draft the given airfoil over a graph sheet and **prepare the model** (S^2)
0AEPC258_2	**Demonstrate** the flow visualization over the Aerofoil & Propeller and Explain the flow patterns. (K^2) (S^2)
0AEPC258_3	Use the wind tunnel effectively for the carrying out **the experimentation** over the aerofoil models. (S^3)
0AEPC258_4	Effectively record the results and **analyze** in details to provide a conclusion(S^3)
0AEPC258_5	Follow the **professional practices** like mainlining a laboratory journal and completion of work on time.(A^2)

List of Experiments

Exp. No.	Title of Experiment
1	Introduction to wind tunnel testing and their applications
2	Calibration of a subsonic wind tunnel
3	Capture the flow field over a circular cylinder using Tuft flow visualization and compare with the flow captured over a cambered airfoil
4	Compare the flow past a circular cylinder and cambered airfoil using smoke flow visualization
5	Capture the flow streamlines over a cambered airfoil using oil flow visualization and study the change in separation point location with increase in angle of attack.
6	Surface pressure distributions on a two-dimensional circular cylinder.
7	Pressure measurement over the surface of an asymmetrical airfoil.
8	Measurement of the aerodynamics forces generated by an aircraft using mechanical strain gage balance at different angle of attack
9	Boundary layer velocity profile measurement on the tunnel wall.
10	Total drag calculation of a circular cylinder using pitot-static probe wake survey

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Course Details

Class	S. Y. B. Tech (Semester - IV)
Course Code and Course Title	**1AEPC259 - Air Breathing Propulsion Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC259_1	**Explain** the various systems of aircraft piston engine, jet engines and Identify the systems on the engines **(K^2)**
1AEPC259_2	**Use the concept** of forced and free convective heat transfer and perform experiment on the heat transfer apparatus **(K^3)**
1AEPC259_3	**Explain** the Heat of combustion of aviation fuel and how to find it using given set up **(K^2)**
1AEPC259_4	Effectively record the **results and analyze** in details to provide a conclusion **(S^3)**
1AEPC259_5	Follow the **professional practices** like mainlining a laboratory journal and completion of work on time. **(A^3)**

List of Experiments

Exp. No.	Title of Experiment
1	Study of an aircraft piston engine and jet engines and its components
2	Study of forced and free convective heat transfer over a flat plate
3	Determination of heat of combustion of aviation fuel
4	An experimental Study of free jet
5	An experimental Study of wall jet
6	Study of performance of Propeller
7	Measurement of Nozzle flow
8	Combustion Study

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Course Details

Class	S. Y. B. Tech (Semester - IV)
Course Code and Course Title	**1AEPC260-Aerospace Materials and Structures Laboratory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC260_1	**Study** the materials and its behavior under given test condition. **(K^2)**
1AEPC260_2	Effectively carry out the **experiment and record** the results, analyze them to provide a conclusion. **(S^3)**
1AEPC260_3	**Learn** the best & effective practices for carrying out the experimentation. **(S^3)**
1AEPC260_4	**Follow** the professional practices like mainlining a laboratory journal and completion of work on time**(A^2)**

List of Experiments

Exp. No.	Title of Experiment
1	Rockwell Hardness Test
2	Brinell's Hardness Test
3	Specimen preparation for microscopy (Metallography)
4	Microstructure examination of Steel and Cast Iron
5	Microstructure examination of non ferrous materials
6	Introduction to Dye Penetrant And Magnetic particle Testing
7	Introduction to Ultrasonic Testing
8	Jominy End Quench Test
9	Case Study For Ferrous Alloys in Aircraft Industry
10	Case Study For Non-Ferrous Alloys in Aircraft Industry
11	Fatigue Test
12	Impact Test

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Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

Department of Aeronautical Engineering

Teaching and Evaluation Scheme
B. Tech: Semester V (Aeronautical Engineering)

Course code	Course	Teaching Scheme				Evaluation Scheme				
						Scheme	Theory (Marks)			Practical (Marks)	
		L	T	P	Credits		Max	Min. for Passing		Max	Min. for Passing
1AEPC301	Aircraft Structures	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEPC302	Flight Dynamics	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEPC303	High Speed Aerodynamics	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC304	Aerospace Propulsion	3	1	-	4	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPE305 - 310	Professional Elective - 1	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEOE311 -315	Open Elective - 1	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEPE351	Self-Learning Course (Supervised Learning)	-	-	-	1	ISE	-	-	-	50	20
1AEHS352	Communication Skills and Competencies	-	-	2	1	ISE	-	-	-	50	20
1AEPC356	Aircraft Structures Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
1AEPC357	Flight Dynamics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
Total		**18**	**2**	**6**	**24**	600			200		
Total Contact Hours/Week= 26 hrs											

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*Course Code	Professional Elective-I
1AEPE305	Experimental Aerodynamics
1AEPE306	Heat and Mass Transfer
1AEPE307	Material Testing and Characterization
1AEPE308	Engineering Design Optimization
1AEPE309	Helicopter Theory
1AEPE310	Lighter-Than-Air Systems

Open Elective –I

Courses Code	Course Name	Department
1AEOE311	Introduction to Flight	Aeronautical Engineering
1AEOE312	Introduction to Experimental Aerodynamics	
1AEOE313	Introduction to Gas Dynamics and Jet Propulsion	
1AEOE314	Introduction to Unmanned Aerial Vehicles	
1AUOE301	Product Design and Development	Automobile Engineering
1AUOE302	Automotive Refrigeration and Air Conditioning	
1CVOE301	Air Pollution & Control	Civil Engineering
1CVOE302	Remote Sensing & GIS Applications	
1CSOE301	Database Essentials and Business Intelligence	Computer Science and Engineering
1CSOE302	Software Engineering and Project Management	
1CSOE303	Data Structures and Algorithms	
1EEOE301	Electrical Technology	Electrical Engineering
1EEOE302	Electrical and Electronics Measurements	
0FTOE311	Packaging Technology	Food Engineering
1MEOE301	Industrial Automation and Robotics	Mechanical Engineering
1MEOE302	Composite Materials	
1MEOE303	Solar Technology	

Course Category	HS	BS	ES	PC	PE	OE	PR
Credits	1	-	-	16	4	3	-
Cumulative Sum	6	20	43	38	4	3	-

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Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

Department of Aeronautical Engineering

Teaching and Evaluation Scheme
B. Tech: Semester VI (Aeronautical Engineering)

Course code	Course	Teaching Scheme				Evaluation Scheme					
						Scheme	Theory (Marks)			Practical (Marks)	
		L	T	P	Credits		Max	Min. for Passing		Max	Min. for Passing
1AEPC305	Vibration and Structural Dynamics	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC306	Computational Fluid Dynamics	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC307	Space Dynamics	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPE316 - 320	Professional Elective - 2	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEOE321 - 325	Open Elective - 2	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEHS353	Constitution of India	2	-	-	2	ISE	-	-	-	25	10
1AEPR354	Internship	-	-	-	2	ISE	-	-	-	25	10
1AEPR355	Mini - Project	-	-	4	2	ISE	-	-	-	25	10
						ESE	-	-	-	25	10
1AEPC358	Vibration and Structural Dynamics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
1AEPC359	Computational Fluid Dynamics Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
Total		**17**	**0**	**8**	**23**		500			200	
Total Contact Hours/Week= 25hrs											

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AE ST - 06/10

*Course Code	Professional Elective-II
1AEPE316	Hypersonic Aerodynamics
1AEPE317	Advanced Propulsion Systems
1AEPE318	Advanced Mechanics of Solids
1AEPE319	Introduction to Air Transportation and Flight Scheduling
1AEPE320	Introduction to Aircraft Design

Open Elective –II

Courses Code	Course Name	Department
1AEOE321	Lighter Than Air Systems	Aeronautical Engineering
1AEOE322	Airline and Airport Management	
~~1AEOE323~~	~~Flight Scheduling and Operations~~	
1AUOE310	Vibration based fault diagnosis	Automobile Engineering
1AUOE311	Engineering Tribology	
1CVOE310	Operation Research	Civil Engineering
1CVOE311	Economics And Management	
1CSOE311	Internet of Things	Computer Science and Engineering
1CSOE312	Cyber Laws and Ethical Hacking	
1EEOE306	Electrical Wiring Harnessing	Electrical Engineering
1EEOE307	Electrical Economics & Energy Audit	
0FTOE321	Process Modeling and Simulation	Food Engineering
1MEOE304	Industrial Management and Operation Research	Mechanical Engineering
1MEOE305	Non-Destructive Testing	
1MEOE306	Computational Fluid Dynamics	

Course Category	HS	BS	ES	PC	PE	OE	PR
Credits	2	-	-	11	3	3	4
Cumulative Sum	8	20	43	49	7	6	4

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AE ST-07/10

Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEPC301, Aircraft Structures**
Prerequisite/s	1AEPC210 Mechanics of Materials
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC301_1	**Sketch** the bending stress distribution over symmetrical and unsymmetrical cross sections.(K^3)
1AEPC301_2	**Apply** principles of structural analyses to calculate the shear flow of various cross sections to anticipate shear center location.(K^3)
1AEPC301_3	**Interpret** the Torsional constants of thin-walled beams which are subjected to shear and torsional loads.(K^4)
1AEPC301_4	**Implement** structural idealization to various cross sections to perform stress analysis.(K^4)
1AEPC301_5	**Relate** Structural idealization to the stress analysis of vaious aircraft components.(K^4)

Course Contents:		
Unit 1	**Bending of open and closed, thin-walled beams:** Symmetrical bending,Anticlastic bending, Unsymmetrical bending, Calculation of section properties, Approximations for thin-walled sections.	**07Hrs**
Unit 2	**Shearof beams:** General stress, strain and displacement relationships for open and single cell closed section thin-walled beams,Shear of open section beams,Shear center of open section beamsShear of closed section beams,Shear center of closed section beams	**07 Hrs**
Unit 3	**Torsion of beams:** Torsion of closed section beams,Bredt–Batho formula,Torsion of thin walled multi-cell structures, Torsion of open section beams, Combined open and closed section beams	**07 Hrs**
Unit 4	**Structural idealization:** Principle,Idealization of a panel,Effect of idealization on the analysis of open and closed section beams, Bending of open and closed section beams, Shear of open section beams, Shear loading of closed section beams	**07 Hrs**
Unit 5	**Stress Analysis of Aircraft Components:** Wing spars and box beams,Tapered wing spar, Open and closed section beams, Beams having variable stringer areas	**07 Hrs**
Unit 6	**Stress Analysis of Fuselage:** Bending of a fuselage section,Shear of a fuselage section,Torsion of a fuselage section	**07 Hrs**

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Text Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Structures for Engineering Students	Megson, T.M.G	Elsvier	5th Edition	2012
02	Understanding Aircraft Structures	John Cutler	Blackwell Publishing Ltd	4th Edition	2005

Reference Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Airframe Structural Design	Michael Niu	CONMILIT PRESS LTD.	-	1995
02	Analysis and Design of Flight Vehicle Structures	E.F. Bruhn	Tristate Offset Co.	-	1980
03	Theory of Plates and Shells	Stephen P. Timoshenko & S. woinowsky Krieger	McGraw-Hill	2nd Edition	1990
04	Analysis of Aircraft Structures – An Introduction	Donaldson, B.K.	McGraw-Hill	2nd Edition	2012

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TY AE-02|66

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Department of Aeronautical Engineering

Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEPC302 - Flight Dynamics**
Prerequisite/s	1AEBS108-Applied Mathematics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC302_1	**Describe** the necessity of stability for dynamic systems like Aircraft. **(K^2)**
1AEPC302_2	**Derive** the Mathematical equations required to analyze aircraft performance, stability and control **(K^2)**
1AEPC302_3	**Apply** the mathematical expressions for calculating the aircraft flight performance under the different operational envelopes **(K^3)**
1AEPC302_4	**Estimate** the static stability parameters such as neutral point, control power etc. for longitudinal and lateral directional motion of aircraft **(K^3)**
1AEPC302_5	**Analyze** the factors/parameters affecting the aircraft flight performance under the various operational conditions. **(K^4)**
1AEPC302_6	**Estimate** the Dynamic stability parameters for longitudinal and lateral directional motion of aircraft using linearized EOM. **(K^4)**

Course Contents:		
Unit 1	**International Standard Atmosphere, Review of Aerodynamics and Propulsion:** International Standard Atmosphere: Pressure, Density & Temperature Variation with altitude, Calculations of the Properties in the Troposphere and Stratosphere, Correction of Air Density due to Humidity, Dynamic Viscosity Calculation. Review of Aerodynamics Concepts: Aerodynamics Lift, Drag and Moments, Aerodynamic Force Coefficients, Lift for a Finite Wing and Wing Body Combinations, Drag – Types of Drag and Drag Polar. Review of Propulsion Concepts: General Thrust Equation, Specific Fuel Consumption, Thrust and Efficiency, Propeller and Jet Engine Performance variation with the Velocity and Altitude.	**06 Hrs**
Unit 2	**Aircraft Performance in Steady Flight:** The Equations of Motion: The Four Forces of Motion, The Equations of Motion for the Steady, Level Flight. The Fundamental Parameters: Thrust to Weight Ratio, Wing Loading, Drag Polar and Lift – Drag Ratio. Thrust and Maximum Velocity: Thrust and Power Required for the Steady Level Flight, Thrust Available and Maximum Velocity, Effect of Drag Divergence on Maximum Velocity, Stall and High Lift Devices Ceiling: Service and Absolute Ceiling, Climb: Rate of Climb, Maximum Climb Angle, Maximum Rate of Climb and Time to Climb, Effect of Wind on Climb Performance, Descent: Gliding Unpowered Flight, Descent Flight	**07 Hrs**

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	Performance, Effect of Wind on Descent Flight, Range: Breguet's Range Equation, Range for Propeller Driven Airplanes, Range for Jet Driven Airplanes, The Effect of Wind, Endurance: The General Endurance Equation, Endurance for Propeller Driven Airplanes, Endurance for Jet Driven Airplanes.	
Unit 3	**Aircraft Performance in Accelerated Flight Turning:** Level Turn, Constraints on Load Factor, Minimum Turn Radius, Maximum Turn Rate, The Pull Up and Pull Down Maneuvers, The V-n Diagram: Limit Load Factor, Ultimate Load Factor, Accelerated Climb: Accelerated Rate of Climb, Energy Height, Specific Excess Power, Rate of Climb and Time to Climb. Take-off Performance: Take-off Ground Roll, Minimum Control Speed on the Ground and Air, Decision Speed, Balanced Field Length, Calculation of Ground Roll, Calculation of Distance While Airborne to Clear an Obstacle, Landing Performance: The Landing Path and Landing Distance, Calculation of Approach Distance, Flare Distance, Ground Roll.	**08 Hrs**
Unit 4	**Longitudinal Stability:** Introduction to static and dynamic stability, Axis systems used in stability and control, Condition for longitudinal static stability, contributions by aircraft components, Neutral point and static margin definition, Elevator effectiveness, Elevator angle to trim, stick fixed and stick free Neutral points. Stick force: Hinge moment, Trim tabs, Stick force gradient	**07 Hrs**
Unit 5	**Lateral Directional Stability:** Definition of Directional stability, side slip, Stability derivatives and contribution from Fuselage and vertical tail, Directional control and Rudder requirements. Roll Stability-Introduction and conditions, Dihedral effect, sweep and contributions from aircraft components, Roll control, estimation of aileron control power	**06 Hrs**
Unit 6	**Dynamic Stability:** Derivation of 6 DOF Equations for aircraft,Linearized EOM,Three degree of motion analysis of Longitudinal Motion, Two DOF approximations for Phugoid and short period motion. Three degree of motion analysis of Longitudinal Motion- Roll mode approximation, Two DOF approximation for Spiral and Dutch Roll motion	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Performance and Design	Anderson, J.D. Jr	International Edition McGraw Hill	1st Edition	1999
02	Flight stability and automatic control	Nelson, R.C.	McGraw-Hill,	2nd Edition	1998
03	Performance, stability, dynamics and control	Pamadi, Bandu N	AIAA Education Series	2nd Edition	2004

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	of an airplane				

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft performance, stability and control	Perkins C.D. & Hage R.E.	John Wiley	4th Edition	1949
02	Introduction to Aircraft Flight Mechanics	Yechout, T.R	AIAA Education Series	1st Edition	2003
03	MATLAB Help documentation	MATLAB PVt. Ltd	MATLAB	-	-

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TY AE-05/66

Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEPC303, High Speed Aerodynamics**
Prerequisite/s	1AEES204- Applied Thermodynamics 1AEES202- Fluid Mechanics 1AEPC208- Low Speed Aerodynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC303_1	**Understand** the characteristics of compressible flow in various flow regimes – subsonic, transonic, supersonic and hypersonic(K^2)
1AEPC303_2	**Use** quasi one dimensional theory to analyze compressible flow problems.(K^3)
1AEPC303_3	**Estimate** the normal and oblique shock properties.(K^3)
1AEPC303_4	**Analyze** the flow behavior over a convex corner, estimate the flow properties through a constant area duct.(K^3)
1AEPC303_5	**Analyze** the flow characteristics over different aerodynamic profiles at various flow regimes.(K^4)
1AEPC303_6	**Predict** the supersonic flow characteristics over the various wing types and various aircraft configurations.(K^4)

Course Contents:		
Unit 1	**Introduction to Quasi One Dimensional compressible flows:** Continuity equation, Euler's Equation, Adiabatic flow, isentropic process and relations, stagnation state of a system, Different forms of energy equation, compressible Bernoulli's Equation, velocity of sound, mach number, characteristic mach number, isentropic one dimensional flow, critical parameters, Area Mach number relation, flow through a De Laval nozzle, Nozzle performance under various back pressure, flow through diffusers	**08 Hrs**
Unit 2	**Normal and Oblique Shocks** Concepts of flow over concave and convex corners, Prandtl relation- Rankine Hugonoit relation, Normal shock relations Oblique shocks and corresponding equations, Θ-β-M relations Strong, Weak and detached shocks, shock polar, shock hodograph and pressure turning angles, Rayleigh pitot static tube formula, shock tube	**08 Hrs**
Unit 3	**Prandtl –Meyer Flows & Flow through Constant Area Duct** Concept of expansion waves, Prandtl- Mayer Expansion Fan, Prandtl- Mayer functions, Fanno flow and Rayleigh flow	**08Hrs**
Unit 4	**Differential Equations Of Motion For Steady Compressible Flows** The velocity potential flow equation, velocity perturbations, Linearized velocity potential equation for subsonic and supersonic flows, Linearized pressure coefficient, Linearized subsonic and supersonic flow	**06 Hrs**

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	using Prandtl Gluert transformation.	
Unit 5	**Flow Over Aerofoil's And Wing Body Combination** Shock expansion theory, Flow over a - flat plate, Diamond shaped aerofoil and Biconvex aerofoil, Effect of sweep back and delta wings, Transonic flow over a wing- Transonic area rule	**06 Hrs**
Unit 6	**Conical flow and introduction to hypersonic flow** Cone at zero angle of attack with attached conical shock, Ordinary differential equation for conical flow, comparison of pressure rise for wedge and cone of equal semi-angle. Qualitative aspects of hypersonic flow, Newtonian flow model, windward surface and leeward surface, lift and drag of flat plate wings at hypersonic speeds.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Modern Compressible Flow with Historical Perspective	John D Anderson	McGraw-Hill Publications	3	2003
02	Foundations of Aerodynamics	A. M. Kuethe and Chuen- Yen Chow	WILEY INDIA	5	2010
03	Elements of Gas Dynamics	Liepmann, H.W., and Roshko, A	John Wiley	1	1957

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aerodynamics, Aeronautics and Flight Mechanics	B W McCormick	John Wiley Publications	2	1995
02	The Dynamics and Thermodynamics of Compressible Fluid Flow	A H Shapiro	John Wiley Publications Vol 1 & 2	1	1953

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Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEPC304, Aerospace Propulsion**
Prerequisite/s	1AEPC209 Air Breathing Propulsion, 1AEES204Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC304_1	**Understand** various concepts of advanced propulsion techniques. **(K^2)**
1AEPC304_2	**Describe** solid, liquid and hybrid rocket motors and their composition.**(K^2)**
1AEPC304_3	**Explain** the fundamentals of rocket propulsion and working of individual rocket propulsion components. **(K^3)**
1AEPC304_4	**Understand** various concepts of electric propulsion system in application to electric thrusters. **(K^3)**
1AEPC304_5	**Evaluate** the various parameters of Electrostatic and Ion thrusters. **(K^3)**

Course Contents:		
Unit 1	**History and Principles of Rocket Propulsion:** The development of the rocket, Classification of rocket engines and their operating principle, Multi-stage rockets, Thermal Rocket engine: Basic configuration, The development of thrust and the effect of the atmosphere, The thermodynamics of the rocket engine, The thermodynamic thrust equation, Specific impulse of rocket engine; Numerical problems.	**07 Hrs**
Unit 2	**Rocket Nozzle Theory:** Ideal Rocket Nozzle, Assumptions for ideal rocket nozzle, Thermodynamic relations, Isentropic flow through nozzle, under expanded and over expanded nozzles, Nozzle configurations: Conical, Bell shaped nozzles, Two stepped nozzles, Nozzles with aerodynamic boundaries, Real nozzles: Principal losses, multiphase flow, performance correction factors and performance parameters.	**07 Hrs**
Unit 3	**Solid Propellant Rocket Engines:** Basic configuration, The properties and the design of solid motors, Propellant composition: Additives, Toxic exhaust, Thrust stability, Thrust profile and grain shape; Integrity of the combustion chamber: Thermal protection, Inter-section joints, Nozzle thermal protection; Ignition, Thrust vector control. Hybrid rocket motors:The basic configuration of a hybrid motor, Propellants and ignition, Combustion, Grain cross-section, Propulsive efficiency.	**07 Hrs**
Unit 4	**Liquid Propellant Rocket Motors:** The basic configuration of the liquid propellant engine, The combustion chamber and nozzle: Injection, Ignition, Combustion instability, Thrust vector control; Liquid propellant distribution systems, Cooling of liquid-fuelled rocket engines. Combustion and the choice of propellants:Combustion temperature, Molecular	**07 Hrs**

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	weight, Propellant physical properties; The performance of liquid-fuelled rocket engines: Liquid oxygen–liquid hydrogen engines, Liquid hydrocarbon–liquid oxygen engines, Storable propellant engines.	
Unit 5	**Electric Propulsion:** Principles of electric propulsion: Electric vehicle performance, Vehicle velocity as a function of exhaust velocity, Vehicle velocity and structural/propellant mass. Electric thrusters: Electro-thermal thrusters, Arc-jet thrusters, Non-Thermal electric thrusters, Propellant choice, Electrical efficiency; Plasma thrusters, Low-power electric thrusters, Electrical power generation, Applications of electric propulsion.	**07 Hrs**
Unit 6	**Electrostatic and Ion Thrusters:** Introduction and fundamentals of Ion propulsion: Performance Analysis, Characteristic Velocity, Payload, Specific Power; Electrical Thrust Devices: IonandColloidElectromagnetic thrusters: Ion propulsion, Electric field and potential,IonthrustIon Rocket Engine: Ion Sources, Electromagnetic Fields, Charged Colloid Sources	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Elements of rocket propulsion	George P. Sutton	Wiley and Sons, Inc	7th Edition	2001
02	Rocket and Spacecraft Propulsion: Principles, Practice and New Developments	Martin J.L Turner	Springer: Praxis Publishing	3rd Edition	2009

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Rocket Propulsion	K. Ramamurthi	Trinity Press	3rd Edition,	2016
02	Introduction to Rocket Science and Engineering	Travis S. Taylor	CRC Press	2nd Edition	2017
03	Aerospace Propulsion Systems	Thomas A. Ward	John Wiley & Sons	1st Edition	2010

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Course Details:

Class	T. Y. B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE305-Experimental Aerodynamics**
Prerequisite/s	1AEPC208 – Low Speed Aerodynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE305_1	**Describe** and recognize various types of wind tunnels, measuring equipment's and their applications. **(K^2)**
1AEPE305_2	**Explain** various techniques of pressure, force and velocity measurement. **(K^2)**
1AEPE305_3	**Analyze** qualitative and quantitative flow behavior over various bodies. **(K^3)**
1AEPE305_4	**Select data** acquisition system for the aerodynamic characteristic measurements. **(K^3)**
1AEPE305_5	**Design** and develop models to be tested on wind tunnels. **(K^4)**

Course Contents:		
Unit 1	**Introduction to Wind Tunnels** Necessity of Wind Tunnels; Basic Principle; Types of Wind Tunnels; Components of Subsonic Tunnel, Supersonic Tunnel, Hypersonic Tunnel and Shock Tunnel; Calibration Methods of Different Wind Tunnels; Design of Wind Tunnel Models; Accessories for Wind Tunnels.	**08 Hrs**
Unit 2	**Flow Visualization** Different Types of Flow Visualization Techniques for Subsonic, Supersonic and Hypersonic Tunnels; Basics of Schlieren, Shadowgraph and Interferometers; Laser Based Flow Visualization Technique (PTV and PIV	**06 Hrs**
Unit 3	**Pressure and Velocity Measurement** Pitot Static Probe; Cup Anemometer; Basic Principle and components of Hot Wire Anemometer, Laser Doppler Velocimeter; Mechanical System for Pressure Measurement; Water and Mercury Manometers; Working Principle of Pressure Transducer; Pressure Scanner; Pressure Sensitive Paint; Calibration of Pressure Measuring Units. Sensitivity	**08 Hrs**
Unit 4	**Force and Moment Measurement** Definition of Forces and Moments on Aerospace Vehicles; Basic Principle of Mechanical Balance and Strain Gage Balance; Types of Strain Gage Balance, Calibration of Force Measuring Units. Sensitivity	**06 Hrs**
Unit 5	**Unsteady Measurement** Introduction to Unsteady Pressure, Velocity and Temperature; Measurement of Unsteady Velocities Using Hot Wire Anemometers; Single and Multiple Hot Wire Probes; Acquiring data and deciphering.	**08 Hrs**
Unit 6	**Data Acquisition System** ADC Cards; Amplifiers; Signal Conditioners; P C Based Data Acquisition	**06 Hrs**

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	System; Error Analysis; Uncertainty Analysis and its uses; Experimental aerodynamics for industrial applications.	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Instrumentation, Measurements, and Experiments in Fluids	Radhakrishnan,	CRC Press – Taylor & Francis	-	2007
02	Experiments In Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Low Speed Wind Tunnel Testing	J.W. Barlow W.H. Rae and A. Pope	John Wiley & Sons, Inc	3rd	1999
02	High Speed Wind Tunnel Testing	Pope, A and Kennith L. Goin	John Wiley & Sons, Inc	-	1965
03	Experimental Fluid Mechanics	Bradsaw	Elsevier	2nd	1970

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Department of Aeronautical Engineering

Course Details:

Class	T. Y. B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE306 - Heat and Mass Transfer**
Prerequisite/s	1AEES204 - Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE306_1	**Apply** the concept of one dimensional steady state heat conduction to solve problems in Plane, Cylindrical and Spherical coordinates(K^3)
1AEPE306_2	**Analyze** the Heat Transfer through Fins and the significance of Dimensional Analysis in unsteady state conduction(K^3)
1AEPE306_3	**Analyze** the empirical correlations for Forced and Free Convection in Laminar and Turbulent Flows(K^4)
1AEPE306_4	**Apply** the various laws governing and the concept of Radiation Heat Transfer (K^3)
1AEPE306_5	**Explain** the general aspects of Boiling and Condensation Heat Transfer; and **design** considerations for Heat Exchangers(K^4)
1AEPE306_6	**Explain** the basic concepts of Mass Transfer(K^3)

Course Contents:		
Unit 1	**Introduction to Heat Transfer and Steady State Heat Conduction** **Introduction to Heat Transfer:-** Modes of Heat Transfer- Basic Laws Governing Heat Transfer- Thermal Conductivity- Thermal Conductivity of various materials- Thermal Resistance. **Steady state one-dimensional heat conduction:-** Fourier's law of Heat Conduction- General Heat Conduction equation in Cartesian Co-Ordinate (Derivation), its reduction to Fourier, Laplace and Poison's equation- Heat Conduction through plane and composite walls- Problems - Overall Heat Transfer Coefficient- Critical Thickness of Insulation(Problems on Cylindrical and Spherical Bodies with insulation).	**08 Hrs**
Unit 2	**Heat Transfer from Extended Surfaces and Unsteady State Heat Conduction** **Heat Transfer from extended surfaces (Fins):-** Types and applications of Fins- Heat transfer through Rectangular Fins (Problems on Infinitely long fins, Fins with Insulation at tip, fins losing heat at tip)-Efficiency and Effectiveness of Fins- Problems. **Unsteady State Heat Conduction:-** Heat conduction with negligible internal resistance- Lumped Parameter Analysis-Biot and Fourier Number, their significance with Problems.	**06 Hrs**
Unit 3	**Convection Heat Transfer** **Introduction to Convection:-** Concept of Hydrodynamic and thermal	**08 Hrs**

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	Boundary layer- local and average convective coefficient for laminar and turbulent flow over flat plate and through pipe- Dimensional Analysis- Buckingham's Pi Theorem. **Forced Convection:-** Empirical correlations for Forced Convection(Nusselt Number, Reynolds Number, Prandtl Number, Stanton Number)- Laminar Flow over Flat plates- Laminar flow inside tubes- Turbulent flow over flat plates- Turbulent flow inside tubes-Problems. **Free Convection:-** Empirical correlations for Free Convection(Nusselt Number, Grashoff Number, Prandtl Number)- Laminar Flow over Horizontal plates- Turbulent flow over Horizontal Plate- Laminar Flow over Horizontal Cylinders- Turbulent flow over Horizontal Cylinders-Problems.	
Unit 4	**Radiation Heat Transfer** **Introduction to Radiation:-** Surface Emission Properties- Absorptivity, Reflectivity and Transmissivity- Concept of Black Body- Stefan-Boltzmann Law, Kirchhoff's Law, Planck's Law, Wien's Displacement Law- Intensity of Radiation and Lambert's Cosine Law- Problems **Radiation Between Surfaces:-** Radiation exchange between black bodies separated by a non-absorbing medium- Shape Factor- Problems- Radiation exchange between gray surfaces without absorbing medium and absence of irradiation and Radiosity- Radiation shields- Problems	**08 Hrs**
Unit 5	**Boiling and Condensation, Heat Exchangers** **Boiling Heat Transfer:-** General Aspects of boiling- Boiling Regimes- Bubble shape and size consideration- Bubble growth and Collapse- Critical Diameter of Bubble- Factors affecting Nucleate Boiling- Boiling Correlations(Nucleate Pool Boiling, Critical heat flux for nucleate pool boiling, Film pool boiling)- Problems. **Condensation Heat Transfer:-** General aspects of condensation- Film Condensation & Dropwise condensation- Nusselt's Theory of Condensation- Problems. **Heat Exchangers:-** Classification and types of Heat Exchangers- Fouling Factor-Overall heat transfer coefficient- Parallel and Counter flow analysis(LMTD and NTU methods)- Problems- Design considerations for Heat Exchangers.	**08 Hrs**
Unit 6	**Mass Transfer** Introduction to Mass Transfer- Modes of Mass Transfer- Concentrations, Velocities and Fluxes- Problems- Fick's Law- Mass diffusion coefficient- Problems- General Mass diffusion equation in stationary media- Steady state diffusion through a plain membrane- Problems	**04 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Heat and Mass Transfer	R K Rajput	S. Chand & Company Ltd	5th	2012
02	Heat and Mass Transfer-	Yunus A	Mc Graw Hill	5th	2015

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	Fundamentals & Applications	Cengel/ Afshin A Ghajar	Education		

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Heat Transfer	J P Holman	Mc Graw Hill Educatiom	10th	2010
02	Fundamentals of Heat and Mass Transfer	Incropera/Dewitt / Bergman/Lavine	John Wiley & Sons	6th	2007

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TY AE-14/66

Course Details:

Class	T. Y- B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE307-Material Testing and Characterization**
Prerequisite/s	1AEPC210-Aerospace Materials and Structures
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE307_1	**Prepare** the specimens as per standards for respective tests. (K^3)
1AEPE307_2	**Select** the appropriate test depending on material and its application. (K^2)
1AEPE307_3	**Understand**, correlate and interpret the results. (K^2)
1AEPE307_4	**Select** the characterization tool for specific application(K^3)
1AEPE307_5	**Understand** basics of thermal analysis techniques. (K^2)
1AEPE307_6	**Identify and justify** the selection of the techniques to evaluate a particular sample(K^4)

Course Contents:		
Unit 1	**Introduction to Material Testing** General characteristics of solid engineering materials, Introduction to properties of materials-mechanical, physical, thermal, Mechanical testing prospective- Importance of materials testing, different mechanical testing methods, Introduction to mechanical behavior of metals and non metals, Accreditation to material testing laboratories.	**06 Hrs**
Unit 2	**Tension and Compression Testing** Introduction, Types of stress strain curves Tension testing- General procedure, tensile testing machines, specimen, test piece orientation and its effects on test, test piece geometry as per ASTM standards, Notch tension test. Test setup- Test procedure, speed of testing, Interpretation of results, reasons of variation in tensile properties. Compression testing- Introduction, compressive properties, deformation modes of axial compression, compressive testing methods, Test piece geometry, Types of compressive fractures.	**10 Hrs**
Unit 3	**Bending/Flexural Testing and Environmental tests for composites** Introduction, Importance of flexural testing, Types of flexural tests- three point flexural test, four point flexural tests, Specimen dimensions and testing arrangement as per ASTM and BSI specifications, Types of failure modes due to flexural testing. Environmental tests- Water absorption test, chemical resistance test, Acid digestion test for void measurement.	**06 Hrs**
Unit 4	**Creep and Fatigue Testing** Creep Testing- Introduction, Creep behavior and creep curve, Methods and	**10 Hrs**

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	equipment's for creep test- test stand, extensometers, specimen preparation as per standard, Types of loading of specimen, temperature control, Assessment and use of creep rupture properties- Evaluating remaining creep rupture life. Fatigue Testing- Introduction, stress-strain-time diagram, S-N curves, ASTM standards for fatigue testing, process of fatigue crack initiation and early growth, Fatigue testing machines, specimen preparation for fatigue test, Importance of surface preparation, Types of loading, Variables affecting fatigue resistance. Creep-Fatigue interaction	
Unit 5	**Characterization Techniques** Optical Microscopy - Introduction, Optical principles, Instrumentation, Specimen preparation-metallographic principles, Imaging Modes, Applications, Limitations. Transmission Electron Microscopy (TEM): Types of Electron sources. Focusing systems for parallel beams & probes. Image contrast & interpretation of images. Specimen preparation techniques, Scanning Electron Microscope (SEM): Working, detectors, Back Scattered & secondary electron imaging. Specimen preparation techniques, Introduction to X-ray diffraction technique.	**06 Hrs**
Unit 6	**Thermal Analysis** Instrumentation, experimental parameters, Different types used for analysis, Differential thermal analysis(DTA), Differential Scanning Calorimetry (DSC), Thermogravimetry (TGA), Dilatometry.	**04 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	An Introduction to Material Characterization	P.R. Khangaonkar	Penram intl. publishing (India) pvt. ltd.-mumbai	--	--

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	ASM Handbook Volume 8, Mechanical testing and evaluation	H. Kuhn and D. Medlin	ASM International.	9th	2019
02	ASM Handbook, Volume 10, Material characterization	--	ASM International.	9th	2019
03	Mechanical testing of advanced fiber composite	J. M. Hodgekinson	Woodhead publishing limited.	1st	2000

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Course Details:

Class	T. Y- B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE308 - Engineering Design Optimization**
Prerequisite/s	1AEBS201- Applied Mathematics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE308_1	**Define** objective function, explain the terms related to optimization problem, classify them (K^2)
1AEPE308_2	**Understand and apply** the techniques of classical optimization single and multivariable optimization with equality and inequality constraints(K^3)
1AEPE308_3	**Understand and apply** the techniques of linear (Simplex) and nonlinear (Elimination and Interpolation) programming to the optimization problems (K^3)
1AEPE308_4	**Understand and apply** techniques of unconstrained optimization through different methods(K^3)
1AEPE308_5	**Apply** the concepts of optimal control, optimality criteria, genetic algorithm, neural network and need of adaptive control(K^3)

Course Contents:		
Unit 1	**Introduction to Optimization methods** Review of differential calculus and matrix operations. Optimization problem definition, components. Classification and applications in aeronautical engineering	**05 Hrs**
Unit 2	**Classical optimization Techniques** Single variable optimization: Local and global minima and maxima, Necessary and sufficient conditions, Stationary point, Multivariable optimization: Necessary and sufficient conditions, Hessian Matrix of a function, Positive/negative definite and semi definite matrix, saddle point, Multivariable optimization with equality constraint: Solution by direct substitution, Multivariable optimization with inequality constraint: Kuhn Tucker conditions..	**07 Hrs**
Unit 3	**Linear Programming Problem-Simplex and Dual Simplex method** General form of LPP, Geometrical interpretations and definitions, Simplex algorithms and applications, Duality in Linear Programming- Construction of Simplex tableau, Duality Theorems, Dual simplex method, Sensitivity analysis, Karmarkar's Interior Method, Quadratic Programming.	**08 Hrs**
Unit 4	**Nonlinear Programming-One dimensional Minimization Methods** Definition of unimodal function, Elimination Methods: unrestrictive search, exhaustive search, Fibonacci Method, Golden Section Method;	**08 Hrs**

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	Interpolation methods: Direct Root Methods- Newton Method, Quasi Newton Method, Secant method, Practical Considerations	
Unit 5	**Unconstrained Optimization Techniques** Indirect search (Descent Methods)-Gradient of a function, Steepest descent, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Marquardt Method	**07 Hrs**
Unit 6	**Optimal control, optimality criteria and Modern methods in optimization** Calculus of variations, Applications to engineering domain, Lagrange multipliers and constraints, optimal control and necessary conditions for optimal control. Modern method of optimization: need of adaptive control for performance evaluation, Genetic algorithm fundamentals, applications in aeronautical engineering, Neural networks	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Engineering optimization Theory and Practice	S. S. Rao	John Wiley & Sons, Ltd	4th	2009
02	Operations Research: Principles and Practice	Ravindran, A., Phillips, D. T., and Solberg, J. J	Wiley India	2nd	2006

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Engineering Optimization	A. Ravindran et al.	John Wiley & Sons, Ltd	2nd	2006
02	Optimization for Engineering Design_ Algorithms and Examples	Deb Kalyanmoy	PHI Learning	2nd	2012
03	Operations Research: Applications and Algorithms	W. L. Winston	Cengage Learning	4th	2010

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Annasaheb Dange College of Engineering and Technology, Ashta
(An Autonomous Institute)

Department of Aeronautical Engineering

Course Details:

Class	T. Y- B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE309 - Helicopter Theory**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE309 _1	**Explain** the basic configurations of helicopter, main rotor and tail rotor - working principles, maintenance and inspection(K^2)
1AEPE309 _2	**Apply** the principles of momentum theory and blade element theory for the Aerodynamics calculation of Rotor blade (K^3)
1AEPE309 _3	**Analyze** the power requirements in forward flight and associated stability problems of helicopters. (K^3)
1AEPE309 _4	**Analyze** the factors/parameters affecting the helicopter performance under the various operational conditions. (K^4)

Course Contents:		
Unit 1	**Introduction to Helicopter theory** Evolution of helicopter-, Helicopter as an aircraft, Basic features, Layout, Generation of lift, Main rotor, Gearbox, Tail rotor, power plant, considerations on blade, flapping and feathering, Rotor controls, Helicopter configurations-rotor arrangements. Compound Helicopter - jet rotor-no tail rotor concepts, Types of rotorcraft – autogiro, gyrodyne, helicopter, Main rotor system – articulated semi rigid, rigid rotors, Collective pitch control, and cyclic pitch control, anti-torque pedals.	**05 Hrs**
Unit 2	**Helicopter Aerodynamics** Momentum / actuator disc theory, Blade element theory, combined blade element and momentum theory, vortex theory, rotor in hover, rotor model with cylindrical wake and constant circulation along blade, free wake model, Constant chord and ideal twist rotors, Lateral flapping, Coriolis forces, reaction torque, compressibility effects, Ground effect.	**08 Hrs**
Unit 3	**Helicopter Performance - Hovering** Dynamics of Hovering Flight: Thrust and Power Coefficients, Calculation of Drag and Torque, Estimation of Hover Ceilings, Power-Ground effect in Hover	**07 Hrs**
Unit 4	**Helicopter Performance - Forward Flight** Dynamics of Forward Flight: Forward Flight Performance, Parasite Drag and Power Stall Limitations, Autorotation in Forward Flight, Climb and Descent Performance: Power Required in Climb and Descent, Descent Speed Calculations	**08 Hrs**
Unit 5	**Stability and Control**	**08 Hrs**

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	Helicopter Trim, Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability.	
Unit 6	**Main Rotor System** Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking– Span wise dynamic balance – Blade sweeping –Electronic balancing – Dampener maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box –Gradient unit control boosts – Maintenance & Inspection control rigging.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aerodynamics of the Helicopter	A. Gessow and G.C.Meyers	Macmillan and Co	-	1982
02	Helicopter Maintenance	Jeppesen	Jeppesons and Sons Inc	-	2000

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Basic Helicopter Aerodynamics	J. Seddon	Blackwell scientific publications	AIAA Education series	1990
02	Helicopter Engineering	Lalit Gupta	Himalayan Books, New Delhi	-	1996

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Annasaheb Dange College of Engineering and Technology, Ashta
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Department of Aeronautical Engineering

Course Details:

Class	T. Y- B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEPE310 - Lighter-Than-Air Systems**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE310 _1	**Understand** the differences between HTA and LTA systems (K^2)
1AEPE310 _2	**Comment** on current developments and future trends of LTA systems(K^2)
1AEPE310 _3	**Describe** the properties and structure of atmosphere, and state the aerostatic principles(K^3)
1AEPE310 _4	**Comment** on the technological challenges in design, development and operation of an LTA system(K^4)
1AEPE310 _5	**Estimate** the static lift generated by an LTA system, given its type, size and operating scenario(K^5)
1AEPE310 _6	Carry out **conceptual layout and sizing** of an LTA system(K^6)

Course Contents:		
Unit 1	**Introduction to Lighter-Than-Air Systems** Introduction to LTA Systems, Types of LTA vehicles-Airship, Aerostat, Hot Air balloon, Historical Developments, Key Subsystems and Components of LTA Systems.	**06 Hrs**
Unit 2	**Principles of Aerostatics** The Atmosphere, Variation of Atmospheric Properties, Contained Gas, Buoyancy and Static Lift, Other Factors Affecting Lift., Static Lift Prediction, Effect of ambient conditions on Static Lift, Climb, Descent and Pressure Height.	**08 Hrs**
Unit 3	**Aerodynamics** Basic Assumptions, Drag, Dynamic Forces, Slender Body Theory, An Estimation Method for Overall Aerodynamic Forces and Moments, Unsteady Aerodynamics, Aerodynamic Parameter Estimation	**08 Hrs**
Unit 4	**Airship Technology** Methodology for airship conceptual design, Aerodynamics & Stability analysis of Airships, Ground Handling and Mooring systems, Case Studies in Airship Operations, Design & Development of Remotely Controlled Airships	**06 Hrs**
Unit 5	**Aerostat Technology** Methodology for sizing of Aerostat sub-systems, Equilibrium and Stability analysis of aerostats, Design and Development of Tethered Aerostats, Numerical problems	**08 Hrs**
Unit 6	**Current and Future Developments** Challenges in design of LTA Systems, Hybrid LTA Systems, Stratospheric	**06 Hrs**

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	Airships, Airships/Aerostats for Planetary Exploration, Current Trends and Recent Developments..	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Principles of Aerostatics - The Theory of Lighter-Than-Air Aircraft	Taylor, J. A.,	CreateSpace Independent Pub	-	2014
02	Airship Technology	Khoury, G., Ed.,	Cambridge Aerospace Series	2nd	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Course Material for Design and Development of LTA systems	Pant, R. S.	Curriculum Development Program, IIT Bombay	-	2010
02	Fundamentals of Aircraft and Airship Design, Volume 2 – Airship Design and Case Studies	Carichner, G. E., and Nicolai, L. M.	AIAA Education Series	-	2013

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Course Details:

Class	T. Y B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEOE311 - Introduction to Flight**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE311_1	**Explain** the historical developments in the Aeronautical Engineering, Current Trends in the Aviation Industry **(K^2)**
1AEOE311_2	**Comment & Explain** in detail the basic components, systems & subsystems of the Aircraft and their functions **(K^2)**
1AEOE311_3	**Explain** the fundamentals of Aerodynamics, Propulsion, Structures & Their classifications **(K^2)**
1AEOE311_4	**Comment & Explain** in detail the basics of Air Transportation & Airport Operations **(K^2)**
1AEOE311_5	**Comment & Explain** on the material requirements for Aeronautical applications **(K^2)**
1AEOE311_6	**Identify & Comment** on the various configurations of the aircraft **(K^2)**

Course Contents:		
Unit 1	**Introduction & Basic Anatomy of Aerospace Vehicles :** History of Aviation(Global & India Perspective), Early Concepts, Wright Brothers Era, First World War Period, Second World War Period, Modern Developments, Classification of Flying Vehicles, Anatomy of (Basic Parts & Their Function), Buoyancy Lift Vehicles(Airships, Aerostats, Hot Air Balloons), Dynamic Lift Vehicles(Aircrafts), Powered Static Lift Vehicles(Helicopters), Reaction Lift Vehicles(Launch & Re-entry Vehicles), Parachutes & Para gliders, Control Surfaces & Their Functions.	**07Hrs**
Unit 2	**Propulsion - Air Breathing and Non Air Breathing Engines:** Air Breathing Propulsion - Principle of Operation , Components Piston Engines , Jet Engines, Turbo Jet, Turbo Fan, Turbo Prop, Turbo Shaft, Ramjet, Scramjet, Station Numbering - Flight Envelope - Non-Air Breathing Propulsion Rocket Propulsion - Types and Classification	**07Hrs**
Unit 3	**Aircraft Maintenance and Repair:** General Aircraft Repairs- A, B, C, D Checks - Starting procedures of Turbo Prop, Turbo Fan and Turbojet Engines- Flight Inspection Procedures - Tools used in Airrcraft Maintenance- MRO Sector - Indian MRO Sector - Various job roles involved in the maintenance sector.	**08Hrs**
Unit 4	**Aviation - Air Transportation systems :** History of Aviation - Regulatory bodies - ICAO, IATA, FAA, EASA, DGCA- Airlines Management in brief - Airport Operations - ARFF - Airport Nomenclature - Air Traffic Control Operations - Airline Ticketing- Job roles	**06Hrs**

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	involved in the Aviation Sector - Flight Scheduling in brief.	
Unit 5	**Aerodynamics :** International Standard Atmosphere, Introduction to Aerodynamic Forces(Lift & Drag), Types of Lift & Drag Forces, Types of Weight & Thrust Forces, Aerofoils – Nomenclature & Types, NACA Series, Pressure Distribution around a Typical Aerofoil, Centre of Pressure, Aerodynamics Centre, Wing – Nomenclature & Configuration Types, Rectangular Wings, Swept Back & Forward Wings, Delta Wings, High Wing, Mid Wing, & Low Wing, High Lift Devices in Wings, Slats & Slots, Flaps, Trim Tabs, Airbrakes.	**07 Hrs**
Unit 6	**Materials and Aircraft Structures :** Materials, Typical Materials used in Aircraft Structures, Aluminum Alloys, Steel (Marging Steel), Nickel & Titanium Alloys, Glass & Carbon Composites, Aircraft Structures, Basic Loads acting on Aircraft Structures, Structural Members of Wing, Structural Members of Fuselage, Structural Members of Landing Gear, Structural Members of Engine Nacelle	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Flight	Anderson, J.D	McGraw-Hill	7th	2011
02	Aerodynamics, Aeronautics and Flight Mechanics	McCormick, B.W.	John Wiley	2nd	1995
03	Gas Turbines and Jet and Rocket Propulsion	Mathur M L and Sharma R P	Standard Publisher	3rd	2014
04	Aircraft Structures for Engineering Students	Megson, T.H.G	Elsevier	4th	2007

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Aerospace Engineering with a Flight Test Perspective	Stephen Corda	Wiley	1st	2011
02	Aviation. An Introduction to the Elements of Flight	Algernon Edward Berriman	Nabu Press	1st	2010
03	Aircraft Propulsion and Gas Turbine Engines	Ahmed F El-Sayed	Taylor and Francis	2nd	-
04	Experiments in Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2010

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Course Details:

Class	T. Y B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEOE312 - Introduction to Experimental Aerodynamics**
Prerequisite/s	Fluid Mechanics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE312_1	**Describe** and recognize various types of wind tunnels, measuring equipments and their applications. **(K^2)**
1AEOE312_2	**Explain** various techniques of pressure, force and velocity measurement. **(K^2)**
1AEOE312_3	**Analyze** qualitative and quantitative flow behavior over various bodies. **(K^3)**
1AEOE312_4	Select data acquisition system for the aerodynamic characteristic **measurements.(K^3)**
1AEOE312_5	**Design and develop** models to be tested on wind tunnels. **(K^4)**

Course Contents:		
Unit 1	**Introduction to Wind Tunnels** Necessity of Wind Tunnels; Basic Principle; Types of Wind Tunnels; Components of Subsonic Tunnel, Supersonic Tunnel, Hypersonic Tunnel and Shock Tunnel; Calibration Methods of Different Wind Tunnels; Design of Wind Tunnel Models; Accessories for Wind Tunnels.	**08Hrs**
Unit 2	**Flow Visualization** Different Types of Flow Visualization Techniques for Subsonic, Supersonic and Hypersonic Tunnels; Basics of Schlieren, Shadowgraph and Interferometers; Laser Based Flow Visualization Technique (PTV and PIV).	**06Hrs**
Unit 3	**Pressure and Velocity Measurement** Pitot Static Probe; Cup Anemometer; Basic Principle and components of Hot Wire Anemometer, Laser Doppler Velocimeter; Mechanical System for Pressure Measurement; Water and Mercury Manometers; Working Principle of Pressure Transducer; Pressure Scanner; Pressure Sensitive Paint; Calibration of Pressure Measuring Units. Sensitivity	**08Hrs**
Unit 4	**Force and Moment Measurement** Definition of Forces and Moments on Aerospace Vehicles; Basic Principle of Mechanical Balance and Strain Gage Balance; Types of Strain Gage Balance, Calibration of Force Measuring Units. Sensitivity	**06Hrs**
Unit 5	**Unsteady Measurement** Introduction to Unsteady Pressure, Velocity and Temperature; Measurement of Unsteady Velocities Using Hot Wire Anemometers; Single and Multiple Hot Wire Probes; Acquiring data and deciphering.	**08Hrs**
Unit 6	**Data Acquisition System** ADC Cards; Amplifiers; Signal Conditioners; P C Based Data Acquisition	**06Hrs**

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	System; Error Analysis; Uncertainty Analysis and its uses; Experimental aerodynamics for industrial applications.	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Instrumentation, Measurements, and Experiments in Fluids	Rathakrishnan, E.	CRC Press – Taylor & Francis	-	2007
02	Experiments In Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Low Speed Wind Tunnel Testing	J.W. Barlow W.H. Rae and A. Pope	John Wiley & Sons, Inc	3rd	1999
02	High Speed Wind Tunnel Testing	Pope, A and Kennith L. Goin	John Wiley & Sons, Inc	-	1965
03	Experimental Fluid Mechanics	Bradsaw	Elsevier	2nd	1970

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TY AE-25/66

Course Details:

Class	T. Y B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEOE313 : Introduction to Gas Dynamics and Jet Propulsion**
Prerequisite/s	Engineering Thermodynamics
Teaching Scheme: Lecture/Tutorial	3/0
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE313_1	**Discuss** the effects of variable area duct under the effect of varying back pressure.(K^3)
1AEOE313_2	**Estimate** the flow parameters over convex and concave corner and comment on the downstream flow (K^3)
1AEOE313_3	Give an insight into advanced jet & rocket propulsion systems and **compare** one another (K^3)
1AEOE313_4	Perform the engine cycle **analysis** for all thermodynamic cases (K^4)
1AEOE313_5	Interpret and **design** various propulsive systems suitable for the application and operation (K^4)

Course Contents:		
Unit 1	**Introduction to Isentropic compressible flows** Adiabatic flow, isentropic process and relations, stagnation state of a system, Different forms of energy equation, compressible Bernoulli's Equation, velocity of sound, mach number, characteristic mach number, isentropic one dimensional flow, critical parameters, Area Mach number relation, flow through a De Laval nozzle, Nozzle performance under various back pressure.	**06 Hrs**
Unit 2	**Concept Of Shocks & Flow Through Constant Area Ducts** Concepts of flow over concave and convex corners, Normal and Oblique Shock relations, Concept of expansion waves, Prandtl- Meyer Expansion Fan, Prandtl- Meyer functions, Fanno flow and Rayleigh flow, Use of gas tables for numerical solutions..	**07 Hrs**
Unit 3	**Parametric Cycle Analysis of Ideal Engines** Brayton Cycle, Gas turbine engines- Classifications, Components, thrust Equations ,Design input, Design of Engine parametric cycle analysis, Ideal & real ramjet, Ideal & real turbojet with and without afterburner, Ideal & real turbofan, Ideal & real turbofan with optimum bypass ratio and fan pressure ratio, Ideal & Real mixed flow turbofan with afterburner, Ideal & Real Turboprop engine, Ideal & Real Turbo shaft engine with regeneration	**07 Hrs**
Unit 4	**Liquid Propellant Rocket Engines** The basic configuration of the liquid propellant engine, The combustion chamber and nozzle- Injection, Ignition, Combustion instability and thrust vector control, Liquid propellant distribution systems,Cooling of liquid-	**08 Hrs**

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	fuelled rocket engines,The Vinci cryogenic upper-stage engine for Ariane 5,The Space Shuttle main engine,Combustion and the choice of propellants,The performance of liquid-fuelled rocket engines	
Unit 5	**Solid propellant rocket motors** Basic configuration,The properties and the design of solid motors, Propellant composition,Integrity of the combustion chamber,Ignition,Thrust vector control,The Space Shuttle SRB, The Ariane MPS solid booster,Hybrid rocket motors.	**06 Hrs**
Unit 6	**Electric & Nuclear propulsion** The importance of exhaust velocity.Principles of electric propulsion,Electric thrusters,Electromagnetic thrusters,Plasma thrusters, Low-power electric thrusters,Electrical power generation,Applications of electric propulsion,Nuclear fission basics,A sustainable chain reaction,Prompt and delayed neutrons,The principle of nuclear thermal propulsion,The fuel elements, , Exhaust velocity of a nuclear thermal rocket.The nuclear thermal rocket engine,Hydrogen storage,Safety issues, Advanced thermal rockets.	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Modern Compressible Flow with Historical Perspective	John D Anderson,	McGraw-Hill Publications	3	2003
02	Elements of Gas Dynamics	Liepmann, H.W., and Roshko, A.,	John Wiley		1957
03	Rocket & Spacecraft propulsion	Martin J L Turner	Springer	3	
04	Elements of Gas turbine propulsion	Jack D. Mattingly	McGraw-Hill Publications	6th reprint	2005

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	The Dynamics and Thermodynamics of Compressible Fluid Flow	A H Shapiro	John Wiley Publications Vol 1 & Vol 2	-	1953

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Course Details:

Class	T. Y B.Tech, Sem.-V (Aeronautical)
Course Code and Course Title	**1AEOE314 - Introduction to UAV**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE314_1	**Classsify** the UAV's and will be equipped with kowledge of Design process involved **(K^2)**
1AEOE314_2	**Explains** the basic aerodynamics and performance concepts associated with Fixed wing UAV **(K^3)**
1AEOE314_3	**Derive** the Equations of motion of an UAV and explain the PID control strategy associated with it **(K^3)**
1AEOE314_4	**Derive** and explain the mathematics associated with Launch and recovery systems **(K^3)**
1AEOE314_5	**Explain** the PID control strategy involved in altitude hold of a quadcopter**(K^4)**

Course Contents:		
Unit 1	**Introduction to UAV Systems** Aviation history, Over view of UAV systems, mission and classification based on air vehicle type; Design Process-Conceptual Design, Preliminary Design and Detail Design.	**07Hrs**
Unit 2	**The Air Vehicle and Performance fundamentals** The Air Vehicle: Basic Aerodynamics: Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag, Performance:Overview, climbing flight, Range and Endurance – for propellerdriven aircraft, range- a jet-driven aircraft, Guiding Flight	**06Hrs**
Unit 3	**Fundamentals of Autopilot Design** Fundamentals of autopilot Design Conventional autopilot system configuration, UAV Dynamic equations, State spacemodelling, Autopilot design process, Block diagram of a open and closed loop control system, Control necessity, control categories, Altitude control system, position control system, Control strategies-PID control and mathematics, LQR control methodology	**09Hrs**
Unit 4	**Navigation and Guidance systems** Navigation system Design: Introduction, Coordinate systems used, Inertial Navigation system, Global positioning system, Position fixed naviagtion system; Inertial Navigation sensors-Accelerometer, Gyroscope, Airspeed indicator, Altimeter, Design considerations; Guidance: Fundamentals of Guidance, Guidance laws, LOS, PN guidance, Way point navigation and Seeker	**08Hrs**

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Unit 5	**Launch and Recovery systems** Ground control station: Introduction, Types-Hand held, portable, Mobile Truck, Central command; Launch and Recovery systems-Fundamentals of Launch, Launcher Equipment, Recovery techniques- Parachute, Impact recovery, Air launch and Hand launch, Launch and Recovery system design Process	**06Hrs**
Unit 6	**Case Study: Quadcopter controller deisgn** Case study: Case study -Altitude and position controller of an Quadcopter using PID controller	**06Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to UAV Systems	Paul GerinFahlstrom, Thomas James Gleason	John Wiley & Sons, Ltd	4	2012
02	Unmanned Aircraft Design- A Review of Fundamentals	Mohammad H. Sadraey	Morgan & Claypool Publishers	1	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Unmanned Aircraftsystems UAVs deisgn, development and Deployment	Reg Austin	Wiley & Sons Ltd	1	2010
02	Aircraft Performance and Design	John D. Anderson, Jr	Tata McGraw Hill	5	2012
03	Small Unmanned Fixed-Wing Aircraft Design. A Practical Approach	Andrew J. Keane, AndrasSobester, James P. Scanlan	Wiley & Sons Ltd	1	2017
04	Introduction to Multicopter Design and Control	QuanQuan	Springer	1	2017

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Annasaheb Dange College of Engineering and Technology, Ashta
(An Autonomous Institute)

Department of Aeronautical Engineering

Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEPE351 - Self Learning Course**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	00/00
Credits	01
Evaluation Scheme: ISE/ESE	50/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE351_1	**Explain** the use of tools/skills and relevant theory learned in the industry **(K^2)**
1AEPE351_2	**Apply** the knowledge learned to an Aeronautical and allied problems **(K^3)**
1AEPE351_3	**Use** the Modern tools learned effectively to solve the problems and interpret the results **(S^3)**
1AEPE351_4	**Document** the results and present them before the department committee on time **(A^3)**

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Course Details

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	**1AEHS352, Communication Skills and Competencies**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	01
Evaluation Scheme: ISE/ESE	**25/00**

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEHS352_1	**Understand** the most important communication skills required for becoming competent professionals(K^2)
1AEHS352_2	**Understand** the 4 modules of competencies required for excelling in IELTS examinations(K^2)
1AEHS352_3	**Understand** the various accents in English communication (K^2)
1AEHS352_4	**Apply** the Professional and General writing styles (K^3)
1AEHS352_5	**Apply** the Professional and General speaking styles (K^3)
1AEHS352_6	**Apply** the concepts of Presenting a topic with the use of effective body language and Audio/Visual Aids(K^3)

List of Experiments

Exp. No.	Titleof Experiment
1	Introduction to Communication Skills and Competencies for Engineers
2	Listening - Specific Information & General Understanding
3	Listening - Talks of Scientific/Technical Nature and Completing Information
4	Reading - Making Judgements about the written text's content (Evaluative Comprehension)
5	Reading - Connecting the text to other written passages and situations (Inferential Comprehension)
6	Writing - Emails and Etiquettes
7	Writing - Analytical & Issue Based Essays
8	Writing - Reports and Proposals
9	Speaking - Understanding Accents and Neutralization of Accent
10	Speaking - Self Introduction & Elevator Pitch
11	Speaking - Extempore Speeches
12	Presentation Skills - Organizing Content, Body Language, Use of Audio/Visual Aids

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Communication Skills for	Sunita Mishra	Pearson	-	-

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	Engineers	C. Muralikrishna	Education		
2	Technical English	Dr. M Sambaiah	Wiley	-	-

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Communication Skills	Sanjay Kumar &Pushp Lata	Oxford University Press	-	2018
2	Basic Oral Communication Skills	British Council	Addison Wesley Longman ELT Division	-	1984

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Course Details

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	1AEPC356 Aircraft Structures Laboratory
Prerequisite/s	1AEES203 Mechanics of Materials
Teaching Scheme: Lecture/Tutorial/practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC356_1	**Determine** the Stresses and Deformations of the specimen by using different loading conditions.
1AEPC356_2	**Identify** use of suitable non destructive method for particular application.
1AEPC356_3	**Fabricate** and analysis of composite structures
1AEPC356_4	**Perform** the experiment on a given topic and explain with the help of knowledge acquired in theory classes.
1AEPC356_5	**Use** non destructive techniques in maintenance practices in the aerospace industry.
1AEPC356_6	**Follow** the professional practices like maintaining a laboratory journal and completion of work on time.

List of Experiments

Exp. No.	Title of Experiment
1	Shear center location of open sections (C, I & L Sections)
2	Shear center location of Closed sections (D & Rectangular Sections)
3	Shear center location of anti-symmetric sections (Z Sections)
4	Wagner's beam
5	Beam with combined loading
6	Manufacturing of GFRP composite using hand layup method
7	Determine Void fraction using acid digestion method
8	Tensile and compression test on given composite
9	Basic Calibration of the Ultrasonic Testing Machine using normal beam probe and Angle beam probe
10	Determination of the defects using the Ultrasonic testing
11	Young's Modulus and Poisson's Ratio Determination using pulse echo Method
12	Shear center location of open sections (C, I & L Sections)

Text Books:					
Sr.	**Title**	**Author**	**Publisher**	**Editio**	**Year of**

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No				n	Edition
1	Aircraft Structures for Engineering Students	Megson, T.M.G	Elsevier	5th Edition	2012
2	Understanding Aircraft Structures	John Cutler	Blackwell Publishing Ltd	4th Edition	2005
3	Practical Non-destructive Testing	Baldev Raj, T. Jayakumar and M. Thavasimuthu	Woodhead Publishing	-	2002

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Annasaheb Dange College of Engineering and Technology, Ashta
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Course Details

Class	T.Y. B.Tech(Aeronautical)
Course Code and Course Title	**1AEPC357-Flight Dynamics Laboratory**
Prerequisite/s	1AEES257-Numerical Analysis with Programming Language Laboratory
Teaching Scheme: Lecture/Tutorial/practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC357_1	**Apply** their knowledge and programming skills to compute the Aircraft Performance Equations. **(K^3)**
1AEPC357_2	**Write** a MATLAB Codes for the Generating Aircraft Performance Curves and Execute & Debug the MATLAB/Python Code for the Syntax & Logical Errors.**(S^3)**
1AEPC357_3	**Estimate** the Stick fixed and free Neutral point for a given the aircaraft data. **(K^3)**
1AEPC357_4	**Estimate** the aerodynamic parameters using ANN. **(K^3)**
1AEPC357_5	**Demonstrate** how to interface and acquire the information from the sensors. **(K^3)**
1AEPC357_6	**Follow** professional and ethical principles, standards while writing the MATLAB/Python Codes. **(A^2)**
1AEPC357_7	**Recognize** the need for learning the Programming Language for solving complex Problems related to Engineering. **(A^3)**

List of Experiments

Exp. No.	Title of Experiment
1	Introduction to MATLAB/Python
2	Introduction to Aerospace Toolbox – Demonstration, International Standard Atmosphere Model
3	Drag Polar Curve Generation for a Typical Aircraft
4	Aircraft Climb and Descent Performance Analysis
5	Ploting Flight Envelope of an Aircraft
6	Estimatation of Takeoff and Landing Distance of an Aircraft
7	Solving second order differential Equation and estimation of critical parameters
8	Data Acquisition using MEMS device (Accerelometer, Gyroscope and Ultrasound)
9	Estimation of Stick fixed neutral point and Stick free neutral point
10	Estimation of lateral and directional Flight stability
11	Aerodynamic parameter estimation using ANN
12	Interfacing flight gear with MATLAB for longitudional stabilty analysis

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Text Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Flight stability and automatic control	Nelson, R.C.	McGraw-Hill,	2nd Edition	1998
2	Performance, stability, dynamics and control of an airplane	Pamadi, Bandu N	AIAA Education Series	2nd Edition	2004

Reference Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Introduction to Aircraft Flight Mechanics	Yechout, T.R	AIAA Education Series	1st Edition	2003

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Course Details:

Class	T. Y B.Tech, Sem.-VI (Aeronautical)
Course Code and Course Title	**1AEPC305 - Vibrations and Structural Dynamics**
Prerequisite/s	1AEES110 – Engineering Mechanics 1AEES203 - Mechanics of Material
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC305 _1	**Describe** the basic concepts of vibration. **(K^2)**
1AEPC305 _2	**Explain** different vibration measuring instruments. **(K^2)**
1AEPC305 _3	**Describe** the interaction among the aerodynamic, elastic and inertia forces. **(K^2)**
1AEPC305 _4	**Determine** natural frequency of mechanical vibrating system/element.**(K^3)**
1AEPC305 _5	**Compute** the parameters of vibration isolation system.**(K^3)**
1AEPC305 _6	**Identify** the vibratory response of mechanical system/element.**(K^3)**

Course Contents:		
Unit 1	**Fundamentals of vibration** Basic Concepts of Vibration, Classification of Vibration, Vibration Analysis Procedure, Spring Elements, Mass or Inertia Elements, Damping Elements, Harmonic Motion.	**05 Hrs**
Unit 2	**Free & Forced Vibration of Single-Degree-of-Freedom Systems** Free Vibration of Single-Degree-of-Freedom Systems – Free Vibration of an Undamped Translational & Torsional System, Rayleigh s Energy Method, Free Vibration with Viscous Damping, Free Vibration with Coulomb Damping Forced Vibration of Single-Degree-of-Freedom Systems – Response of a Damped System a) Under Harmonic Force, b) Under the Harmonic Motion of the Base, c) Under Rotating Unbalance, Self-Excitation and Stability Analysis	**08 Hrs**
Unit 3	**Two-Degree & Multi-Degree of Freedom Systems** Two-Degree-of-Freedom Systems - Equations of Motion for Forced Vibration, Free Vibration Analysis of an Undamped System, Torsional System, Coordinate Coupling and Principal Coordinates Multi-degree-of-Freedom Systems – Modelling of Continuous Systems as Multi-degree of-Freedom Systems, Using Newton s Second Law to Derive Equations of Motion, Influence Coefficients, Generalized Coordinates and Generalized Forces, Using Lagrange s Equations to Derive Equations of Motion, Hamilton's principle, Equations of Motion of Undamped Systems in Matrix Form	**09 Hrs**

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Unit 4	**Approximate Methods to determine the natural frequencies & mode shape** Rayleigh's Method- Properties of Rayleigh s Quotient, Computation of the Fundamental Natural Frequency , Fundamental Frequency of Beams and Shafts Holzer's Method – Torsional Systems, Spring-Mass Systems Matrix Iteration Method - Convergence to the Highest Natural Frequency, Computation of Intermediate Natural Frequencies	**08 Hrs**
Unit 5	**Continuous Systems** Transverse Vibration of a String or Cable - Equation of Motion, Initial and Boundary Conditions, Free Vibration of a Uniform String, Free Vibration of a String with Both Ends Fixed Longitudinal Vibration of a Bar or Rod - Equation of Motion and Solution, Orthogonality of Normal Functions Torsional Vibration of a Shaft or Rod & Lateral Vibration of Beams	**06 Hrs**
Unit 6	**Introduction to Aeroelasticity** Divergence of Lifting Surface - The phenomenon of divergence, divergence of 2-D wing section, divergence of an idealized cantilever wing Steady State Aero-Elasticity Problems in General - Loss and reversal of aileron Control: 2D case, aileron reversal general case. Introduction to Flutter and Buffeting – The phenomenon of flutter, flutter of a cantilever wing, buffeting and stall flutter- An introduction	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Mechanical Vibrations	Singiresu.S.Rao	Pearson Education LPE	5th Edition	2004
02	Vibration Problems in Engineering	Timoshenko S	Wiley and Sons, New York	2nd Edition	1993
03	Dynamics of Structures	R.W. Clough and Penzien	McGraw Hill	2nd Edition	1993

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to the study of Aircraft Vibration and Flutter	Scanlan R.H. and Rosenbaum R	John Wiley and Sons. New York	2nd Edition	1982
02	Mechanical Vibrations	Tse. F.S., Morse, I.F., Hinkle, R.T	Prentice Hall, New York	2nd Edition	1984
03	An Introduction to the Theory of Aero elasticity	Fung Y.C	John Wiley and Sons, New York	3rd Edition	1995

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Course Details:

Class	T. Y. B. Tech (Semester - VI)
Course Code and Course Title	**1AEPC306-Computational Fluid Dynamics**
Prerequisite/s	1AEES202- Fluid Mechanics 1AEES207- Numerical Analysis with Programming Language
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC306_1	**Describe** components of the CFD algorithms, the role of CFD algorithms in the product design cycle & the governing equations of the fluid flow applicable for the general & special cases of the fluid flows.(K^2)
1AEPC306_2	**Discuss** the need for grids, types of grid generation techniques & the advancements in the grid generation process.(K^2)
1AEPC306_3	**Categorize** the Partial Differential Governing Equations applicable for specific fluid flow cases by applying the principles of mathematics. (K^3)
1AEPC306_4	**Describe** the various Finite Difference & Finite Volume schemes used in the Computational Algorithms & Apply them for solving simple fluid flow cases.(K^3)
1AEPC306_5	**Describe** the role of Turbulence Models in the CFD Solution Procedure and Apply and use the appropriate Turbulence Models for solving the cases.(K^3)
1AEPC306_6	**Analyze** the Stability characteristics of the various Finite Difference schemes.(K^4)

Course Contents:		
Unit 1	**Introduction:** Number Representation in the Computer, Fixed and Floating point Representation, Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations –Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.	**07 Hrs**
Unit 2	**Partial Differential Equations: Impact on CFD:** 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.	**07 Hrs**
Unit 3	**Discretization:** Essence of discretization, Taylor series approach for the construction of finite-difference quotients; Higher order difference quotients, Up-wind differencing, Midpoints leap frog method, Reflection boundary condition,	**07 Hrs**

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	Difference equations, Explicit and Implicit approach: Definition and Contrasts, Errors and analysis of stability, Error propagation, Stability properties of Explicit and Implicit methods.	
Unit 4	**Finite Volume Methods:** Finite Volume discretization, Cell Centered Formulation, High resolution finite volume upwind scheme, Runge–Kutta Time Stepping, Multi Time Step Integration scheme, Cell Vertex Formulation, Numerical dispersion.	**07 Hrs**
Unit 5	**Grid Generation:** Body fitted coordinate system, Need for grid generation, Essential properties of grids, Types of grids (O-type, C-type and H-type), Various grid generation techniques, Algebraic and Numerical grid generation, Elliptic grid generation, Structured, Un-structured grids, Adaptive grids, Grid collapse, Multi-Grid methods ,Grid accuracies.	**07 Hrs**
Unit 6	**Turbulence Models:** Turbulence models, mixing length model, Two equation models – High and low Reynolds number models	**07 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Computational Fluid Dynamics - The Basics with Applications	John D. Anderson	McGraw Hill Publishers	First Edition	1995
02	Introduction to Computational Fluid Dynamics	Pradip Niyogi, S. K. Chakarbartty, M. K. Laha	Pearson Education Ltd.	First Edition	2006

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Numerical Computation of Internal and External Flows	Charles Hirsch	John Wiley and Sons, New York		
02	Computational Fluid Dynamics for Engineers	Klaus A Hoffmann and Steve T, Chiang	Engineering Education System	Volume I and II	-
03	Computational Fluid Dynamics - An Introduction	John F, Wendt	Springer – Verlag	-	1992

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Course Details:

Class	T. Y B.Tech, Sem.-VI (Aeronautical)
Course Code and Course Title	**1AEPC307, Space Dynamics**
Prerequisite/s	Applied Mathematics, Engineering Mechanics, Applied Physics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC307_1	**Explain** the Basic concepts related to space dynamics such as Celestial sphere, Newtons laws of motion.**(K^2)**
1AEPC307_2	**Apply** the concept of two body and restricted three body problem to celestial objects of interest.**(K^3)**
1AEPC307_3	**Explain** the concept of Unrestricted threebody and Many body problem **(K^2)**
1AEPC307_4	**Apply** the comcept of various orbital maneuvers for interplanetary trajectories.**(K^3)**
1AEPC307_5	**Apply** the concept of Lagrange multiplier to determine the optimal staging for rockets.**(K^3)**

Course Contents:		
Unit 1	**Basic Concepts:** The Solar System, References Frames and Coordinate Systems, The Celestial Sphere, The Ecliptic, Motion of Vernal Equinox, History of Solar System Discovery and Planetary Motion, Conic Sections, Newton's Law of Gravitation, Kepler's Laws of Planetary Motion, Particle Kinematics, Newton's Laws of motion..	**08 Hrs**
Unit 2	**Two Body Problems:** Two body problems: Equation of Motion in an inertial reference frame, Eqauation of relative motion, Angular Momentum and Orbital Formulas, Energy Laws, Circular, Elliptic, Parabolic and Hyperbolic Trajectories, Lagrange's Coefficients.	**07 Hrs**
Unit 3	**Three Body and Many Body Problems:** Three Body Problem: Circular Restricted and Elliptic restricted three body problem, Lagrange's Points and Jacobi Constants, Applications to Spaceflight, Many Body Problem: The many body concept and its application, The General N-body problem, Integrals of Motion, The Virial Theorem and The Jacobi Integrals.	**07 Hrs**
Unit 4	**Orbital Maneuvers:** Introduction, Impulsive Maneuvers, Hohmann Transfer, Bi-elliptic Hohmann Transfer, Phasing maneuvers, Non-Hohmann transfers with a common apse line, Apse line rotation, Chase maneuvers, Plane change maneuvers.	**08 Hrs**
Unit 5	**Interplanetary Trajectories:** Introduction, Interplanetary Hohmann transfers, Rendezvous opportunities,	**07 Hrs**

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	Sphere of influence, Method of patched conics, Planetary departure, Sensitivity analysis, Planetary rendezvous, Planetary flyby, Planetary ephemeris, Non-Hohmann interplanetary trajectories.	
Unit 6	**Rocket Vehicle Dynamics:** Introduction, Equations of motion, The thrust equation, Rocket performance, Restricted staging in field-free space, Optimal staging, Lagrange multiplier.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Orbital Mechanics for Engineering Students	Howard D. Curtis	Elsevier Butterworth-Heinemann	1st Edition	2005
02	Spacecraft Dynamics and Control, A Practical Engineering Approach	Marcel J. Sidi	Cambridge University Press	1st Edition	1997
03	Fundamentals of Astrodynamics and Applications	Vallado, David A.	Springer Publication	2nd Ed.	2001

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Space Flight Dynamics	William E. Wiesel	Irwin McGraw-Hill	2nd Edition	1995
02	Space Vehicle Dynamics and Control	Bong Wie	AIAA Education Series	2nd Edition	2008
03	Rocket Propulsion and Space Dynamics	J. W. Cornelisse, H. F. R. Schoyer, K. F. Wakker	Pitman Publishing Ltd	1st Edition	1979

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPE316, Hypersonic Aerodynamics**
Prerequisite/s	1AEPC202 – Fluid Mechanics 1AEPC208 – Low speed Aerodynamics 1AEPC303 – High Speed Aerodynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
IAEPE316_1	**Define** the fundamental of hypersonic flow physics. **(K^2)**
IAEPE316_2	**Explain** the theories related to analysis of hypersonic flow. **(K^2)**
IAEPE316_3	**Analyze** the hypersonic shock theories. **(K^3)**
IAEPE316_4	**Develop** the viscous effect in hypersonic flow.**(K^3)**
IAEPE316_5	**Implement** similarity rule on various bodies moving at hypersonic speed.**(K^3)**

Course Contents:		
Unit 1	**Introduction** Hypersonic Flow; Shock Layer; Entropy Layer; Viscous Interaction; High Temperature Flows; Low Density Flows; Velocity Altitude Map.	**05 Hrs**
Unit 2	**Hypersonic Shock- Expansion Theory** Shock Relation ; Hypersonic Shock Relations in Terms of the Hypersonic Similarity Parameter; Expansion Relation; Newtonian Flow; Modified Newtonian Law; Centrifugal Force Corrections to Newtonian Theory; Tangent- Wedge/ Tangent- Cone Methods; Shock- Expansion Method.	**08 Hrs**
Unit 3	**Hypersonic Inviscid Flowfields (Approximate Methods)** Introduction; The Governing Equations; Mach Number Independence; The Hypersonic Small- Disturbance Equations; Hypersonic Similarity; Hypersonic Small- Disturbance Theory; The Hypersonic Equivalence Principle and Blast Wave Theory; Thin Shock- Layer Theory.	**07 Hrs**
Unit 4	**Hypersonic Inviscid Flowfields (Exact Methods)** General Thoughts; Method of Characteristics; The Hypersonic Blunt- Body Problem; Correlations for Hypersonic Shock- Wave Shapes; Modern Computational Hypersonics	**08 Hrs**
Unit 5	**Viscous Hypersonic Flow** Governing Equations for Viscous Flow; The Navier- Stokes Equations; Similarity Parameters and Boundary Conditions; The Boundary Layer Equations for Hypersonic Flow; Hypersonic Boundary Layer Theory; Self-Similar Solutions, Flat Plate Case, Stagnation Point Case; Hypersonic Transition; Hypersonic Turbulent Boundary Layer; Hypersonic Aerodynamic Heating; Entropy Layer Effects on Aerodynamic Heating.	**08 Hrs**
Unit 6	**Similarly Rules** Prandtl-Glauert and Goethert Similarly Rules, Karman Similarity and	**06 Hrs**

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	Transonic Speed; Hypersonic Similarity Rule; Area Rule; Drag Divergence; Critical Mach Number; Flow Past Wedge and Cone at Subsonic and Supersonic Speed.	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Hypersonic and High Temperature Gas Dynamics	John D. Anderson	AIAA	3rd	2019

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Super- and Hypersonic Aerodynamics and Heat Transfer	G. K.Mikhailov, V. Z. Parton	CRC Press	1st	Reprint, 2010

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPE317 - Advanced Propulsion Systems**
Prerequisite/s	1AEPC304-Aerospace Propulsion
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE317_1	**Understand** the concept of various types of advanced chemical propulsion system and its application to real systems. **(K^2)**
1AEPE317_2	**Demonstrate** the utilization of combustion systems in scramjet, ramjet propulsion and hypersonic propulsion. **(K^2)**
1AEPE317_3	**Infer** the concept of nuclear rockets and evaluate the performance, operation parameters and handling hazard involved. **(K^2)**
1AEPE317_4	**Differentiate** between electro-thermal and pure electric thrusters and interpret the concept for power generation in space. **(K^3)**
1AEPE317_5	**Appraise** the various micro-propulsion systems developed and emerging technologies involved. **(K^3)**
1AEPE317_6	**Understand** the concepts of hybrid propulsion systems. **(K^2)**

Course Contents:		
Unit 1	**Advanced Chemical Propulsion System** High Performance Chemical Propulsion Systems, Tripropellants; Metalized Propellants; Free Radical Propulsion; Flight Hybrid Rocket Propulsion Systems.	**05 Hrs**
Unit 2	**Scramjet Propulsion** Scramjet and Ram Rocket Propulsion System; Scramjet Inlets; Scramjet Performance, Engine Cycle; Diffusion Flame Combustion and Supersonic Combustion; Supersonic Flow Combustors; Dual-mode Combustion System.	**07 Hrs**
Unit 3	**Hypersonic Propulsion** Introduction to Hypersonic Propulsion; Developments in High Speed Vehicle Propulsion System; Aerodynamic Shape of a Hypersonic Vehicle with an Air Breathing Engine.	**06 Hrs**
Unit 4	**Nuclear Propulsion System** Types of Nuclear Propulsion Systems; Heat Transfer in Nuclear Rockets; Gaseous Core Nuclear Rockets; Pure Nuclear Propulsion System; Operation, Performance and Application Areas; Nuclear Hazards; Nuclear Power Generation in Space.	**08 Hrs**
Unit 5	**Electric Propulsion System** Overview of Application Areas; Ideal Flight Performance; Electro-thermal Thrusters – Resistojets and Arcjets. Pure Electric Thrusters – Electrostatic, Electro Magnetic and Hall- effect Thrusters; Optimum Flight Performance;	**08 Hrs**

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	Electric Power Generation in Space.	
Unit 6	**Micropropulsion System** Recent Micro Spacecraft Developments; Micro-propulsion Options; Primary Set of Micropropulsion Requirements; Chemical Propulsion Options; Review of Electric Propulsion Technologies for Micro and Nano- satellites; Emerging Technologies: MEMS and MEMS- Hybrid Propulsion System.	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Developments in High Speed- Vehicle Propulsion System	Murthy, S.N.B, Curran, E.T.	Progress in Astronautics & Aeronautics	Vol. 165	1996
02	Scramjet Propulsion	Murthy, S.N.B, Curran, E.T.	Progress in Astronautics & Aeronautics	Vol. 189	2001
03	Micropropulsion for Small Spacecraft	Paul, Z	Progress in Astronautics & Aeronautics	Vol. 187	2000

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Rocket Propulsion Elements	Sutton, G.P., Biblarz, O	John Wiley & Sons, Inc., New York	7th	2001
02	Rocket and Spacecraft Propulsion	Martin J. L. Turner	Springer	2nd	2005

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPE318 - Advanced Mechanics of Solids**
Prerequisite/s	1AEES103- Engineering Mechanics: Statics 1AEES110- Engineering Mechanics: Dynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE318_1	**Understand** the basic concepts of stress,strain and deformation. **(K^2)**
1AEPE318_2	**Analyze** the elastic and plastic behavior of materials, stress invariants, principal stresses and their directions. **(K^3)**
1AEPE318_3	**Analyze** strain in variants, principal strains and their directions. **(K^3)**
1AEPE318_4	**Develop** constitutive relationships between stress and strain for linearly elastic solid. **(K^3)**
1AEPE318_5	**Apply** the concepts of energy methods in solving structural problems. **(K^3)**
1AEPE318_6	**Analyze** theories of failure and design considerations for safe operations. **(K^4)**

Course Contents:		
Unit 1	**Introduction** Strength of materials; Elastic and plastic behaviour; Average stress and strain; Tensile deformation of ductile metal; Ductile vs brittle behaviour; Concept of stress and types of stresses; Concept of strain and types of strain; Units of stress and other quantities.	**06 Hrs**
Unit 2	**Analysis of Stress** Body force, surface force and stress vector; State of stress at a point; Normal and shear stress components; Rectangular stress components; Stress components on an arbitrary plane (Cauchy's stress formula); Equality of cross shears; Principal stresses; Stress invariants; State of stress referred to principal axes; Mohr's circles for three-dimensional state of stress, Plane state of stress; Differential equations of equilibrium; Equilibrium equations for plane stress state; Equations of equilibrium in cylindrical coordinates; Axisymmetric case and plane stress case.	**09 Hrs**
Unit 3	**Analysis of Strain** Deformations; Deformation in the neighbourhood of a point; Change in length of a linear element; Rectangular strain components; State of strain at a point; Interpretation of shear strain components; Change in direction of linear element; Cubical dilatation; Change in angle between two line elements; Principal axes of strain and principal strains; Plane state of strain; Plane strains in polar coordinates; Compatibility conditions (Saint Venant's equations); Strain deviator and its invariants.	**09 Hrs**
Unit 4	**Stress-Strain relations for Linearly Elastic Solids**	**06 Hrs**

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	Generalized statement of Hooke's law; Stress–Strain relations for isotropic materials; Modulus of rigidity; Bulk modulus; Young's modulus and Poisson's ratio; Relations between elastic constants; Displacement equations of equilibrium (Lame's equations).	
Unit 5	**Theories of failure** Maximum principal stress theory; Maximum shear stress theory; Maximum elastic strain theory; Octahedral shear stress theory; Maximum elastic energy theory; Energy of distortion theory; Significance of the various theories of failure; Use of factor of safety in design.	**06 Hrs**
Unit 6	**Energy Methods** Hooke's law and the principle of superposition; Corresponding force and displacement or work-absorbing component of displacement; Work done by forces and elastic strain energy stored; Reciprocal relation; Maxwell-Betti-Rayleigh reciprocal theorem; Generalized forces and displacements.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Advanced Mechanics of Solids	L. S. Srinath	McGraw Hill	3rd	2010
02	Mechanical metallurgy	G. E. Dieter	McGraw Hill	3rd	1998
03	Solid Mechanics	S. M. A. Kazimi	McGraw Hill	1st	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Theory of elasticity	S. P. Timoshenko, J.N.Goodier	McGraw Hill	1st	1970
02	An introduction the theory of elasticity	R.J. Atkin, and N. Fox	Longman	1st	1980
03	Engineering mechanics of solids	E. P. Popov	Prentice Hall	2nd	1998

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPE319- Introduction to Air Transportation and Flight Scheduling**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE319_1	**Describe** the complexity of airline planning, operations and dispatch.. **(K^2)**
1AEPE319_2	**Calculate** the shortest path flow for minimum cost flow problem. **(K^3)**
1AEPE319_3	**Understand** the maximum path flow for multi commodity flow problem. **(K^2)**
1AEPE319_4	**Analyze** the Integer programming models- set covering/ partitioning problems, traveling salesman problem. **(K^4)**
1AEPE319_5	**Differentiate** and **analyze** the problems in aircraft routing and management for maintenance of regular operations. **(K^4)**
1AEPE319_6	**Analyze** the role of solution for constructing flight scheduling and operations. **(K^4)**

Course Contents:		
~~Unit 1~~	**Network Flows and Integer Programming Models** Complexity of airline planning, operations and dispatch- need for optimization- role of operations research and simulation. Networks- definitions, network flow models- shortest path problem, minimum cost flow problem, maximum flow problem, multi-commodity problem. Integer programming models- set covering/ partitioning problems, traveling salesman problem- mathematical formulation- decision variables, objective function, constraints, and methods of solution, Solution by simulation.	~~05 Hrs~~
Unit 2	**Aircraft Routing and Management of Irregular Operations** Goal of aircraft routing- maintenance requirements, other constraints. Routing cycles, route generators. Mathematical models of routing- decision variables, objective functions, alternatives, constraints- flight coverage and aircraft available. Example problems and solutions. The problem statement, the time band approximation model-formulation of the problem-the scenarios- solution.	**08 Hrs**
Unit 3	**Flight Scheduling** Significance of flight scheduling. The route system of the airlines- point-to-point flights, hub and spoke flights. Schedule construction-operational feasibility, economic viability. Route development and flight scheduling process- load factor and frequency- case study.	**07 Hrs**
Unit 4	**Fleet Assignment** Purpose of fleet assignment. Fleet types, fleet diversity, and fleet availability- performance measures, Formulation of the fleet assignment problem-	**08 Hrs**

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	decision variables, objective function, constraints, and solution. Scenario analysis, fleet assignment models.	
Unit 5	**Crew and Manpower Scheduling** Crew scheduling process-significance. Development of crew pairing- pairing generators- mathematical formulation of crew pairing problem- methods of solution. Crew rostering- rostering practices. The crew rostering problem- formulation, solutions. Man power scheduling- modeling, formulation of the problem, solutions	**08 Hrs**
Unit 6	**Gate Assignment and Aircraft Boarding Strategy** Gate assignment-significance- the problem-levels of handling-passenger flow, distance matrix- mathematical formulation, solution. Common strategies for aircraft boarding process, mathematical model, interferences, model description, aisle interferences.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Airline Operations and Scheduling	Bazargan M	Ashgate Publishing Ltd	2nd	2010

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	The Global Airline Industry	Belobaba P, Odoni, A., Barnhart, C.	Wiley	2nd	2009
02	Airline Operations and Delay Management	Wu, Cheng-Lung	Routledge	1st	2010

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPE320- Introduction to Aircraft Design**
Prerequisite/s	1AEPC302-Flight Dynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE320_1	**Describe** about the various design process and methodology, and will be able to explain about various types of configuration alternatives and their significance. **(K^2)**
1AEPE320_2	**Describe** about various cost factors involved in the operation of an aircraft and about airline economics. **(K^2)**
1AEPE320_3	**Apply** the knowledge of design and estimate take-off weight and the dimensional parameters of wing, fuselage, tail, control surfaces and Engine based on the requirement. **(K^3)**
1AEPE320_4	**Analyze** the performance characteristics- take-off, landing level turn, climb for the given aircrafts. **(K^3)**
1AEPE320_5	**Estimate** the Drag characteristics, air loads, V-n diagram gust load diagrams for the Aircrafts. **(K^4)**
1AEPE320_6	**Perform** constraint and performance analysis for the given design problem. **(K^5)**

Course Contents:		
Unit 1	**Overview of the Design Process, Preliminary Weight Estimation** Phases of aircraft design, Aircraft conceptual design process, Project brief / request for proposal, Problem definition, Information retrieval, Aircraft requirements, configuration options, The initial conceptual sketches. Initial takeoff weight build-up, Empty weight estimation, Historical trends, Fuel fraction estimation, Mission profiles, Mission segment weight fractions.	**08 Hrs**
Unit 2	**Airfoil and Geometry Selection, Thrust To Weight Ratio, Wing Loading** Initial Airfoil selection, Airfoil design, Design lift coefficient, stall, Airfoil thickness ratio and other airfoil considerations, Wing geometry and wing vertical location, Wing tip shapes, Tail geometry and arrangements, Thrust to weight ratio, Statistical estimation, Thrust matching, Wing loading, Performance constraints, Selection of thrust-to-weight ratio and wing loading.	**08 Hrs**
Unit 3	**Baseline Design Analysis** Estimation of lift curve slope, Maximum lift coefficient, Complete drag build up, Installed performance of an engine, Installed thrust methodology, Net propulsive force, part power operation. Aircraft loads, categories, Manoeuvre, Gust, inertial, power plant, landing gear loads, Limit loads, the	**07 Hrs**

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	V, n diagram, Air load distribution on lifting surfaces, Review of methods of structural analysis, Material selection, Weights and moments- statistical group estimation method, centre of gravity excursion control.	
Unit 4	**Stability and Performance Analysis** Estimation of stability and control derivatives, Static lateral-directional stability and trim, Estimation of aircraft dynamical characteristics, handling qualities. Performance analysis: Steady level flight, Minimum thrust required for level flight, range and loiter endurance, Steady climbing and descending flight, Best angle and rate of climb, Time to climb and fuel to climb, Level turning flight, instantaneous turn rate, sustained turn rate, Energy maneuverability methods of optimal climb trajectories and turns	**07 Hrs**
Unit 5	**Constraint Analysis** The aircraft operating envelope, Take off analysis, Balanced field length, Landing analysis, Fighter performance measures of merit, Effects of wind on aircraft performance, Initial technical report of baseline design analysis and evaluation, Refined baseline design and report of specifications.	**06 Hrs**
Unit 6	**Cost Estimation, Parametric Analysis and Trade Studies** Elements of life cycle cost, Cost estimating method, RDT and E and production costs, operation and maintenance costs, Fuel and oil costs, Crew salaries, Maintenance expenses, depreciation. Cost measures of merit, Aircraft and airline economics, DOC and IOC, Airline revenue, Breakeven analysis, Investment cost analysis, Trade studies, Design trades, Requirement trades, growth sensitivities.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Design: A Conceptual Approach	Raymer, D.P	AIAA Education Series	5th	1999
02	Aircraft Performance and Design	Anderson, J.D.	McGraw-Hill	3th	2016

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to Aircraft Design	Fielding . J. P	Cambridge University Press	2nd	2017

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEOE321 - Lighter-Than-Air Systems**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE321_1	**Understand** the differences between HTA and LTA systems(K^2)
1AEOE321_2	**Comment** on current developments and future trends of LTA systems(K^2)
1AEOE321_3	**Describe** the properties and structure of atmosphere, and state the aerostatic principles(K^3)
1AEOE321_4	**Comment** on the technological challenges in design, development and operation of an LTA system(K^4)
1AEOE321_5	**Estimate** the static lift generated by an LTA system, given its type, size and operating scenario(K^5)
1AEOE321_6	**Carry out** conceptual layout and sizing of an LTA system(K^6)

Course Contents:		
Unit 1	**Introduction to Lighter-Than-Air Systems:** Introduction to LTA Systems, Types of LTA vehicles-Airship, Aerostat, Hot Air balloon, Historical Developments, Key Subsystems and Components of LTA Systems	**06Hrs**
Unit 2	**Principles of Aerostatics:** The Atmosphere, Variation of Atmospheric Properties, Contained Gas, Buoyancy and Static Lift, Other Factors Affecting Lift., Static Lift Prediction, Effect of ambient conditions on Static Lift, Climb, Descent and Pressure Height	**08Hrs**
Unit 3	**Aerodynamics:** Basic Assumptions, Drag, Dynamic Forces, Slender Body Theory, An EstimationMethod for Overall Aerodynamic Forces and Moments, Unsteady Aerodynamics, Aerodynamic Parameter Estimation	**08Hrs**
Unit 4	**Airship Technology:** Methodology for airship conceptual design, Aerodynamics & Stability analysis of Airships, Ground Handling and Mooring systems, Case Studies in Airship Operations, Design & Development of Remotely Controlled Airships	**06Hrs**
Unit 5	**Aerostat Technology:** Methodology for sizing of Aerostat sub-systems, Equilibrium and Stability analysis of aerostats, Design and Development of Tethered Aerostats, Numerical problems	**08Hrs**
Unit 6	**Current and Future Developments:** Challenges in design of LTA Systems, Hybrid LTA Systems, Stratospheric Airships, Airships/Aerostats for Planetary Exploration, Current Trends and	**06Hrs**

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	Recent Developments.	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Principles of Aerostatics - The Theory of Lighter-Than-Air Aircraft	Taylor, J. A.,	Createspace Independent Pub	-	2014
02	Airship Technology	Khoury, G., Ed.,	Cambridge Aerospace Series	2nd	2012

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Course Material for Design and Development of LTA systems	Pant, R. S.	"Curriculum Development Program, IIT Bombay"	-	2010
02	Fundamentals of Aircraft and Airship Design, Volume 2 – Airship Design and Case Studies	. Carichner, G. E., and Nicolai, L. M.	AIAA Education Series	-	2013

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEOE322 - Airline and Airport Management**
Prerequisite/s	1AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE322_1	**Understand** about the airline industry and its regulatory bodies(K^2)
1AEOE322_2	**Understand** the characteristics of Airline Industry and its characteristics(K^2)
1AEOE322_3	**Understand** the organizational structure of the airline industry(K^2)
1AEOE322_4	**Understand** the security, navigation and traffic control(K^2)
1AEOE322_5	**Understand** the importance of safety and security(K^2)

Course Contents:		
Unit 1	**Introduction:** Airline Industry – Scope – Types – Scheduled and Non-Scheduled Flights – Air Cargo Transport – Economic and Social impact – Regulatory Bodies – Key Performance indicators	**05Hrs**
Unit 2	**Characteristics of Airline Industry:** Airline Profitability – Main Industry - Characteristics of Passenger airlines – Service Industry – Characteristics	**08Hrs**
Unit 3	**Organizational Structure:** Airline Alliances – Development of commercial airlines – Deregulation – Impact of Deregulated Airline industry – Organizational Structure – Types of Airline Personnel – Flight crew and Cabin Crew – Training – Organizational Culture	**07 Hrs**
Unit 4	**Airports and its services:** Airports – Personnel – Processing Passengers and Freight – Airport Security – Air Navigation Services – Air Traffic Control – Airplanes – Manufacturers – Types of Aircraft	**08Hrs**
Unit 5	**Airline Marketing:** Marketing Environment, Customer Oriented Organization, Marketing Conceptual Framework, Marketing Mix, Stages in application of marketing principles to airline management	**08Hrs**
Unit 6	**Safety and security:** Air Safety and Security – Role of Regulatory Agencies – Airside Safety – Culture of Safety – Issues in Air safety – Accident and Incident Investigation – Future of Airline Industry Issues in Air safety – Accident and Incident Investigation – Future of Airline Industry	**06Hrs**

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Text Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Stephen Shaw " Airline Marketing and Management "	Ashgate	Wiley	6th	2003
02	Marketing management	PhlipKortler	Prentice Hall of India P (ltd)	Millenium edition	2001

Reference Books:					
Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Marketing Management	Boyd Walker	McGraw Hill	-	2002
02	Marketing Management and Information Technology	Keith Flether	Prentice Hall	-	1998

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Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEOE323 - Flight Scheduling and Operations**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE323_1	**Describe** the complexity of airline planning, operations and dispatch(K^2)
1AEOE323_2	**Calculate** the shortest path flow for minimum cost flow problem(K^3)
1AEOE323_3	**Understand** the maximum path flow for multi commodity flow problem(K^2)
1AEOE323_4	**Analyze** the Integer programming models- set covering/ partitioning problems, traveling salesman problem(K^4)
1AEOE323_5	**Differentiate and analyze** the problems in aircraft routing and management for maintenance of regular operations (K^3)
1AEOE323_6	**Analyze** the role of solution for constructing flight scheduling and operations(K^3)

Course Contents:		
Unit 1	**Network Flows and Integer Programming Models:** Complexity of airline planning, operations and dispatch- need for optimization- role of operations research and simulation. Networks- definitions, network flow models- shortest path problem, minimum cost flow problem, maximum flow problem, multi-commodity problem. Integer programming models- set covering/ partitioning problems, traveling salesman problem- mathematical formulation- decision variables, objective function, constraints, and methods of solution, Solution by simulation.	**05Hrs**
Unit 2	**Aircraft Routing and Management of Irregular Operations:** Goal of aircraft routing- maintenance requirements, other constraints. Routing cycles, route generators. Mathematical models of routing- decision variables, objective functions, alternatives, constraints- flight coverage and aircraft available. Example problems and solutions. The problem statement, the time band approximation model-formulation of the problem-the scenarios- solution.	**08Hrs**
Unit 3	**Flight Scheduling:** Significance of flight scheduling. The route system of the airlines- point-to-point flights, hub and spoke flights. Schedule construction-operational feasibility, economic viability. Route development and flight scheduling process- load factor and frequency- case study.	**07 Hrs**
Unit 4	**Fleet Assignment:** Purpose of fleet assignment. Fleet types, fleet diversity, and fleet availability- performance measures, Formulation of the fleet assignment problem-	**08Hrs**

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	decision variables, objective function, constraints, and solution. Scenario analysis, fleet assignment models.	
Unit 5	**Crew and Manpower Scheduling:** Crew scheduling process-significance. Development of crew pairing- pairing generators- mathematical formulation of crew pairing problem- methods of solution. Crew rostering- rostering practices. The crew rostering problem-formulation, solutions. Man power scheduling- modeling, formulation of the problem, solutions.	**08Hrs**
Unit 6	**Gate Assignment and Aircraft Boarding Strategy:** Gate assignment-significance- the problem-levels of handling-passenger flow, distance matrix- mathematical formulation, solution. Common strategies for aircraft boarding process, mathematical model, interferences, model description, aisle interferences.	**06Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Airline Operations and Scheduling	Bazargan M	Ash gate Publishing Ltd	2nd	2010

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	The Global Airline Industry	Belobaba P, Odoni, A., Barnhart, C.	Wiley	-	2009
02	Airline Operations and Delay Management	Wu, Cheng-Lung	Ashgate Publishing Ltd	-	2010

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Annasaheb Dange College of Engineering and Technology, Ashta
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Department of Aeronautical Engineering

Course Details:

Class	T. Y B.Tech, Sem.-VI (Aeronautical)
Course Code and Course Title	**1AEHS353 Constitution of India**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	02/00
Credits	2
Evaluation Scheme: ISE/ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEHS353_1	**Understand** the basic features and modalities about Indian constitution.(K^2)
1AEHS353_2	**Understand** the functioning of Indian parliamentary system at the center and state level.(K^2)
1AEHS353_3	**Understand** the different aspects of Indian Legal System and its related bodies.(K^2)
1AEHS353_4	**Apply** different laws and regulations related to engineering practices.(K^3)
1AEHS353_5	**Differentiate** the role of Engineers in different organizations and governance.(K^4)

Course Contents:		
Unit 1	**Introduction to Indian Constitution:** The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.	**04 Hrs**
Unit 2	**Union Executive and State Executive:** Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.	**04 Hrs**
Unit 3	**Introduction to the Legal System in India:** Sources of Law and the Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law, Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court). Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this	**04 Hrs**

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	will instead be referred to arbitration. Contract law, Tort, Law at workplace.	
Unit 4	**Intellectual Property Laws and Regulation to Information:** Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright and its Ownership, Infringement of Copyright, Civil Remedies for Infringement, Regulation to Information Introduction, Right to Information Act, 2005, Information Technology Act, 2000, Electronic Governance, Secure Electronic Records and Digital Signatures, Digital Signature Certificates, Cyber Regulations Appellate Tribunal, Offences, Limitations of the Information Technology Act..	**06 Hrs**
Unit 5	**Business Organizations & Laws:** Sole Traders, Partnerships: Companies: The Company's Act: Introduction, Formation of a Company, Memorandum of Association, Articles of Association, Prospectus, Shares, Directors, General Meetings and Proceedings, Auditor, Winding up.	**06 Hrs**
Unit 6	**E-Governance and Role of Engineers:** E-Governance, Meaning and Concept, Role of Engineers in E-Governance, Need for reformed engineering serving at the Union and State level, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.	**04 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Introduction to the Indian Constitution	Brij Kishore Sharma	PHI Learning Pvt. Ltd.	8	2017
02	Introduction to the Constitution of India	Durga Das Basu	Prentice –Hall	-	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Our Constitution: An Introduction to India's Constitution and constitutional Law	Subhash C. Kashyap	NBT	-	2018
02	Law relating to Intellectual Property Rights	Dr.M.K Bhandari	Central Law Publications, Allahabad	5	2017
03	Handbook on e-Governance Project Lifecycle	Department of Electronics & Information Technology, Government of India	National Institute for Smart Government	-	2012

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Annasaheb Dange College of Engineering and Technology, Ashta
(An Autonomous Institute)

Department of Aeronautical Engineering

Course Details:

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPR355, Mini project**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial/Practical	00/00/04
Credits	2
Evaluation Scheme: ISE/ESE	25/25

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPR355_1	**Understand** existing literatures, analyze and identify the research gaps and formulate project objective(s).**(K^4)**
1AEPR355_2	**Evaluate** existing methodologies and adopt a suitable research methodology. **(K^5)**
1AEPR355_3	**Develop** the required technical expertise and infrastructure to perform the project. **(K^6)**

Instructions:

- Students in group of 3 to 5 should conduct literature survey/visit industry/analyze current trends and identify the problem for Project and finalize in consultation with Guide.
- Students should use multiple literatures and understand the problem.
- Students should attempt solution to the problem by experimental/simulation methods. The solution to be validated with proper justification and report to be compiled in standard format.
- Project work shall be based on any of the following:
  1. Design / Fabrication of product / testing setup of an experimentation unit / apparatus / small equipment, in a group with engineering analysis / performance analysis / modeling
  2. Experimental verification of principles used in Aeronautical Engineering Applications.
  3. Projects having valid database, data flow, algorithm, and output reports, preferably based on software's.

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Course Details

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPC358, Vibration and Structural Dynamics Laboratory**
Prerequisite/s	1AEES110 – Engineering Mechanics 1AEES203 - Mechanics of Material
Teaching Scheme: Lecture/Tutorial/practical	00/00/02
Credits	01
Evaluation Scheme: ISE/ESE	**25/25**

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC358_1	**Illustrate** and carry out measurement of various vibration parameters **(K^3)**
1AEPC358_2	**Determine** the behavior of system under different vibratory conditions **(K^3)**
1AEPC358_3	**Analyze** the vibration phenomena as a mathematical model & evaluate its response **(K^3)**
1AEPC358_4	**Carry out** the Performance study of the vibration of plate and beam **(K^3)**
1AEPC358_5	**Effectively** record the results and analyze them to provide a conclusion **(S^3)**
1AEPC358_6	**Follow** the professional practices like mainlining a laboratory journal and completion of work on time **(A^3)**

List of Experiments

Exp. No.	Titleof Experiment
1	Experiment on equivalent spring mass system.
2	Experiment on study of forced vibration characteristics.
3	Determination of logarithmic decrement for single DOF damped system.
4	Experiment on torsional vibration of two rotors without damping.
5	Measurement of vibration parameters using vibration measuring instrument.
6	Introduction to FFT analyzer to determine the vibration parameters.
7	Case study on Vibration analysis of cantilever beam.
8	Case study on effect of soft material at the support on the vibrations of plate.
9	Experiment on free vibration of a coupled pendulum and double pendulum
10	Use of different types of exciters for vibration analysis
11	Exercise on numerical calculation of natural frequencies by Holzer method.
12	Exercise on numerical calculation of natural frequencies by Rayleigh's Method

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Mechanical Vibrations	Singiresu.S.Rao	Pearson Education LPE	5th	2004
2	Vibration Problems in Engineering	Timoshenko S	Wiley and Sons, New York	2nd	1993

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3	Dynamics of Structures	R.W. Clough and Penzien	McGraw Hill	2nd	1993

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Introduction to the study of Aircraft Vibration and Flutter	Scanlan R.H. and Rosenbaum R	John Wiley and Sons. New York	2nd	1982
2	Mechanical Vibrations	Tse. F.S., Morse, I.F., Hinkle, R.T	Prentice Hall, New York	2nd	1984
3	An Introduction to the Theory of Aero elasticity	Fung Y.C	John Wiley and Sons, New York	3rd	1995

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Course Details

Class	T. Y. B. Tech, Sem.-VI
Course Code and Course Title	**1AEPC359-Computational Fluid Dynamics Laboratory**
Prerequisite/s	1AEPC308-Computational Fluid Dynamics
Teaching Scheme: Lecture/Tutorial/practical	00/00/02
Credits	01
Evaluation Scheme: ISE/ESE	**25/25**

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC359_1	**Carry Out** the analysis of complex engineering problems related to Aerodynamics to provide solutions **(K^4)**
1AEPC359_2	**Use** the Modern Software Tool for solving & simulation the simple fluid flow cases **(S^2)**
1AEPC359_3	**Effectively** record the analysis reports of the Analysis Report carried out using the software tool and present them orally **(S^3)**
1AEPC359_4	**Recognize** the need for life-long learning of the modern tools & techniques used for providing solutions to the complex engineering problems **(A^3)**
1AEPC359_5	**Follow** professional and ethical principles during laboratory work **(A^3)**

List of Experiments

Exp. No.	Title of Experiment
1	Introduction to CFD / Need for Programming and Getting to the GUI of ANSYS Fluent
2	Simulation of Laminar Flow through a pipe
3	Simulation of Turbulent Flow through pipe
4	Simulation of Flow over Airfoil
5	Simulation of 3D flow over wing
6	Simulation of steady flow past a stationary and rotating cylinder
7	Simulation of Unsteady flow past a stationary cylinder
8	Simulation of supersonic Flow over a wedge
9	Simulation of compressible flow through nozzle
10	Solve 1-Dimensional Advection (Wave) equation using Explicit Finite difference method
11	Solve 1-Dimensional unsteady heat diffusion equation using Explicit Finite difference method
12	Solve 1-Dimensional unsteady heat diffusion equation using Implicit method

Text Books:

Sr.	Title	Author	Publisher	Editio	Year of

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No				n	Edition
1	ANSYS FLUENT User Manual	ANSYS	ANSYS	-	2019
2	MATLAB Help manual	MATLAB	MATLAB	-	-

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	"Numerical Computation of Internal and	Charles Hirsch	"John Wiley and Sons, New York"	-	-
2	External Flows"	"Klaus A Hoffmann and Steve T, Chiang"	"Engineering Education System"	"Volume I and II"	-
3	"Computational Fluid Dynamics for	John F, Wendt	Springer – Verlag	-	1992

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Course Details:

Class	T.Y. B.Tech Sem-VI
Course Code and Course Title	1AEPR354, Internship
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial /Practical	--
Credits	02
Evaluation Scheme: ISE / ESE	25/00

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPR354_1	**Evaluate** Techniques observed during internship (K^5)
1AEPR354_2	**Comply** with advanced tools & techniques used in industries (A^2)
1AEPR354_3	**Prepare** a precise project report on internship (S^2)
1AEPR354_4	**Communicate effectively** at work and Exhibit Technical Curiosity in the industry (S^2)
1AEPR354_5	**Express** awareness of the concepts and their applications with satisfactory demonstration as a response. (A^3)

- The student has to undergo industrial internship of minimum two weeks in winter vacation, after T.Y. B.Tech Sem-V, in an aeronautical/aerospace industry.
- Each student has to prepare a report on industrial training of about 25 pages of "A4" size sheets in single bound copy. An assessment of his training will be done based on the quality of the work & preparation and understanding of the candidate. Format for the report.
  - Cover page with Name, URN, Course Name: Internship, Course Code: 1AEPR354.
  - Training certificate signed by industry authority.
  - Industry profile (Organization structure, Layout, functioning etc.)
  - Notes, assignments, etc. from Internship.
  - Training outcomes.

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Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

Department of Aeronautical Engineering

Teaching and Evaluation Scheme

B. Tech: Semester VII (Aeronautical Engineering)

Course code	Course	Teaching Scheme				Evaluation Scheme					
						Scheme	Theory (Marks)			Practical (Marks)	
		L	T	P	Credits		Max	Min. for Passing		Max	Min. for Passing
1AEPC401	Finite Element Methods	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPC402	Introduction to Control Systems	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPE403 - 408	Professional Elective - 3	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEPE409 - 414	Professional Elective - 4	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30				
						ISE 2	10				
						ESE	50	20		-	-
1AEOE421 - 424	Open Elective - 3	3	-	-	3	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEHS407	Project and Finance Management	2	-	-	2	ISE 1	10	-	40	-	-
						MSE	30			-	-
						ISE 2	10			-	-
						ESE	50	20		-	-
1AEPR451	Project Phase 1	-	-	8	4	ISE	-	-	-	75	30
1AEPC454	Finite Element Methods Laboratory	-	-	2	1	ISE	-	-	-	25	10
						ESE	-	-	POE	25	10
Total		**17**	**0**	**10**	**22**		600			125	
Total Contact Hours/Week= 27hrs											

*Course Code	Professional Elective-III
1AEPE403	Turbulence Modeling
1AEPE404	Avionics and Aircraft Systems
1AEPE405	Theory of Elasticity
1AEPE406	Aircraft Rules and Regulations - DGCA (CAR)
1AEPE407	Design of Unmanned Aerial Systems
1AEPE408	Quality Engineering and Management

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*Course Code	Professional Elective-IV
1AEPE409	Automobile and Industrial Aerodynamics
1AEPE410	Numerical Heat Transfer and Fluid Flow
1AEPE411	Experimental Stress Analysis
1AEPE412	Airframe Maintenance and Repair
1AEPE413	Aircraft Engine Design
1AEPE414	Product Life Cycle Management

Open Elective –III

Courses Code	Course Name	Department
1AEOE421	Air Traffic Control and Airport Design	Aeronautical Engineering
1AEOE422	Aircraft General Engineering Maintenance	
1AEOE423	Design of Fixed wing unmanned aerial vehicles	
1AUOE401	Vehicle maintenance and safety	Automobile Engineering
1AUOE402	Vehicle Aerodynamics	
1CVOE401	Structural Auditing	Civil Engineering
1CVOE402	Disaster Management	
1CSOE401	Introduction to image processing and computer vision	Computer Science and Engineering
1CSOE402	Introduction to machine learning	
1EEOE401	Electric Vehicles	Electrical Engineering
1EEOE402	Wind and Solar Energy Systems	
0FTOE411	Process Optimization	Food Technology
0FTOE412	Cold Storage and Supply Chain Management	
1MEOE401	Total Quality Management	Mechanical Engineering
1MEOE402	Reliability engineering	
1MEOE403	Renewable Energy Engineering	

Course Category	HS	BS	ES	PC	PE	OE	PR
Credits	02	-	-	04	06	03	04
Cumulative Sum	08	20	43	56	13	09	08

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Annasaheb Dange College of Engineering and Technology, Ashta

(An Autonomous Institute)

Department of Aeronautical Engineering

Teaching and Evaluation Scheme
B. Tech: Semester VIII (Aeronautical Engineering)

Course code	Course	Teaching Scheme				Evaluation Scheme				
						Scheme	Theory (Marks)		Practical (Marks)	
		L	T	P	Credits		Max	Min. for Passing	Max	Min. for Passing
1AEHS408	Entrepreneurship Essentials	2	-	-	2	ISE 1	10	-	-	-
						MSE	30		-	-
						ISE 2	10		-	-
						ESE	50	20	-	-
1AEPE415 - 420	Professional Elective - 5	3	-	-	3	ISE 1	10	-	-	-
						MSE	30			
						ISE 2	10			
						ESE	50	20	-	-
1AEPR453	Project Phase 2/Internship	-	-	12	6	ISE	-	-	100	40
						ESE	-	-	50	20
Total		**5**	**0**	**12**	**11**		200		150	
Total Contact Hours/Week= 17hrs										

*Course Code	Professional Elective-V
1AEPE415	Nanomaterials and Nanotechnology
1AEPE416	Non - Destructive Testing
1AEPE418	Airframe Maintenance and Repair
1AEPE420	Cryogenics

Course Category	HS	BS	ES	PC	PE	OE	PR
Credits	02	-	-	-	03	-	06
Cumulative Sum	10	20	43	56	16	09	14

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Aero -ST- 03/03

Course Details:

Class	B. Tech, Sem.-VII
Course Code and Course Title	**1AEPC401 - Finite Element Methods**
Prerequisite/s	1AEES203-Mechanics of Materials
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC401_1	**Describe** the concept of FEM, types of FEM analyses and its applications.
1AEPC401_2	**Choose** the appropriate meshing parameters and **perform** the meshing for a FEM analysis of a problem.
1AEPC401_3	**Apply** appropriate constraints and boundary conditions for a FEM analysis of a problem.
1AEPC401_4	**Solve** the linear and non-linear Static finite element Analysis problems using appropriate solution technique.
1AEPC401_5	**Determine** convergence of solutions obtained from FEA solutions and **interpret** the results.

Course Contents:		
Unit 1	**Introduction to Finite Element Analysis:** Methods Solve any Engineering Problem – Analytical, Numerical and Experimental; Past, Present and Future of FEA; Practical Applications of FEA, Steps of FEM analysis, Types of Analyses: Introduction, Linear Static Analysis, Non-Linear Analysis, Dynamic Analysis, Linear Buckling Analysis, Thermal Analysis, Fatigue analysis, Optimization, Computational Fluid Dynamics, Crash Analysis, Noise Vibration and Harshness, NVH.	**06Hrs**
Unit 2	**Introduction to Meshing:** need of Meshing, Types of Elements, How to Decide Element Type, Meshing Techniques, Meshing in Critical Areas. **1-D Meshing:** Stiffness Matrix Derivation, Stiffness Matix- Assembly of Two Rod Elements, Beam Element, Special Features of Beam Elements **2-D Meshing:** When to Use 2D Elements, Family of 2-d Elements, Thin Shell Elements, Effect of Mesh Density in the Critical Region, Effect of Biasing in the Critical Region, Symmetric Boundary Conditions, Different Element Type Options for Shell Meshing, Geometry Associative Mesh, Quality Checks, Other Checks for Meshing **3-D Meshing:** When to Use 3D Elements, DOFs for Solid Elements, Tetra Meshing Techniques, Quality Checks for Tetra Meshing, Other Checks for Tetra Meshing, Brick Meshing, Brick Mesh Quality Checks, Other Checks for Brick Meshing	**10Hrs**
Unit 3	**Material Properties and Boundary Conditions:**Material properties E, G &ν, Material Classification, Material Properties, Boundary Conditions, Applications of Constraints, Symmetry	**05 Hrs**

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Unit 4	**Linear Static Analysis:** Definition, While Starting any Finite Element Analysis Project,Checking Mesh Model, Design Modifications Based on Linear Static Analysis: A Case Study,Linear Static Solvers, Solution Restart Method, h-element vs. p-element, Sub-modeling, Linear Buckling Analysis	**07Hrs**
Unit 5	**Non-Linear Analysis:** Introduction, Comparison of Linear and Nonlinear FEA, Types of Non-linearity, Stress- Strain Measures for Nonlinear Analysis, Solution Techniques for Nonlinear Analysis, Issues Related to the Convergence of Newton Raphson Method, Essential Steps to Start with Nonlinear FEA, A General Procedure for Nonlinear Static Analysis Project.	**08Hrs**
Unit 6	**Post Processing Techniques:** How to Validate &Check Accuracy of the Result, How to View Results, Average and Unaverage Stresses, Special tricks for Post Processing, Interpretation of Results and Design Modifications, CAE Reports.	**06Hrs**

Text-Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Practical Finite Element Analysis	Nitin S Gokhale Sanjay S Deshpande Sanjeev V Bedekar Ananad N Thite	Finite to Infinite	First	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	An Introduction to Finite Element Method	Reddy J.N	Tata McGraw-Hill	2nd Edition	2000
02	Introduction to Finite Elements in Engineering	Tirupathi.R. Chandrapatha and Ashok D. Belegundu	Prentice Hall of India	4th Edition	2012
03	Text Book of Finite Element Analysis	P. Seshu	Prentice Hall of India Private Limited	2nd Edition	2003

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Course Details:

Class	B. Tech, Sem.-VII
Course Code and Course Title	**1AEPC402 - Introduction to Control systems**
Prerequisite/s	1AEBS201 - Applied Mathematics – III 1AEPC302 – Flight Dynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC402 _1	**Summarize** the fundamentals of (feedback) control systems and the associated terms
1AEPC402 _2	**Develop** Mathematical Models for a given dynamic systems in forms suitable for use in the analysis and design of control systems
1AEPC402 _3	**Compare** the time and frequency-domain responses of first and second-order system subjected to standard inputs
1AEPC402 _4	**Assess**the stability of the system using root locusor Routh's table
1AEPC402 _5	**Analyze** the time invariant systems using state space model and comment on controllability and observability of the system

Course Contents:		
Unit 1	**Unit 1: Introduction to Control Systems & Basic Concepts** **Introduction** – Introduction to Control systems, Examples of control systems, closed loop control system and open loop control system. Different examples of control systems –classification of control systems, feed –back characteristics, Effects of feedback. **Basic Concepts** - Review of complex variables and complex functions, Laplace Transformation Theorems, Inverse Laplace Transformations, Partial fractions, Solving Linear, Time-Invariant, Differential Equations	**07 Hrs**
Unit 2	**Unit 2: Mathematical Modeling of Dynamic Systems** Introduction - Mathematical models- transfer function, Transfer Function Representation - Block diagram representation of systems such as Mechanical systems, Electromagnetics and concept of Linearization. Reduction of block diagram. State space representation and conversion from state space to transfer function	**07 Hrs**
Unit 3	**Time Response Analysis** Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants – Effects of proportional derivative, proportional integral systems	**08 Hrs**
Unit 4	**Stability Analysis** The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.The root locus	**07 Hrs**

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	concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.	
Unit 5	**Frequency Response Analysis** Introduction, Frequency domain specifications-Bode diagrams, Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin stability Analysis from Bode .polar plots-Nyquist plots-stability analysis compensation technique –lag, lead and lead-lag controllers design in frequency domain, PID controllers. .	**08 Hrs**
Unit 6	**State space analysis of continuous system** Concept of state, state variables and state model, derivation of state models from block diagrams, diazotization-solving the time invariant state equation – state transition matrix and its properties –concept of controllability and observability.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Modern Control Engineering	K. Ogata	Prentice hall	4th	2001
02	Control system Engineering	Norman S Nise	Wiley	7th	2015

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Automatic Control Systems,	B.C. Kuo	Prentice hall	2nd	1992
02	Control Systems	Nagoorkani	RBA Publisher	4th	2012
03	Modern control Design with MATLAB and SIMULINK	Ashish Tewari	John Wiley & Sons Ltd	-	2002

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEHS407 - Project and Finance Management**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
IAEHS407_1	**Describe** the role of economics involved in the decision making process.
IAEHS407_2	**Calculate** the rate of return, depreciation charges and taxes.
IAEHS407_3	**Apply** different cost entities in estimation, and explain the importance of finance functions.
IAEHS407_4	**Apply** globally accepted project management techniques for successful implementation of projects
IAEHS407_5	**Apply** appropriate communication techniques for successful project management.

Course Contents:		
Unit 1	**Managerial Economics** The Economic way of thinking-Demand Analysis I-Demand Analysis II & Estimation-Production & Costs I-Production & Costs: II-Profit-Maximization & Competitive Markets- Price-Searchers, Cartels, Oligopoly-Advanced Pricing and Auctions-Game Theory and Asymmetric Information Types of Business Organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management.	**07 Hrs**
Unit 2	**Indian Economy and Policy** Introduction to the course-Colonialism and development of the Indian economy - De-industrialization of Indian economy-Business enterprises-Growth and economic reforms-Poverty and Inequality-Macroeconomic overview and Fiscal and Monetary Policy-Financial sector performance and impending reforms-Economic reforms towards more liberalization-Agriculture, industry and services-Government reforms and the emerging energy-economy-environment regulatory framework.	**06 Hrs**
Unit 3	**Financial Reporting, Statement and Analysis** Accounting principles, concepts and conventions, Accounting process, Preparation of Financial statement, Financial Reporting, Reporting practices, Analysis of financial statements with managerial perspective. Understanding and analyzing published financial statements of a company.	**08 Hrs**
Unit 4	**Project Management: Scope, Schedule and Cost Management** Project Lifecycle understanding-Project definition. WBS (Work Breakdown	**07 Hrs**

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	Structure), Planning Scope-Planning Schedule-CPM and PERT, Schedule Compressions-Cost estimation & Quality definition-Planning Resources & Risks-Stakeholder identification, analysis and communication planning-Understanding different fundamental contract types and some of the variants-Earned value management-Behavioural aspects in project management and project closure	
Unit 5	**Project Management: Quality and Risk Management** Quality definition-Planning Resources & Risks-Stakeholder identification, analysis and communication planning-Understanding different fundamental contract types and some of the variants-Earned value management-Behavioural aspects in project management and project closure	**08 Hrs**
Unit 6	**Project Management: Business Communication** Introduction & Communication Basics; Just-A-Minute Presentation Workshop-Jam, Feedback and overcoming Glossophobia - Presentation–1 (Planning & Preparing) - Presentation–2 (Visual Aids) Presentation–3 (Delivery)-Graded Team Presentations-Group 1-Graded Team Presentations-Group 2-Reading, listening & Questioning-Writing Business Communication basics-Writing Reports, Proposals, Emails, Summaries-Graded Individual Presentations- Group 1-Graded Individual Presentations- Group 2-Presentation feedback, Bios and Resumes.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Economics	Samuelson. Paul A and Nordhaus W.D.	McGraw Hill	20th	2019
02	A Guide to the Project Management Body of Knowledge (PMBOK)	Project Management Institute	Project Management Institute	7th	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Fundamentals of Financial Management	Prasanna Chandra	Tata McGraw Hill Publishing Ltd.	4th	2005

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Course Details

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPC454 - Finite Element Methods Laboratory**
Prerequisite/s	1AEES203-Mechanics of Materials
Teaching Scheme: Lecture/Practical	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPC454_1	**Develop** the finite element model for the engineering problem.
1AEPC454_2	**Perform** meshing of model using appropriate meshing technique.
1AEPC454_3	**Apply** appropriate material properties, boundary conditions, loads and constraints to the finite element model.
1AEPC454_4	**Use** the computational tool to perform the finite element analysis.
1AEPC454_5	**Check** and **interpret** the results obtained in FEA and prepare the report.

List of Experiments

Exp. No.	Title of Experiment
1	Experiment on Analysis of 1-D bar element with axial loading
2	Experiment on Analysis of Two-Dimensional Truss.
3	Experiment on Analysis of Space Frame Example
4	Experiment on Analysis of tensile-Loaded Thin Plate with a Central Hole.
5	Experiment on Analysis of Plane Stress Bracket
6	Non-Linear Analysis of a Cantilever Beam
7	Non-Linear Analysis of a buckling of column
8	Experiment on adding non-linear material properties
9	Experiment on Modal Analysis of a Cantilever Beam
10	Experiment on analysis of pure conduction (thermal)
11	Experiment on analysis of Thermal - Mixed Boundary Example
12	Experiment on the post-processing techniques.

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Course Details:

Class	B. Tech. Sem.-VII
Course Code and Course Title	**1AEPE403 - Turbulence Modeling**
Prerequisite/s	1AEES202 - Fluid Mechanics 1AEPC306 - Computational Fluid Dynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE403_1	**Understand** the basics of turbulence and its nature.
1AEPE403_2	**Discuss** different hypothesis of turbulence modeling
1AEPE403_3	**Identify** the scales of turbulence in a given flow.
1AEPE403_4	**Apply** the appropriate turbulence model in different flow problems.
1AEPE403_5	**Model** the near-wall flows.

Course Contents:		
Unit 1	**Introduction** Nature of turbulent flows, irregularity, diffusivity, three dimensional motions, dissipation, wide spectrum, origin of turbulence, eddy motions and length scales.	**06 Hrs**
Unit 2	**Statistical Description of Turbulence** Random nature of turbulence, distribution function, probability density, moments, correlations, Taylor's hypothesis, integral micro scales, homogeneous and isotropic turbulence, Kolmogorov hypothesis, scales of turbulence, energy cascade, turbulence spectra.	**07 Hrs**
Unit 3	**Turbulent Transport of Moment and Heat** Reynolds decomposition, turbulent stresses, vortex stretching, Reynolds-averaged Navier-Stokes (RANS) equations, mixing-length model, Reynolds' analogy, dynamics of turbulence.	**07 Hrs**
Unit 4	**Free Shear Flows** Mixing Layer, Turbulent Wakes and Jets, Grid Turbulence.	**06 Hrs**
Unit 5	**Wall-Bounded Turbulent Flows** Channel and pipe flows, Reynolds stresses, turbulent boundary layer equations, logarithmic-law of walls, turbulent structures.	**08 Hrs**
Unit 6	**Turbulence Modeling** Introduction, eddy-viscosity hypothesis, algebraic models, k-ε and k-ω model, Reynolds-stress model, near-wall treatment, Introduction to LES and DNS.	**08 Hrs**

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Turbulence Modelling for CFD	David C. Wilcox	DCW Industries, Inc.	3rd	2006
02	Turbulent Flows	Stephen B. Pope	Cambridge University Press	1st	2000
03	A First Course in Turbulence	H. Tennekes and J. L. Lumley	MIT Press	1st	1972

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Viscous Fluid Flow	Frank M. White	McGraw Hill	3rd	2006

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Course Details:

Class	B. Tech., Sem - VII
Course Code and Course Title	**1AEPE404 – Avionics and Aircraft Systems**
Prerequisite/s	1AEPC205 – Introduction to Aerospace Engineering.
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE404_1	**Illustrate** cockpit and display technologies of civil and fighter airplanes
1AEPE404_2	**Interpret** the concept of Flight Control Systems from an earlier era to advanced Technologies.
1AEPE404_3	**Discriminate** the technologies of communication and navigation systems with different failure conditions and operational difficulties.
1AEPE404_4	**Summarize** the operation of integrated civil aircraft fuel systems and in-flight refueling and also troubleshoot the snags using the components of a fuel and Engine control system.
1AEPE404_5	**Appraise** the advancements in the auxiliary systems and their benefits through emergency flying conditions
1AEPE404_6	**Plan** the process chart for installation, inspection & troubleshooting procedures of avionics & electrical components.

Course Contents:		
Unit 1	**Introduction to Avionics and Instrumentation:** Need for avionics in civil and military aircraft and space systems, integrated avionics and weapon systems, typical avionics subsystems, Introduction to digital computer and memories. Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 429 – ARINC – 629, Control and display technologies: CRT, LED, LCD, EL and plasma panel, Touch flight display – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.	**06 Hrs**
Unit 2	**Flight Control Systems:** Principles of flight control, Flight control surfaces, Control surface actuation, Flight control linkage systems, Trim and feel. Power control, Mechanical, Direct drive, Electromechanical, Electro-hydrostatic actuation, Autopilot system, Fly by wire system, fly by optics system, Autonomous taxi, Neural sensing.	**07 Hrs**

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Unit 3	**Introduction to Communication and Navigation systems:** VHF, HF communication, Satcom, ACARS. SelCal, ELT, Radio navigation – Radio Altimeter, ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS, TCAS, – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS, Turning airplanes into communication satellites.	**07 Hrs**
Unit 4	**Fuel System & Engine Control Systems:** Characteristics of aircraft fuel systems, Airframe Fuel system components - Fuel transfer pumps, Fuel booster pumps, Fuel transfer valves, Nonreturn valves. Fuel quantity measurement systems, Level sensors, Fuel gauging probes. Fuel system operation, Fuel pressurization, Engine feed, Fuel transfer, Use of fuel as a heat sink, External fuel tanks, Fuel jettison, The engine control System- Fuel flow control, Airflow control, Control system parameters, Example systems, Design criteria, Engine starting, Fuel control, Ignition Control, Engine rotation, Throttle levers, Engine indications, DECU.	**09 Hrs**
Unit 5	**Auxiliary systems**: Electrical systems -AC and DC Power, DC System, Airline Electrical System, Switches, Lighted Pushbutton, Circuit Breakers/Fuses, Lubrication system- Its components and operation, Anti Icing & Deicing systems, Fire warning and alarm systems.	**07 Hrs**
Unit 6	**Installation, Test & Troubleshooting of Avionics systems:** Planning the Installation, Mounting Avionics, Connectors, wiring of the airplane, panel labels & Abbreviations, Test and troubleshooting of ADF, Autopilot, COM Receivers, DME, ELT, Transponder, Wiring, and connectors.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration	Moir, I. and Sea bridge, A	AIAA (American Institute of Aeronautics and Astronautics)	3rd	2001
02	Avionics Training Systems, Installation, and Troubleshooting.	Len Buckwalter	Avionics Communications Inc	2nd	2005
03	Airframe & Powerplant Handbook	FAA	FAA	-	2008

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Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Advanced Avionics Handbook	FAA	U.S. Department of Transportation	-	2009

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Course Details:

Class	B. Tech., Sem. -VII
Course Code and Course Title	**1AEPE405 - Theory of elasticity**
Prerequisite/s	1AEES203-Mechanics of Materials 1AEPC301-Aircraft Structures
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE405_1	**Use** mathematical knowledge to solve problem related to structural elasticity.
1AEPE405_2	**Identify** stress-strain relation in 3D, principal stress and principal strain.
1AEPE405_3	**Analyze** a structure using Elasticity concepts.
1AEPE405_4	**Use** analytical techniques to predict deformation, internal force and failure of simple solids and structural components.
1AEPE405_5	**Solve** aerospace-relevant problems in plane strain and plane stress in Cartesian and polar coordinates.
1AEPE405_6	**Apply** energy methods to solve elasticity problems.

Course Contents:		
Unit 1	**Basic Equations of Elasticity** Definition of Stress and Strain: Stress - Strain relationships - Equations of Equilibrium, Compatibility equations, Boundary Conditions, Saint Venant's principle - Principal Stresses, Stress Ellipsoid - Stress invariants	**07Hrs**
Unit 2	**Plane Stress and Plane Strain Problems** Airy's stress function, Bi-harmonic equations, Polynomial solutions, Simple two dimensional problems in Cartesian coordinates like bending of cantilever and simply supported beams.	**07 Hrs**
Unit 3	**Polar Coordinates** Equations of equilibrium, Strain - displacement relations, Stress – strain relations, Airy's stress function, Axi – symmetric problems, Introduction to Dunder's table, Curved beam analysis, Lame's, Kirsch, Michell's and Boussinesque problems – Rotating discs.	**07 Hrs**
Unit 4	**Torsion** Navier's theory, St. Venant's theory, Prandtl's theory on torsion, semi-inverse method and applications to shafts of circular, elliptical, equilateral triangular and rectangular sections. Membrane Analogy.	**07 Hrs**
Unit 5	**Introduction to Theory of Plates and Shells** Classical plate theory – Assumptions – Governing equations – Boundary conditions – Navier's method of solution for simply supported rectangular plates – Levy's method of solution for rectangular plates under different boundary conditions.	**07 Hrs**
Unit 6	**Energy Methods**	**07 Hrs**

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	Work Done in Deformation, Reciprocity Theorem, Castigliano's Theorem, Unit or Dummy Load Method, Crotti-Engesser Theorem, Statically Indeterminate Systems, Principle of Virtual Work, Principle of Minimum Potential Energy, Application of Trigonometric Series, Rayleigh-Ritz Method.	

Text-Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Theory of elasticity	Dr. Sadhu Singh	Khanna Publisher	4th Edition	2015
02	Advanced Strength and Applied Elasticity	Ansel C Ugural and Saul K Fenster	Prentice Hall, New Jersey, 2003.	4th Edition	2003
03	Theory of Isotropic/Orthotropic Elasticity	Bhaskar, K., and Varadan, T. K.	CRC Press USA,	1st Edition	2009.
04	Theory of Elasticity	Timoshenko, S., and Goodier T.N.	McGraw – Hill Ltd., Tokyo,.	3rd Edition	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Elasticity	Barber, J. R	Kluwer Academic Publishers	1st Edition	2004
02	Mathematical Theory of Elasticity"	Sokolnikoff, I. S.	McGraw – Hill, New York	1st Edition	1978.

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Course Details:

Class	B. Tech. Sem.-VII
Course Code and Course Title	**1AEPE406 - Aircraft Rules and Regulations - DGCA (CAR)**
Prerequisite/s	-
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE406_1	**Explain** various Airworthiness requirements for Civil aviation.
1AEPE406_2	**Identify** various series of CAR.
1AEPE406_3	**Identify** various aircraft maintenance programmes under CAR.
1AEPE406_4	**Identify** various processes of registration of aircraft.
1AEPE406_5	**Identify** the various documents to be carried on an Indian registered aircraft.

Course Contents:		
Unit 1	**C.A.R. SERIES 'A'** C.A.R. SERIES 'A' – PROCEDURE FOR CIVIL AIRWORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS vis-a-vis AIRWORTHINESS DIRECTORATE Responsibilities of operators / owners- Procedure of CAR issue, amendments etc., Objectives and targets of airworthiness directorate; airworthiness regulations and safety oversight of engineering activities of operators.	**06 Hrs**
Unit 2	**C.A.R. SERIES 'B'** ISSUE APPROVAL OF COCKPIT CHECKLIST, MEL, CDL Deficiency list (MEL & CDL); preparation and use of cockpit checklist and emergency list.	**06 Hrs**
Unit 3	**C.A.R. SERIES 'C'** C.A.R. SERIES 'C' – DEFECT RECORDING, MONITORING, INVESTIGATION AND REPORTING Defect recording, reporting, investigation, rectification and analysis; flight report; reporting and rectification of defects observed on aircraft; analytical study of in-flight readings & recordings; maintenance control by reliability method.	**06 Hrs**
Unit 4	**C.A.R. SERIES 'D' – AIRCRAFT MAINTENANCE PROGRAMMES** Reliability programmes (Engines); Aircraft maintenance programme & their approval; on-condition maintenance of reciprocating engines; TBO – Revision programme; maintenance of fuel and oil uplift and consumption records – Light aircraft engines; fixing routine maintenance periods and component TBOs – Initial & revisions.	**08 Hrs**

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Unit 5	**C.A.R. SERIES 'F'** C.A.R. SERIES 'F' – AIRWORTHINESS AND CONTINUED AIRWORTHINESS Procedure relating to registration of aircraft; Procedure for issue / revalidation of Type Certificate of aircraft and its engines / propeller; Issue / revalidation of Certificate of Airworthiness; Requirements for renewal of Certificate of Airworthiness.	**08 Hrs**
Unit 6	**C.A.R. SERIES 'T' & 'X'** Flight testing of (Series) aircraft for issue of C of A; Flight testing of aircraft for which C of A had been previously issued. Registration Markings of aircraft; weight and balance control of an aircraft; Provision of first aid kits & Physician's kit in an aircraft; use furnishing materials in an aircraft; Concessions; aircraft log books; document to be carried on board on Indian registered aircraft; procedure for issue of tax permit; procedure for issue of type approval of aircraft components and equipment including instruments.	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)	DGCA	DGCA	-	2000
02	Aeronautical Information Circulars (relating to Airworthiness)	DGCA	DGCA	-	2000

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Manual (India) Volume	Andrew Ford	Shroff	1st	2005
02	Advisory Circulars	DGCA	DGCA	-	2003

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE407 – Design of Unmanned Aerial Systems**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE407_1	**Explain** the Classification of UAVs and Its applications.
1AEPE407_2	**Classify** the UAV types and **explain** Design Standards and Regulatory Bodies.
1AEPE407_3	**Explain** the Launch and Recovery Systems.
1AEPE407_4	**Explain** the Ground Control Systems.
1AEPE407_5	**Make use of** the Avionic Hardware and **apply** the Hardware to integrate with UAVs.
1AEPE407_6	**Make use of** Aerial vehicle subsystems and **apply** the knowledge for Ground testing.

Course Contents:		
Unit 1	**Introduction to UAV:** History of UAV, Classification of UAVs, Introduction to Unmanned Aircraft Systems, Models and Prototypes, System composition, Application of UAVs	**06Hrs**
Unit 2	**The Design of UAV Systems:** Introduction to Design and Selection of the System, Aerodynamics and Airframe Configurations – Characteristics of Aircraft Types, Design Standards and Regulatory Aspects, Design of Stealth, Control surfaces, Specifications of UAVs	**08 Hrs**
Unit 3	**Avionic Hardware:** Autopilot, AGL, Pressure sensors, Servos, Accelerometer, Gyro-actuators, Power supply processor, Integration, Installation, Configuration, and Testing	**07Hrs**
Unit 4	**Communication payloads and controls:** Payloads, Telemetry, Tracking, Aerial photography, Controls, PID feedback, Radio frequency range, Modems, Memory system, Simulation, Ground test, Analysis and troubleshooting	**07Hrs**
Unit 5	**Launch and Recovery Systems:** Launch and Recovery systems – Fundamentals of Launch, Launcher Equipment, Recovery techniques- Parachute, Impact recovery, Air launch and Hand launch, Launch and Recovery system design Process, Vertical Takeoff and Landing	**06Hrs**

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Unit 6	**Ground Control Systems:** Ground control station – Introduction, Types-Hand held, portable, Mobile Truck, Central command, GCS Software, Waypoint navigation, System Ground Testing, System In-flight Testing, Future Prospects and Challenges Case Studies – Mini and Micro UAVs	**08Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Unmanned Aircraftsystems UAVs design, development and Deployment	Reg Austin	Wiley & Sons Ltd	1st	2010
02	Introduction to UAV Systems	Paul GerinFahlstrom, Thomas James Gleason	John Wiley & Sons, Ltd	4th	2012
03	Unmanned Aircraft Design- A Review of Fundamentals	Mohammad H. Sadraey	Morgan & Claypool Publishers	1st	2017

Reference:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Flight Stability and Automatic Control	Robert C. Nelson	McGraw-Hill Inc	-	1998
02	Advances in Unmanned Aerial Vehicles: State of Art and the Road to Autonomy	KimonP.Valavanis	Springer	-	2007
03	Design of Unmanned Air Vehicle Systems	Dr.ArmandJ.Chaput	Lockheed	-	-

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE408 – Quality Engineering and Management**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE408_1	**Explain** the need and concept of quality management
1AEPE408_2	**Explain** the Quality Management principles and process
1AEPE408_3	**Explain** the Standards for quality management / quality systems
1AEPE408_4	**Apply** the tools and techniques of quality management to manufacturing and services processes.
1AEPE408_5	**Compare** the quality management tools in manufacturing.

Course Contents:		
Unit 1	**Introduction:** Introduction - Need for quality - Evolution of quality - Definitions of Quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements	**07Hrs**
Unit 2	**Quality Management Principles - I:** Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality, Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment,	**07Hrs**
Unit 3	**Quality Management Principles - II:** Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement, PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.	**07Hrs**
Unit 4	**Quality Management Tools and Techniques - I:** The seven traditional tools of quality - new management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.	**07Hrs**

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Unit 5	**Quality Management Tools and Techniques - II:** Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function –Total Productive Maintenance (TPM) - Concepts, improvement needs - Performance measures.	**07Hrs**
Unit 6	**Quality Systems:** Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.	**07Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Total quality Management	Dale H. Besterfiled	Pearson Education Asia	3rd	2006

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	The Management and Control of Quality	James R. Evans and William M. Lindsay	First Indian Edition, Cengage Learning	8th	2012
02	Total quality Management	Suganthi.L and Anand Samuel	Prentice Hall (India) Pvt. Ltd	-	2006
03	Total Quality Management - Text and Cases	Janakiraman. B and Gopal .R.K	Prentice Hall (India) Pvt. Ltd	-	2006

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE409 - Automobile & Industrial Aerodynamics**
Prerequisite/s	1AEES202 – Fluid Mechanics 1AEPC208 – Low Speed Aerodynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE409_1	**Identify** the atmospheric wind and its elements.
1AEPE409_2	**Construct** wind energy harvesting using different methods
1AEPE409_3	**Discover** flow control techniques for vehicle aerodynamics
1AEPE409_4	**Compare** effects of wind loading on building and urban planning.
1AEPE409_5	**Examine** and **assess** wind structure induced vibration

Course Contents:		
Unit 1	**Atmosphere** Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.	**05 Hrs**
Unit 2	**Wind Energy Collectors** Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory – Piezo wind energy collectors – various bladeless wind energy harvesting methods.	**06 Hrs**
Unit 3	**Vehicle Aerodynamics** Power requirements and drag coefficients of automobiles, Effects of cut back angle, Aerodynamics of trains and Hovercraft, Various drag reduction and optimization techniques, flow control and its applications.	**07 Hrs**
Unit 4	**Building Aerodynamics** Pressure distribution on low rise buildings, wind forces on buildings. Environmental winds in city blocks, Special problems of tall buildings, Building codes, Building ventilation and architectural aerodynamics, urban planning and human comfort.	**08 Hrs**
Unit 5	**Flow Induced Vibrations** Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter, Vibration of stay cables under wind load.	**08 Hrs**

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Unit 6	**Meteorological Aerodynamics** Cyclones- When, where & How do they occur, Classification of cyclones, Mitigation and preparedness measures for cyclones, safety tips on cyclones, Hurricane Tropical & Non Tropicall Hurricanes, Atmospheric phenomenon, Storms- Vortex storms, atmospheric phenomenon of storms, Torrential stroms, Tornadoes & vertical vortices	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year
1	Aerodynamics and drag mechanisms of bluff bodies and road vehicles	M.Sovran (Ed)	Plenum press, New York	--	1978
2	Winds forces in engineering	P. Sachs	Pergamon Press	--	1978

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Flow induced vibrations	R.D. Blevins	Van Nostrand	--	1990
2	Wind Power Principles	N.G. Calvent	Charles Griffin & Co., London	--	1979

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Course Details:

Class	B. Tech., Sem. VII
Course Code and Course Title	**1AEPE410 - Numerical Heat Transfer and Fluid Flow**
Prerequisite/s	1AEES207 - Numerical Analysis with Programming Language 1AEPC306 - Computational Fluid Dynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE410_1	**Develop** the general transport equation and specify the procedure to convert it to continuity, momentum and energy equation
1AEPE410_2	**Apply** the concept of FVM to steady/ unsteady 1D and 2D Diffusion and Convection equations.
1AEPE410_3	**Apply** the iterative solving methods to the system of linear equations to obtain the solution to discretized equations
1AEPE410_4	**Compare** various schemes used to solve the discretized diffusion and convection equations and specify the relative advantages and disadvantages
1AEPE410_5	**Compare** the SIMPLE, SIMPLER and SIMPLEC algorithms used to solve the discretized flow equations

Course Contents:		
Unit 1	**Mathematical Modeling of physical phenomena**: Conservation Equations, Governing Equations-Energy, Momentum and species Equation, General Scalar Transport Equation, Mathematical Classification of Partial Differential Equations, Nature of coordinates-one way and two-way coordinates, proper choice of coordinates	05 Hrs
Unit 2	**Discretization methods**: The Nature of numerical methods: Task, Discretization concept, structure of discretization equation. Methods- Taylor series, Method of weighted residuals, control volume formulation. Illustrative example of Control volume approach, Four golden rules of control volume approach	08 Hrs
Unit 3	**Heat conduction (Diffusion Equation)**: Steady one-dimensional conduction-Basic equation, Grid spacing, Interface conductivity, Source term linearization, Boundary conditions. Unsteady one dimensional Conduction-General Equation, Explicit and implicit Discretization Equations. Two Dimensional- Heat diffusion Equation Solution of Algebraic equations, over relaxation and under relaxation	07 Hrs

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Unit 4	**Diffusion Equation a closer Look**: Diffusion on Orthogonal Meshes, Non-Orthogonal Meshes, Boundary conditions, Gradient calculation- Structured and Unstructured meshes, Influence of secondary gradients on coefficients, Implementation Issues- Data structures, over all solution loop	08 Hrs
Unit 5	**Convection and Diffusion Equation**: Steady one-dimensional Convection and Diffusion Equation- Preliminary equation, Upwind scheme, Exact solution, Exact solution, Exponential scheme, Hybrid scheme, Power law scheme. Discretization of two-dimensional equation, False Diffusion	08 Hrs
Unit 6	**Calculation of Flow Field**: Difficulties in evaluation of flow field, Remedy-Staggered Grid, Momentum Equations, Pressure velocity coupling, SIMPLE Algorithm, SIMPLER Algorithm, SIMPLEC.	06 Hrs

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Numerical Heat Transfer and Fluid Flow	S. V. Patankar	CRC Press	2nd	2009
02	An Introduction to Computational Fluid Dynamics	H. K. Versteeg and W. Malalasekera	Pearson -Prentice Hall	2nd	2007

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Finite volume methods in computational fluid dynamics	F. Moukalled et al.	Springer	1st	2016
02	Introduction to Computational Fluid Dynamics: Development, Application and Analysis	Atul Sharma	John Wiley & Sons Ltd	1st	2017

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE411-Experimental stress analysis**
Prerequisite/s	1AEES203-Mechanics of Materials
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE411_1	**Explain** the Transmission Photoelasticity and its related parameters.
1AEPE411_2	**Use** various extensometers and displacement Sensors for the measurement of displacement.
1AEPE411_3	**Determine** the stress-strain values in material and structure subjected different loading
1AEPE411_4	**Use** strain gauges to calculate the strain and stress induced in the material.
1AEPE411_5	**Analyze** the behaviour of solids under load using Photo-elastic Coatings and Brittle Coatings

Course Contents:		
Unit 1	**Extensometers and Displacement Sensors** Principles of measurements, Accuracy, Sensitivity and range of measurements, Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages, Capacitance gauges, Laser displacement sensors.	**05 Hrs**
Unit 2	**Stress-Strain Relationships** Overview of Experimental Stress Analysis, Optical Methods Work as Optical Computers, Stress- Strain and Displacement Fields, Physical Principle of Strain Gauges, Photoelasticity and Moiré, Introduction to Moiré, Brittle Coatings and Holography, Hologram Interferometry, Speckle Methods, Introduction to Shearography, TSA, DIC and Caustics, Fringe Patterns – Richness of Qualitative Information, Multi-Scale Analysis in Experimental Mechanics, Selection of an Experimental Technique	**12Hrs**
Unit 3	**Transmission Photoelasticity- I** Introduction to Transmission Photoelasticity, Ordinary and Extraordinary Ray, Light Ellipse, Passage of Light Through a Crystal Plate, Retardation Plates, Stress-optic Law, Plane Polariscope, Jones Calculus, Circular Polariscope	**07Hrs**
Unit 4	**Transmission Photoelasticity- II** Determination of Photoelastic Parameters at an Arbitrary Point, Tardy's Method of Compensation, Calibration of Photo elastic Materials, Fringe Thinning Methodologies, Fringe Ordering in Photoelasticity, Miscellaneous Topics in Transmission Photoelasticity, Three Dimensional	**07Hrs**

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	Photoelasticity, Overview of Digital Photoelasticity	
Unit 5	**Photoelastic Coatings and Brittle Coatings** Introduction to Photoelastic Coatings, Correction Factors for Photoelastic Coatings, Coating Materials, Selection of Coating Thickness, Industrial Application of Photoelastic Coatings, Calibration of Photoelastic Coatings, Introduction to Brittle Coatings, Analysis of Brittle Coatings	**05Hrs**
Unit 6	**Strain Gauges** Introduction to Strain Gauges, Strain Sensitivity of a Strain Gauge, Bridge Sensitivity, Rosettes, Strain Gauge Alloys, Carriers and Adhesives, Performance of Strain Gauge System, Temperature Compensation, Two wire and Three-wire Circuits, Strain Gauge Selection, Bonding of a Strain Gauge, Soldering, Accounting for Transverse Sensitivity Effects, Correction Factors for Special Applications, Special Gauges	**09Hrs**

Text-Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Experimental Stress Analysis	J.W. Dally and W.F. Riley	McGraw-Hill	2nd Edition	1991
02	Experimental Stress Analysis	L.S. Srinath, M.R. Raghavan, K. Lingaiah, G. Gargesa, B. Pant, and K. Ramachandra	Tata Mc Graw Hill	2nd Edition	1984

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Digital Photoelasticity – Advanced Techniques and Applications	K. Ramesh	Springer	3rd Edition	2000
02	Springer Handbook of Experimental Solid Mechanics	W.N. Sharpe (Ed.)	Springer	4th Edition	2008

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Annasaheb Dange College of Engineering and Technology, Ashta
(An Autonomous Institute)
Department of Aeronautical Engineering

Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE412 - Aircraft General Engineering Maintenance**
Prerequisite/s	1AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE412_1	**Identify** Aircraft Maintenance Practices, Tool and its usages.
1AEPE412_2	**Examine and** Inspect and maintain the basic checks on aircraft piston engines.
1AEPE412_3	**Classify** repair procedures that occur in plastic and composite components of an Aircraft.
1AEPE412_4	**Select** the maintenance procedure of various systems of aircraft according to various manuals.
1AEPE412_5	**Appraise** the safety practices while handling Aircraft hazardous materials.

Course Contents:		
Unit 1	**Aircraft Maintenance Practices - An Introduction** Standard Maintenance Practices – Start up procedure of a Turboprop, Turbojet and Turbofan engine- Engine starters - Pre-Flight inspection before departure – Various Tarmac vehicles assisting the Aircraft and their Objectives.	**05 Hrs**
Unit 2	**Aircraft Maintenance Tools** Regulatory bodies – Role of ICAO, EASA certifications, FAA, DGCA – Role of Regulatory bodies in defining regulations- Tools used in Aircraft Maintenance in detail – Commercial Aircraft Maintenance tools and Military Aircraft Maintenance tools – A Checks – B Checks - C Checks – D Checks.	**06 Hrs**
Unit 3	**Inspection of Piston Engines** Inspection, Maintenance and Troubleshooting: Inspection of all engine components- Daily and routine checks, Overhaul procedures, Compression Testing of cylinder, Special Inspection Schedules: Engine Fuel, Control and Exhaust System- Engine mount and super chargers, Checks and inspection Procedures. Starting procedure for Cessna 152 - SOP.	**10 Hrs**
Unit 4	**Aircraft Jacking, Assembly and Rigging** Airplane jacking, weighing and C.G. Location, Balancing of control surfaces, Inspection maintenance, Helicopter flight controls. Tracking and balancing of main rotor.	**10 Hrs**

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Unit 5	**Aircraft System Components and Its Maintenance Practices** Troubleshooting and maintenance practices, Service and inspection: Inspection and maintenance of landing gear systems, Inspection and maintenance of air-conditioning and pressurization system, Water and waste system, Installation and maintenance of Instruments - handling, Testing, Inspection and maintenance of auxiliary systems , Fire protection systems , Ice protection system , Rain removal system , Position and warning system and Auxiliary power units (APUs).	**06 Hrs**
Unit 6	**Safety Practices** Hazardous materials storage and handling, Aircraft furnishing practices, Aircraft Fuelling and defueling safety procedures, Maintenance briefing and debriefing Procedures. Supportive equipment and emergency operations.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Maintenance and Repair	William J. Watkins, Jr., Ronald Sterkenburg, Kroes, Frank Delp	McGraw Hill, New York	7th	2013
02	Civil Aircraft Inspection Procedures	CAA (Civil Aviation Authority)	CAA	1st	1992
03	Aircraft Power Plants	Kroes and Wild	McGraw Hill, New York	8th	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Repair Manual	Larry Reithmaier	Sterling Book House	1st	2008

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE413 - Aircraft Engine Design**
Prerequisite/s	1AEPE308 - Engineering Design Optimization
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
0AEPE413_1	**Build** preliminary design parameters for compressors and turbines and characterize their performance based on a mean line approach.
0AEPE413_2	**Apply** the principles of cycle analysis to choose an engine suitable for a given aircraft requirement.
0AEPE413_3	**Analyze** the operation and performance of a jet engine based on compressor and turbine maps for different operating conditions.
0AEPE413_4	**Measure** the preliminary design parameters and define key design issues, constraints and architectures for main combustors in jet engines.
0AEPE413_5	**Create** the conceptual design of the Jet Engine

Course Contents:		
Unit 1	**The Design Process, Constraint and Mission Analysis.** Preliminary propulsion design sequence, Compressible flow relations, Constraint analysis, Preliminary estimates for constraint analysis, Constraint boundary analysis, Mission analysis - Aircraft weight and fuel consumption, Aircraft Engine Efficiency and Thrust Measures	**06 Hrs**
Unit 2	**Engine Selection** Parametric Cycle Analysis, Design Tools, Finding promising solution, Component Behavior, Engine Performance Analysis, Sizing the Engine: Installed Performance, Example Installed Performance and Final Engine Sizing	**08 Hrs**
Unit 3	**Engine Component Design: Global and Interface Quantities** Concept, Design Tools, Engine Systems Design, Example Engine Global and Interface Quantities.	**06 Hrs**
Unit 4	**Engine Component Design: Turbomachinery** Axial architectures, Euler equations and cascade nomenclature, Mean line design of compressors and compressor performance, Cascade flow angles and velocity triangles, Multistage compressors, Mean line design of turbines and turbine performance, Stage inlet swirl, solidity, losses and other design requirements, Blade and disk stresses, Compressor and turbine design point procedures	**08 Hrs**

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Unit 5	**Engine Component Design: Combustion Systems** Concept, Design Tools - Main Burner, Afterburners, Example Engine Component Design: Combustion Systems	**06 Hrs**
Unit 6	**Engine Component Design: Inlets and Exhaust Nozzles** Concept, Inlets, Exhaust Nozzles, Engine Component Design: Inlet and Exhaust Nozzle	**08 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year
1	Aircraft Engine Design	Jack D. Mattingly, William H. Heiser, David T. Pratt, Keith M. Boyer and Brenda A. Haven	AIAA Education Series	3rd	2003

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Jet Engines: Design, Development and Operation	C Jaganathan and S K Jain	Yes Dee Publishing Pvt Ltd	1st	2017
2	Aircraft Propulsion Systems Technology and Design	Gordon C. Oates	AIAA Education Series	1st	1989

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEPE414 - Product Life Cycle Management**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE414_1	**Explain** history, concepts and terminology of PLM.
1AEPE414_2	**Apply** the functions and features of PLM/PDM.
1AEPE414_3	**Utilize** different modules offered in commercial PLM/PDM tools.
1AEPE414_4	**Utilize** PLM/PDM implementation approaches.
1AEPE414_5	**Analyze** PLM/PDM with other applications.

Course Contents:		
Unit 1	**History, Concepts and Terminology of PLM:** Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM), PLM /PDM Infrastructure.	**09Hrs**
Unit 2	**PLM/PDM Functions and Features:** Network and Communications, Data Management, Heterogeneous data sources and applications, User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Program Management.	**07Hrs**
Unit 3	**PLM/PDM Features and Details of Modules:** Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration. Case studies based on top few commercial PLM/PDM tools	**07Hrs**
Unit 4	**Role of PLM in Industries - I:** Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM,	**06Hrs**
Unit 5	**Role of PLM in Industries - II:** Barriers to PLM implementation, financial justification of PLM, ten step approach to PLM, benefits of PLM for–business, organization, users, product or service, process performance.	**06Hrs**
Unit 6	**Basics on Customization/Integration of PDM/PLM Software:** PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.	**07Hrs**

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Product Lifecycle Management	Antti Saaksvuori and AnselmiImmonen	Springer Publisher	3rd	2008
02	Product Life Cycle Management	Michael Grieves	Tata McGraw Hill	-	2006

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	International Journal of Product Lifecycle Management	-	Inderscience Publishers	-	-
02	Implementing and Integrating Product Data Management and Software Configuration Management	Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist	Artech House Publishers	-	2003
03	Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question	John Stark	Springer Publisher	-	2007
04	Product Lifecycle Management: 21st Century Paradigm for Product Realisation	John Stark	Springer Publisher	2nd	2011

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Course Details:

Class	B. Tech, Sem.-VII
Course Code and Course Title	**1AEOE421 - Air Traffic Control and Airport Design**
Prerequisite/s	1AEPC205 – Introduction to Aerospace Engineering 1AEPC211 – Aircraft Systems and Instruments
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE421_1	**Illustrate** the requirements of air traffic control systems and types of air traffic control systems.
1AEOE421_2	**Apply** the rules of air traffic systems.
1AEOE421_3	**Organize** a system for the alerting and emergency services.
1AEOE421_4	**Simplify** the use of primary and secondary runways and its obstacles restriction.
1AEOE421_5	**Justify** the importance and requirements of airport marking and airport lighting for the safety landing of aircraft.

Course Contents:		
Unit 1	**Basic Concepts:** Objectives of air traffic control systems - Parts of ATC services – Scope and Provision of ATCs – VFR & IFR operations – Classification of ATS air spaces – Various kinds of separation – Altimeter setting procedures – Establishment, designation and identification of units providing ATS – Division of responsibility of control.	**05 Hrs**
Unit 2	**Air Traffic Systems:** Area control service, assignment of cruising levels - minimum flight altitude - ATS routes and significant points – RNAV and RNP – Vertical, lateral and longitudinal separations based on time / distance –ATC clearances – Flight plans – position report.	**08 Hrs**
Unit 3	**Flight Information systems:** Radar service, Basic radar terminology – Identification procedures using primary / secondary radar – performance checks – use of radar in area and approach control services – assurance control and co- ordination between radar / non radar control – emergencies – Flight information and advisory service – Alerting service – Coordination and emergency procedures – Rules of the air.	**07 Hrs**

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Unit 4	**Aerodrome Data:** Aerodrome data - Basic terminology – Aerodrome reference code – Aerodrome reference point – Aerodrome elevation – Aerodrome reference temperature – Instrument runway, physical Characteristics; length of primary / secondary runway – Width of runways – Minimum distance between parallel runways etc. – obstacles restriction.	**08 Hrs**
Unit 5	**Navigation services:** Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements.	**08 Hrs**
Unit 6	**Airport Lighting:** Aerodrome beacon, identification beacon – Simple approach lighting system and various lighting systems – VASI & PAPI - Visual aids for denoting obstacles; object to be marked and lighter – Emergency and other services.	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	AIP (India) Vol. I & II	DGCA	The English Book Store	-	2003

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Manual (India) Volume I	DGCA	The English Book Store	-	-
02	"PANS – RAC – ICAO DOC 4444"	DGCA	The English Book Store	-	-
03	International Standards and Recommended Practices - Aerodromes	International Civil Aviation Organization	International Civil Aviation Organization	1st	1951

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEOE422, Aircraft General Engineering Maintenance**
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE422_1	**Identify** Aircraft Maintenance Practices, Tool and their usage.
1AEOE422_2	**Examine,** inspect and maintain the basic checks on aircraft piston engines.
1AEOE422_3	**Classify** repair procedures that occur in plastic and composite components of an Aircraft.
1AEOE422_4	**Select** the maintenance procedure of various systems of aircraft according to various manuals.
1AEOE422_5	**Appraise** the safety practices while handling Aircraft hazardous materials.

Course Contents:		
Unit 1	**Aircraft Maintenance Practices - An Introduction** Standard Maintenance Practices – Start up procedure of a Turboprop, Turbojet and Turbofan engine- Engine starters - Pre-Flight inspection before departure – Various Tarmac vehicles assisting the Aircraft and their Objectives.	**05 Hrs**
Unit 2	**Aircraft Maintenance Tools** Regulatory bodies – Role of ICAO, EASA certifications, FAA, DGCA – Role of Regulatory bodies in defining regulations- Tools used in Aircraft Maintenance in detail – Commercial Aircraft Maintenance tools and Military Aircraft Maintenance tools – A Checks – B Checks - C Checks – D Checks.	**06 Hrs**
Unit 3	**Inspection of Piston Engines** Inspection, Maintenance and Troubleshooting: Inspection of all engine components- Daily and routine checks, Overhaul procedures, Compression Testing of cylinder, Special Inspection Schedules: Engine Fuel, Control and Exhaust System- Engine mount and super chargers, Checks and inspection Procedures. Starting procedure for Cessna 152 - SOP.	**10 Hrs**
Unit 4	**Aircraft Jacking, Assembly and Rigging** Airplane jacking, weighing and C.G. Location, Balancing of control surfaces, Inspection maintenance, Helicopter flight controls. Tracking and balancing of main rotor..	**10 Hrs**

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Unit 5	**Aircraft System Components and Its Maintenance Practices** Troubleshooting and maintenance practices, Service and inspection: Inspection and maintenance of landing gear systems, Inspection and maintenance of air-conditioning and pressurization system, Water and waste system, Installation and maintenance of Instruments - handling , Testing ,Inspection and maintenance of auxiliary systems , Fire protection systems , Ice protection system , Rain removal system , Position and warning system and Auxiliary power units (APUs).	**06 Hrs**
Unit 6	**Safety Practices** Hazardous materials storage and handling, Aircraft furnishing practices, Aircraft Fuelling and defueling safety procedures, Maintenance briefing and debriefing Procedures. Supportive equipment and emergency operations.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Maintenance and Repair	William J. Watkins, Jr., Ronald Sterkenburg, Kroes, Frank Delp	McGraw Hill, New York	7th	2013
02	Civil Aircraft Inspection Procedures	CAA (Civil Aviation Authority)	CAA	1st	1992
03	Aircraft Power Plants	Kroes and Wild	McGraw Hill, New York	8th	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Repair Manual	Larry Reithmaier	Sterling Book House	1st	2008

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Course Details:

Class	B. Tech., Sem.-VII
Course Code and Course Title	**1AEOE423–Design of Fixed-wing Unmanned Aerial Vehicles**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEOE423_1	**Explain** the classification of UAVs, parts and anatomy of fixed-wing UAVs
1AEOE423_2	**Illustrate** Standard Atmospheric Conditions.
1AEOE423_3	**Identify** the forces acting on fixed-wing UAV and **solve** for forces acting on UAV
1AEOE423_4	**Analyze** the performance of fixed-wing UAV in basic conditions
1AEOE423_5	**Explain** the stability condition and **analyze** the parameter affecting stability
1AEOE423_6	**Analyze** the size of Fixed-wing UAV and **explain** testing method of UAV

Course Contents:		
Unit 1	**Introduction to UAV and Standard Atmosphere:** Introduction of UAVs, Classification of UAVs, UAV Parts and Sub-systems, Models and Prototypes, Application of UAVs, International Standard Atmospheric conditions	**06Hrs**
Unit 2	**Anatomy of Fixed-wing UAV:** Introduction to Fixed-wing UAV, Measurement of Flight Velocity, Airfoil Nomenclature, Aerodynamic center, Center of pressure, Interpretation of airfoil data, Fixed-wing UAV parts and control surfaces	**07Hrs**
Unit 3	**Basic UAV dynamics:** Airfoil and Finite Wing, Wing planforms, Generation of Lift and Drag. Forces acting on fixed-wing UAV, Thrust required and Power required, Design algorithm of fixed-wing UAV	**07Hrs**
Unit 4	**Performance of fixed-wing UAV:** Calculation of performance parameters, Equation of motion, Steady Flight, Level Flight, Steady-level flight, Climb and Glide performance, Minimum thrust required condition, Minimum power required condition, Range and Endurance	**08Hrs**
Unit 5	**Stability of fixed-wing UAV:** Types of Stability, Effect of C.G location, Neutral point, Static margin, Longitudinal stability, Contribution of tail in static stability and neutral point	**07Hrs**
Unit 6	**Fixed-wing UAV sizing:** Weight estimation, Wing sizing, Wing planform selection, Fixed-wing	**07Hrs**

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	UAV frame configuration, Tail sizing, Sizing of Control surfaces, Testing methodology of fixed-wing UAV, Wind-tunnel testing	

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Performance and Design	John D Anderson	McGraw-Hill Inc	5th	2012
02	Unmanned Aircraft Systems UAVs design, development and deployment	Reg Austin	Wiley & Sons Ltd	1st	2010
03	Introduction to UAV Systems	Paul Gerin Fahlstrom, Thomas James Gleason	John Wiley & Sons, Ltd	4th	2012
04	Unmanned Aircraft Design- A Review of Fundamentals	Mohammad H. Sadraey	Morgan & Claypool Publishers	1st	2017

Reference:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Flight Stability and Automatic Control	Robert C. Nelson	McGraw-Hill Inc	-	1998
02	Advances in Unmanned Aerial Vehicles: State of Art and the Road to Autonomy	Kimon P.Valavanis	Springer	-	2007
03	Design of Unmanned Air Vehicle Systems	Dr.Armand J.Chaput	Lockheed	-	-

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Course Details:

Class	B. Tech., Sem.-VIII
Course Code and Course Title	**1AEHS408 – Entrepreneurship Essentials**
Prerequisite/s	--
Teaching Scheme: Lecture/Tutorial	02/00
Credits	02
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEHS408_1	**Describe** the perspective of an entrepreneur.
1AEHS408_2	**Identify** suitable business ideas in the market and **evaluate** opportunities.
1AEHS408_3	**Apply** basic accounting principles for a start-up.
1AEHS408_4	**Apply** basic techniques for setting up a founding team and obtain funds for new ventures.
1AEHS408_5	**Apply** basic techniques for marketing strategies.
1AEHS408_6	**Apply** basic techniques for start-up valuation and growth.

Course Contents:		
Unit 1	**Entrepreneurship Mindset** Economic contributions of entrepreneurs, definitions, motivation and types of entrepreneurship; vision, mission and values; entrepreneurial qualities,	**07 Hrs**
Unit 2	**Opportunity identification** Creativity and business ideas; marketing research, factors driving competitive advantages, protecting the idea and other legal issues for the entrepreneur.	**06 Hrs**
Unit 3	**Business planning** Accounting principles, concepts and conventions, Accounting process, Preparation of Financial statement, Financial Reporting, Reporting practices, Analysis of financial statements with managerial perspective. Understanding and analyzing published financial statements of a company, cost, volume, profit: break-even point	**08 Hrs**
Unit 4	**Funding New Venture** Founding team and early recruits, pitching the business plan, funding strategies for new ventures	**07 Hrs**
Unit 5	**Market Strategies** Go-to-market strategies, Dos and Donts	**08 Hrs**
Unit 6	**Start-up Valuation** Start-up valuation techniques, human resource management, succession planning, growth strategies	**06 Hrs**

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Text Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Entrepreneurship	Robert Hisrich, Michael Peters, Dean Shepherd	McGraw Hill	Indian	2020

Reference Books:					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
01	Entrepreneurship Essentials	Baljeet Gujral	BUUKS	1st	2021
02	Entrepreneurship Essentials	Hakan Koch	CreateSpace Independent Publishing Platform	1st	2012

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Course Details:

Class	B. Tech., Sem.-VIII
Course Code and Course Title	**1AEPE415 - Nanomaterials and Nanotechnology**
Prerequisite/s	1AEBS102 - Applied Physics 1AEBS107 - Applied Chemistry
Teaching Scheme: Lecture/Tutorial	03/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE415_1	**Explain** the basics of quantum mechanics, nanosystems and properties at nano scale.
1AEPE415_2	**Illustrate** the applications of nanotechnology.
1AEPE415_3	**Identify** different classes of nanomaterial based on applications.
1AEPE415_4	**Identify** suitable methods for synthesis of nanomaterials based on the applications.
1AEPE415_5	**Identify** the appropriate characterization techniques to evaluate a particular nanostructure.

Course Contents:		
Unit 1	**Introduction to Quantum Mechanics** Failure of Classical Mechanics; Brief discussion of general ideas such as dual nature of particles, Uncertainty principle, Superposition principle etc.; Solutions of Schrodinger Equation for 1-D and 3-D square wells and potential barriers, H-atom. Matrix Mechanics: Operators, Change of basis, Eigen-values and Eigen-vectors; Simultaneous Eigen vectors, Harmonic Oscillator in matrix mechanics; Exchange operators and identical particles.	**06 Hrs**
Unit 2	**Basics and Scale of Nanotechnology** Introduction and scientific revolutions -Time and length scale in structures Definition of a nanosystem- Dimensionality and size dependent phenomena - Surface to volume ratio - Fraction of surface atoms and surface energy - Surface stress and surface defects - Properties at nanoscale – optical & mechanical -. Properties at nanoscale – electronic & magnetic.	**08 Hrs**
Unit 3	**Different Classes of Nanomaterial** Classification based on dimensionality - Quantum dots, wells and wires - Carbon-based nano materials – fullerences and buckyballs- Carbon nanotubes and graphene- Metal based nano materials – Nanogold and Nanosilver- Metal oxide based nano materials -Nanocomposites and nanopolymers-Nanoglasses and nano ceramics - Biological nanomaterials	**09 Hrs**

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Unit 4	**Synthesis of Nanomaterials** Chemical methods: Metal nanocrystals by reduction -Solvothermal synthesis and photochemical synthesis -Sonochemical routes and chemical vapor deposition (CVD) - Metal oxide chemical vapor deposition (MOCVD) - Physical methods: Ball milling. Electrodeposition techniques -Spray pyrolysis and flame pyrolysis-DC/RF magnetron sputtering, Molecular beam epitaxy (MBE)	**08 Hrs**
Unit 5	**Fabrication and Characterization of Nanostructures** Nanofabrication: Photolithography and its limitation and electron beam lithography (EBL) -Nanoimprinting and soft lithography patterning - Characterization: Field emission scanning electron microscopy (FESEM) and environmental scanning electron microscopy (ESEM) - High resolution transmission electron microscope (HRTEM) - Scanning tunneling microscope (STM)-Surface enhanced raman spectroscopy (SERS)- X-ray photoelectron spectroscopy (XPS) - Auger electron spectroscopy (AES), Rutherford backscattering spectroscopy (RBS)	**06 Hrs**
Unit 6	**Applications in Nanotechnology** Solar energy conversion and catalysis - Molecular electronics, nanoelectronics and printed electronics -Polymers with a special architecture, liquid crystalline systems - Linear and nonlinear optical and electro-optical properties -Applications - nanomaterials for data storage - Photonics and plasmonics- Chemical and biosensors -Nanomedicine and nanobiotechnology, Nanotoxicology challenges	**08 Hrs**

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	A Textbook of Nano science and Nanotechnology	T. Pradeep,	Tata McGraw Hill Education Pvt. Ltd.,	3rd	2012
2	Nanostructured Materials and Nanotechnology	Hari Singh Nalwa	Academic Press,	3rd	2008

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Nano science: Nanotechnologies and Nanophysics	C.Dupas, P.Houdy, M.Lahmani	Springer-Verlag Berlin Heidelberg,	1st	2007
2	Nanomaterials: Synthesis, Properties and Applications	A. S. Edelstein and R. C. Cammarata,	Institute of Physics Pub.,	1st	2001

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Course Details:

Class	B. Tech. Sem.-VIII
Course Code and Course Title	**1AEPE416 - Non - Destructive Testing**
Prerequisite/s	**NIL**
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE416_1	**Explain** scope and limitations of various Non-Destructive Testing methods
1AEPE416_2	**Compare** various nondestructive testing methods and Choose appropriate method for testing.
1AEPE416_3	**Check** different metals and alloys by visual inspection method.
1AEPE416_4	**Explain** and **perform** non-destructive tests like: liquid penetrant test, Magnetic particle test, Ultrasonic test, X-ray and Gamma ray radiography, Leak Test, Eddy current test.
1AEPE416_5	**Identify** defects by using relevant NDT method.

Course Contents:		
Unit 1	**Introduction:** Fundamentals of and introduction to destructive and non-destructive testing. Scope and limitations of NDT, Visual examination methods, Different visual examination aids. **Dye penetrant Testing/ liquid penetrant testing:** Principle, procedure, characteristics of penetrant, types of penetrants, penetrant testing materials, fluorescent penetrant testing method– sensitivity, application and limitations	**06Hrs**
Unit 2	**Magnetic Particle Testing:** Important terminologies related to magnetic properties of material, principle, magnetizing technique, procedure, equipment, fluorescent magnetic particle testing method, sensitivity, application and limitations	**06Hrs**
Unit 3	**Ultrasonic Testing:** Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection, flaw characterization technique, defects in welded products by UT, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, advantage, limitations acoustic emission testing – principles of AET and techniques.	**10Hrs**
Unit 4	**Radiographic testing:** X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations, Types of films, screens and penetra-meters. Interpretation of radiographs, Safety in industrial radiography.	**08Hrs**
Unit 5	**Leak and pressure testing:** Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation	**06Hrs**

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Unit 6	**Eddy current testing:** Principle, instrument, techniques, sensitivity, application, limitation Thermal methods of NDT	**06Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Practical Non-Destructive Testing	Baldevraj, T. Jayakumar, M. Thavasimuthu	Norosa Publishing House, New Delhi.	3rd	2019
02	Non Destructive Testing	Sadashiva M	Notion Press	1st	2021

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Non-Destructive Test and Evaluation of Materials	Dr.CG.Krishnadas Nair	Tata McGraw Hill Publishing Company	1st	2008
02	Non-Destructive Testing and Evaluation of Material	J Prasad, C C K Nair	Tata McGraw-Hill	2nd	2011

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ADCET	**Annasaheb Dange College of Engineering and Technology, Ashta** (An Autonomous Institute) **Department of Aeronautical Engineering**

Course Details:

Class	B. Tech., Sem.-VIII
Course Code and Course Title	**1AEPE418 - Aircraft Maintenance and Repair**
Prerequisite/s	1AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE418_1	**Identify** Aircraft Maintenance Practices, Tool and its usages for structural repair of an aircraft.
1AEPE418_2	**Examine and** Inspect and maintain the basic checks on aircraft and its systems
1AEPE418_3	**Classify** repair procedures that occur in plastic and composite components of an Aircraft.
1AEPE418_4	**Select** the maintenance procedure of various systems of aircraft according to various manuals.
1AEPE418_5	**Appraise** the safety practices while handling Aircraft hazardous materials.

Course Contents:		
Unit 1	**Welding of Aircraft Structural Components** Equipments used in welding shop and their maintenance, Ensuring quality welds, Welding jigs and fixtures, Soldering and brazing	**05 Hrs**
Unit 2	**Sheet Metal Repair and Maintenance** Inspection of damage, Classification, Repair or replacement, Sheet metal inspection, N.D.T. Testing, Riveted repair design, Damage investigation, Reverse technology	**06 Hrs**
Unit 3	**Plastics and Composites in Aircraft** Review of types of plastics used in airplanes, Maintenance and repair of plastic components, Repair of cracks, holes etc., Various repair schemes, Scopes, Inspection and Repair of composite components, Special precautions, Autoclaves.	**10 Hrs**
Unit 4	**Aircraft Jacking, Assembly and Rigging** Airplane jacking, weighing and C.G. Location, Balancing of control surfaces, Inspection maintenance, Helicopter flight controls. Tracking and balancing of main rotor..	**10 Hrs**

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Unit 5	**A Review of Hydraulic and Pneumatic Systems** Troubleshooting and maintenance practices, Service and inspection. , Inspection and maintenance of landing gear systems, Inspection and maintenance of air-conditioning and pressurization system, Water and waste system, Installation and maintenance of Instruments , handling , Testing ,Inspection and maintenance of auxiliary systems , Fire protection systems , Ice protection system , Rain removal system , Position and warning system , Auxiliary power units (APUs)	**06 Hrs**
Unit 6	**Safety Practices** Hazardous materials storage and handling, Aircraft furnishing practices, Aircraft Fuelling and defueling safety procedures, Maintenance briefing and debriefing Procedures. Supportive equipment and emergency operations.	**05 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Maintenance and Repair	William J. Watkins, Jr., Ronald Sterkenburg, Kroes, Frank Delp	McGraw Hill, New York	7th	2013
02	Civil Aircraft Inspection Procedures	CAA (Civil Aviation Authority)	CAA	1st	1992
03	Aircraft Power Plants	Kroes and Wild	McGraw Hill, New York	8th	2017

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Aircraft Repair Manual	Larry Reithmaier	Sterling Book House	1st	2008

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Course Details:

Class	B. Tech - Sem. VIII
Course Code and Course Title	**1AEPE420 -Cryogenics**
Prerequisite/s	1AEES204 -Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
1AEPE420_1	**Explain** the concept of low temperature scales and applications of cryogenics in aerospace and allied areas
1AEPE420_2	**Develop** thermodynamic equations that can be used to analyze the low temperature processes involved with cryogenic engineering
1AEPE420_3	**Apply** and Analyze various liquefaction process involved in cryogenic engineering
1AEPE420_4	**Examine** the importance of material properties at cryogenic temperatures for storage and transportation of low temperature fluids
1AEPE420_5	**Identify** the challenges involved in the design of cryogenic rockets with the help of various performance parameters

Course Contents:		
Unit 1	**Introduction to Cryogenics:** Importance of cryogenics, Development and history of cryogenics, **Applications of Cryogenics** in space, aviation, surgery, metallurgy and biology **Superconductivity Applications:** Current applications and Emerging devices	**05 Hrs**
Unit 2	**Thermodynamic Analysis of Low Temperature Processes** Refrigeration fundamentals, Thermodynamic Minimum Work principle, Production of low temperatures by Joule thomson expansion, Adiabatic reversible turbine work, sudden adiabatic expansion, philips refrigerator, Gifford McMahon Refrigeration, helium dilution refrigerator	**07 Hrs**
Unit 3	**Cryogenic Liquefaction processes:** Ideal Liquefaction system, Liquefaction of Nitrogen,Oxygen and Argon by- Linde Hampson process, Precooled Linde hampson Process, Simple Claude process, Dual pressure Claude process. Liquefaction of Neon and Hydrogen by Precooled Linde hampson Process, Precooled Claude process	**10 Hrs**
Unit 4	**Cryogenic propellants for Rocket propulsion** Nature of propellants, challenges in cryogenic propellants, performance analysis of rockets, Selection of propellants, Design Concepts- Boil-of rate, storage tank, safety, propellent feed system, transportation of propellants	**08 Hrs**

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Unit 5	**Storage and Transportation of Cryogenic Fluids** Storage Vessel fundamentals, Thermal shields and insulation, Effect of size and shape of storage vessel on Heat In Leak, Transfer and Draining of Liquids Transportation of Fluids-Liquid Nitrogen Dewars, Hydrogen refrigerated Dewar, powder insulated dewar to transport helium	**08 Hrs**
Unit 6	**Material properties at Cryogenic Temperatures** mechanical properties - Ultimate and yield strength, Fatigue strength, Impact strength, Elastic moduli Thermal properties-Thermal conductivity, Specific heat and expansion coefficient Electric properties- Electric conductivity, Semiconductivity, Superconductivity	**06 Hrs**

Text Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Fundamentals of Cryogenic Engineering	Mamatha Mukhopadhyay	PHI Learning pvt Ltd	2nd	2010

Reference Books:

Sr. No	Title	Author	Publisher	Edition	Year of Edition
01	Cryogenics: Theory, Processes and Applications	E. Allyson, E. Hayes	Nova Science publication	1st	2010
02	Cryogenics systems	R.F. Barron	Oxford University Press	1st	1985

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