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 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

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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.

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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 the products those enhancing the mobility in the society.
PSO 2	Develop frameworks and subsystems of the Aerospace and aviation components to progress towards becoming technocrats
PSO 3	Solve the difficulties faced by the Aviation Industry with regards to operating and maintaining with Innovative Solutions.

Head of Department

Annasaheb Dange College of Engineering and Technology, Ashta

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Curriculum

S.Y. B. Tech.

AERONAUTICAL ENGINEERING

SEM III & SEM IV

(Academic Year 2018-2019)

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S.Y. B. Tech. Aeronautical Engineering: III Semester

Teaching and Evaluation Scheme

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	C	Scheme	Theory (Marks)		Practical (Marks)	
							Max.	Min. for passing	Max.	Min. for passing
0AEBS201	Applied Mathematics-III	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC202	Applied Thermodynamics	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC203	Fluid Mechanics	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC204	Solid Mechanics	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC205	Introduction to Aerospace Engineering	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEES251	Computer Programming with C++	2	--	2	3	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC252	Applied Thermodynamics Laboratory	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC253	Fluid Mechanics Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC254	Solid Mechanics Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC255	Aircraft Component Drawing	--	--	2	1	ISE	--	--	50	20
Total		**17**	**3**	**10**	**25**	**Total**	**500**		**300**	
Total Contact Hours/ Week=30						**Total Marks=800**				

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	---	3	3	19	--	--	--	--	--
Cumulative Sum	3	19	32	19	--	--	--	--	--

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEBS201 – Applied Mathematics III
Prerequisite/s	0BSBS102 – Appied Mathematics - I 0BSBS113– Applied Mathematics - II
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Objectives: The course enables students to:	
01	Improve mathematical skills for enhancing of logical thinking power of students.
03	Acquire knowledge with a sound foundation in mathematics and prepare them for graduate studies in Aeronautical Engineering.
04	Aware about mathematics fundamental necessary to solve and analyze engineering problem.

Course Outcomes (COs): After successful completion of this course, the student will be able to:		
0AEBS201_1	Solve the problems on Fourier Series and Laplace Transform.	(K^3)
0AEBS201_2	Make use of Linear Differential Equation to solve the Aeronautical Engineering problems.	(K^3)
0AEBS201_3	Make use of Partial Differential Equation to solve the Aeronautical Engineering problems.	(K^3)
0AEBS201_4	Solve the problems of vector calculus.	(K^3)
0AEBS201_5	Demonstrate Numerical ability to solve the problem.	(S^2)

Course Contents:

Unit 1	**Vector Calculus**	**07 Hrs**
	1.1 Introduction 1.2 Scalar and vector point functions - vector operator del. 1.3 Del applied to scalar point functions - gradient, directional derivative 1.4 Del applied to vector point functions - Divergence and curl 1.5 Line integral 1.6 Green's theorem in the plane	

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Unit 2	**Linear Differential Equations**	**07 Hrs**
	2.1 Definitions 2.2 Complete solution. 2.3 Operator D 2.4 Rules for finding Complementary function. 2.5 Inverse operator 2.6 Rules for finding the Particular integral. a. When $X = e^{ax}$ b. When $X = \sin(ax+b)$ *or* $\cos(ax+b)$ c. When $X = x^m$. d. When $X = e^{ax}V$, whereV is a function of x . e. When X is any other function of x. 2.7 Cauchy's homogeneous linear differential equations.	
Unit 3	**Applications of Linear Differential Equations**	**07Hrs**
	3.1 Introduction 3.2 Oscillations of a spring a. Free oscillations b. Damped Oscillations c. Forced oscillations without damping. 3.3 The Whirling of Shafts.	
Unit 4	**Laplace Transform**	**07Hrs**
	4.1 Introduction 4.2 Laplace transform of elementary functions. 4.3 Properties of Laplace Transforms. 4.4 Transforms of derivatives, Transforms of integrals, Multiplication by t^n, Division by t 4.5 Evaluation of integrals by Laplace Transforms. 4.6 Inverse Laplace transforms - Method of Partial Fractions, convolution Theorem. 4.7 Applications of Laplace transform to solve linear differential equations	
Unit 5	**Fourier Series**	
	5.1 Introduction. 5.2 Euler's Formulae. 5.3Conditions for a Fourier expansion. 5.4 Functions having points of discontinuity 5.5 Change of interval 5.6 Expansion of odd or even periodic functions 5.7 Half range series.	

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Unit 6	Partial Differential Equations and its Application	07Hrs
	6.1 Introduction –Formation of partial differential equations 6.2 linear equation of the first order (Lagrange's equation) 6.3 Method of separation of variables 6.4 Vibration of a stretched string, one dimensional wave equation (using separation of variables) 6.5 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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List of Tutorials		
Sr. No	**Title of Tutorial**	**Contact Hrs**
01.	Vector Differential Calculus - gradient, directional derivative, Divergence and curl	01 Hr
02.	Vector Differential Calculus - Line integral, Green's theorem in the plane	01 Hr
03.	Linear Differential Equations – Solution of linear differential equation f(D) = X where a. $X = e^{ax}$, b. $X = \sin(ax+b)$ *or* $\cos(ax+b)$ c. $X = x^m$. d. $X = e^{ax}$V, whereV is a function of x .	01 Hr
04.	Linear Differential Equations - – Solution of linear differential equation f(D) = X where a. When X is any other function of x. b. Cauchy's homogeneous linear differential equations.	01 Hr
05.	Applications Linear Differential Equations - Oscillations of a spring a. Free oscillations b. Damped Oscillations	01 Hr
06.	Applications Linear Differential Equations – a. Forced oscillations without damping. b. The Whirling of Shafts.	01 Hr
07.	Fourier Series - Euler's Formulae, Conditions for a Fourier expansion, Change of interval	01 Hr
08.	Fourier Series - Expansion of odd or even periodic functions, Half range series.	01 Hr
09.	Laplace Transform	01 Hr
10.	Inverse Laplace Transform	01 Hr
11.	Partial Differential Equations	01 Hr
12	Applications of Partial Differential Equations	01 Hr

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEPC202: Applied Thermodynamics
Prerequisite/s	OBSES 111 - Basic Mechanical Engineering
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Impart throw knowledge on various physical quantities, measuring techniques and their units.
2	Introduce the laws of thermodynamics and applications associated with them & make students to solve application problems related to laws of thermodynamics.
3	Introduce the various power cycles and refrigeration cycle and applications associated with them & make students to solve application problems related thermodynamics cycles.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC202_1	Explain the basic physical quantities & their Units, principles of thermodynamics such as systems, properties, and thermodynamics laws. (K^2)
0AEPC202_2	Explain the concept of Entropy & its significance in the irreversible & reversible process. (K^2)
0AEPC202_3	Apply the First Law of Thermodynamics to solve problems related to the Flow & Non Flow Processes. (K^3)
0AEPC202_4	Explain the Fundamentals of combustion process, form the balanced combustion equation and calculate the heat released from the combustion process. (K^3)
0AEPC202_5	Apply the Second Law of Thermodynamics to solve problems related to thermodynamic cycles (K^3)
0AEPC202_6	Solve the problems based on the air standard cycles such as Otto cycle, Diesel and Brayton cycle, etc. (K^3)

Course Contents:
Unit 1: Definitions & Concepts
Fundamentals units. Derived units (SI units) systems, properties, energy, thermodynamic equilibrium work, state postulate, Zeroth law of thermodynamics, temperature scale; pure substance, ideal gas law, van der wall equation, numerical on steam table and mollier chart
Total Hours: 7

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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.
Total Hours: 7
Unit 3: Fundamentals of Combustion
Introduction, classification of flames, Flammability limits, Global Reaction Rate Theory, Laminar Premixed Flames – Factors influencing Laminar Flame Speed , Laminar Diffusion Flames, Turbulent Premixed Flames, Flame Propagation in Heterogeneous Mixtures of Fuel drops, Fuel vapor, and Air, Droplet and Spray Evaporation, Ignition Theory – Gaseous Mixtures, Heterogeneous Mixtures, Spontaneous Ignition, Flashback, Stoichiometry, Adiabatic Flame Temperature, Factors Influencing the Adiabatic Flame Temperature
Total Hours: 8
Unit 4: 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.
Total Hours: 6
Unit 5: Entropy
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.
Total Hours: 7
Unit 6: 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.
Total Hours: 7

Text Books

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

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Reference Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	A Textbook of Refrigeration and Air Conditioning	R. K Rajput	S. K. Kataria and Sons,2012	2nd	2012
2	Fundamentals of combustion processes	Sara McAllister, Jyh-Yuan Chen, A. Carlos Fernandez-Pello,	Springer Science & Business Media	-	2011
3	Fundamentals of Engineering Thermodynamics	E. Radhakrishnan	PHI	2nd	-
4	Principles of Engineering Thermodynamics	Moran, Shapiro , Boettner , Bailey	Wiley	8th	2015
5	Advanced Engineering Thermodynamics	Adrian Bejan	Wiley	3rd	2006

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEPC203, Fluid Mechanics
Prerequisite/s	0BSES110 – Engineering Mechanics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to make students able to	
1	Explain the fluid properties, flow characteristics & their applications to the field of Aeronautical Engineering.
2	Solve problems of the internal & external fluid flow over the solid boundary & to calculate the forces acting upon.
3	Explain the working principles of various categories of fluid machinery
4	Explain the basic concepts of the computational fluid dynamics.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC203_1	Explain the fluid properties, their definitions & SI units. (K^2)
0AEPC203_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)
0AEPC203_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)
0AEPC203_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)
0AEPC203_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)
0AEPC203_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)
0AEPC203_7	Determine the lift & drag forces on the bodies like flat plate, cylinder & aerofoil and comment on the comparative study. (K^4)

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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 & Vapour 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.
Total Hours: 06
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 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.
Total Hours: 06
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.
Total Hours: 08
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 Aerofoil & Pressure distribution.
Total Hours: 08
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
Total Hours: 08
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
Total Hours: 06

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Text Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Fluid Mechanics (SIE)	Yunus A. Cengel, John M. Cimbala	McGraw Hill Education (India) Private Limited, New Delhi	3rd Edition	2016
2	Introduction to Fluid Mechanics & Fluid Machines	S K Som, Gautam Biswas, Suman Chakraborthy	Tata McGraw-Hill, New Delhi	3rd	2012
3	Fluid Mechanics	Kumar, K.L	Tata McGraw-Hill, New Delhi	2nd Edition	2000

Reference Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Introduction to Fluid Mechanics	Robert W. Fox and Alan T. McDonald	Wiley and Sons, Inc	5th Edition	1998
2	Textbook of Fluid Mechanics and Hydraulic Machines	R K Bansal	Laxmi Publications (P) Ltd.	9th Edition	2017
3	Vectors, Tensors and the Basic Equations of Fluid Mechanics	Rutherford Aris	Dover Publications, Inc	New Edition	1990
4	Fluid Mechanics	Frank M. White	McGraw-Hill Professional	SIE	2011
5	Turbomachinery – Theory & Design	Gorla & Khan	Taylor & Francis India Pvt Ltd - New Delhi	HRD	2003

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEPC204 & Solid Mechanics
Prerequisite/s	0BSES 110 Engineering Mechanics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to develop an ability to	
1	Explain basic concept of stress, strain, transformation of stress/strain and strength of materials.
2	Calculate shear forces, bending moments, deflections and stresses in the beams due to different loading conditions.
3	Explain the concept of torsion and shear stresses in shafts.
4	Explain the concept of buckling of simple columns subjected to various boundary conditions.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC204_1	Describe basic concept of stress, strain, transformation of stress/strain and strength of materials. (K^2)
0AEPC204_2	Calculate the shear forces and bending moment variation for different beams and loads and draw shear force and bending moment diagram. (K^3)
0AEPC204_3	Calculate the bending and shear stresses in beams for different sections. (K^3)
0AEPC204_4	Calculate the deflection of beams under the different end conditions & loading conditions. (K^3)
0AEPC204_5	Explain the concept of torsion and apply it for design of power transmission shaft. (K^4)
0AEPC204_6	Describe and Analyze the buckling in columns. (K^4)

Course Contents:
Unit 1 Simple stresses and strains
Concept of stress and strain, Normal stress under axial loading, Direct and shear stress, bearing stress, stress on an oblique plane under axial loading,. Thermal Stresses, Concept of strain: Normal strain, shear strain and thermal strain, Elastic Limit, Hooke's Law, stress-strain diagrams, Poisson's Ratio, Modulus of elasticity, Bulk Modulus, Modulus of Rigidity. Composite Bars. Stresses in thin-walled pressure vessel.
Total Hours: 08

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Unit 2 Transformation of stresses
Transformation of stresses, Principal Stresses, Mohr's Stress Circle, Theories of failure-Maximum principal stress theory, maximum shear stress theory, maximum strain theory, maximum strain energy theory and maximum shear strain energy theory.
Total Hours: 06
Unit 3 Shearing Force and Bending Moment
Shearing Force and Bending Moment: Diagram for simply supported Beam, Cantilevers, with concentrated, uniformly distributed and variable loads. Castigliano's theorems, unit load method.
Total Hours:07
Unit 4 Bending and Shear stresses in Beams
Pure Bending: Deformation in a transverse cross-section, derivation of formula for bending stresses. Section modulus of rectangular 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.
Total Hours: 06
Unit 5 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.
Total Hours: 05
Unit 6 Buckling & Torsion in Shafts
A)Columns Buckling, Euler formula for pin-ended columns and its extension to columns with other end conditions. Rankine Gordon formula. **B) Torsion** Torsion: Deformation in a circular shaft, angle of twist, stresses due to torsion, derivation of torsion formula, torsion in composite shafts.
Total Hours: 08

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Strength of Materials	S. Ramamrutham R. Narayanan	Dhanpat Rai Publishing Co.	18th	2011
2	Mechanics of Materials	Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain	Laxmi Publications Pvt. Ltd.	Revised	2017
3	A Textbook of strength of materials	Dr. R. K. Bansal,	Laxmi Publications Pvt. Ltd.	6th	2017

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Reference Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Mechanics of Materials	E P Papov	PHI Learning Pvt Ltd.	2nd	1999
2	Mechanics of Materials	F. B. Beer, E.R. Johnston & J T Dewolf	Tata McGraw Hill	-	2008
3	Aircraft Structures for Engineering Students	T H G Megson	Elsevier	5th	-
4	Advanced Mechanics of Solids	L S Srinath	Tata McGraw Hill	3rd	2011
5	Elements of Strength of Materials	Timoshenko	East West	-	2003

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEPC205, Introduction to Aerospace Engineering
Prerequisite/s	---
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Explain the students historical developments in the Aeronautical Engineering & Current Trends
2	Make student understand the basic components, systems & subsystems of the Aircraft and their functions
3	Provide students the fundamental knowledge on the Verticals of Aeronautical Engineering – Aerodynamics, Propulsion, & Structures
4	Explain the students the basics of Air Transportation & Airport Operations

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC205_1	Explain the historical developments in the Aeronautical Engineering, Current Trends in the Aviation Industry (K^2)
0AEPC205_2	Comment & Explain in detail the basic components, systems & subsystems of the Aircraft and their functions (K^2)
0AEPC205_3	Explain the fundamentals of Aerodynamics, Propulsion, Structures & Their classifications (K^2)
0AEPC205_4	Comment & Explain in detail the basics of Air Transportation & Airport Operations & the Components of the Flight Deck Instruments & Systems (K^2)
0AEPC205_5	Comment & Explain on the material requirements for the Aeronautical applications (K^2)
0AEPC205_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
Total Hours: 06

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Unit 2: Aerodynamics of Fixed Wing Aircraft
International Standard Atmosphere, Layers of Atmosphere, Pressure, Density & Temperature Variation with altitude, Calculations of the Stratosphere, Calculations of Troposphere, Introduction to Aerodynamic Forces(Lift & Drag), Types of Lift & Drag Forces, Types of Weight & Thrust Forces, Aerofoils – Nomenclature & Types, NACA Series, Pressure Distribution around an 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
Total Hours: 08
Unit 3: Propulsive Systems for Flight Vehicles
Development of Propulsive Technologies, Air Breathing Propulsion, The Basic Thrust Equation for Air Breathing Propulsion, Piston Engines & Propellers, Jet Engines, Turbo Jet, Turbo Fan, Turbo Prop, Turbo Shaft, Ramjet, Scramjet, Their propulsive efficiency & specific impulse, Non-Air Breathing Propulsion Rocket Propulsion The Basic Thrust Equation for Non-Air Breathing Propulsion
Total Hours: 06
Unit 4: Materials & 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
Total Hours: 08
Unit 5: Flight Control Systems
Primary & Secondary Control Systems, Elevator, Rudder, Aileron, Flaps, Trim-Tabs, Slats, Conventional Control Systems (Push-Pull Rod & Bell Crank Lever type), Fly-By-Wire & Fly-By-Signal Systems, Steady Level Flight Equations, Introductory Idea on Aircraft Performance & Stability.
Total Hours: 08
Unit 6: Flight Deck Instruments & Aircraft Systems
Basic Instrument Panel in the Aircraft Flight Deck, Altimeters, Airspeed Indicators, Vertical Airspeed Indicator, Temperature Measuring Instruments, Gyroscopic Instruments, Direction Indicating Instruments Engine Instruments, Fuel Quantity & Fuel Flow Indicting Systems, Stall Warning & AOA Indication System, Navigation System, Communication System, Analog & Digital Cockpit, Aircraft Electrical System, Hydraulic & Pneumatic System, Fuel System & Their Functions
Total Hours: 06

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Introduction to Flight	Anderson, J.D	McGraw-Hill	7th	2011
2	Aerodynamics, Aeronautics and Flight Mechanics	McCormick, B.W.	John Wiley	2nd	1995
3	Gas Turbines and Jet and Rocket Propulsion	Mathur M L and Sharma R P	Standard Publisher	3rd	2014
4	Aircraft Structures for Engineering Students	Megson, T.H.G	Elsevier	4th	2007
5	Aircraft Instruments	EHJ Pallett	Pearson	2nd	2017

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Reference Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Introduction to Aerospace Engineering with a Flight Test Perspective	Stephen Corda	Wiley	1st	2011
2	Aviation. An Introduction to the Elements of Flight	Algernon Edward Berriman	Nabu Press	1st	2010
3	Aircraft Propulsion and Gas Turbine Engines	Ahmed F El-Sayed	Taylor and Francis	2nd	-
4	Experiments in Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2010
5	Aircraft Communication & Navigation System	Mike Tooley & David Wyatt	Routledge (SIE)	1st	2007

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEES251, Computer Programing with C++
Prerequisite/s	0BSES112 - Computer Programming 0BSES161 – Computer Programming Laboratory
Teaching Scheme: Lecture/Tutorial	02/02
Credits	03
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to	
1	Make students understand the concepts of Object Oriented Programing concepts using C++ Programing language. & Apply them for solving the simple cases of computing problems.
2	Impart the skill of programing the engineering problems
3	Make students recognize the importance of scientific computing using programing languages.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEES251_1	Explain the concepts of object oriented programming concepts using C++. (K^2)
0AEES251_2	Apply their knowledge and programming skills to solve various computing problems (K^3)
0AEES251_3	Write a C++ program for the simple cases. (S^3)
0AEES251_4	Execute & Debug the C++ program for the simple cases for the Syntax & Logical Error (S^3)
0AEES251_5	Follow professional and ethical principles, standards while writing the C++ Codes (A^2)
0AEES251_6	Recognize the need for learning the Programming Language for solving complex Problems related to Engineering. (A^3)

Course Contents:

Unit 1: Introduction & Basic Programing using C++
Brief History, Applications of Programing Languages, C++ Basic Syntax, Compiling & Execution of a C++ Program, Comments in the C++
Total Hours: 03
Unit 2: C++Data Types & Variables
Data Types - Primitive Built-in Data Types, Data Type Modifiers, typedef Declarations, Enumerated Types Variables - Variable Definition, Variable Declaration, Variable Scope (Local & Global Variables), Variable Initialization, Constants/Literals, Storage Class Specifies Math Operations in C++, C++ Time & Date
Total Hours: 05

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Unit 3: Decision Making & Looping in C++
Decision Making – The ? : Operator, if Statement, if... else Statement, Nested if... else Statement, switch Statement, Nested switch Statement Loop Control Statement - while loop, for loop, do... while loop, Nested loops, break, continue & goto Statements
Total Hours: 04
Unit 4: Functions & User Defined Data Structures
C++ Functions, - Defining a function, Function declaration, Calling a function, Function Argument Arrays, Strings, Pointers
Total Hours: 04
Unit 5: Data Structures & Object Oriented Programing
Data Structures in C++ - Defining a Structure, Accessing a Structure Member, Structure as Function Argument, Pointers to Structures, The typedef Keyword Classes & Objects – Inheritance, Polymorphism, Encapsulation
Total Hours: 04
Unit 6: Files, Streams & Data Handling
Files & Streams - Opening a File, Closing a File, Writing to a File, Reading From a File Exception Handling, Dynamic Memory
Total Hours: 04

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	The C++ Programing Language	Bjarane Strustrup	Pearson	3rd	2000
2	Object Oriented Programing using C++	E Balaguruswamy	Tata McGraw Hill	6th	2001
3	Computer Concepts and Programming in C++	RS Salaria	Khanna Book Publishing	1st	2016
4	Advanced Objected-Oriented Programming Using C++	RS Salaria	Khanna Book Publishing	1st	2014

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	https://www.tutorialspoint.com/cplusplus/index.htm	Tutorials Point	Web Reference		
2	Guide to Scientific Computing in C++	Joe Pitt-Francis, Jonathan Whiteley	Springer	1st	2012
3	Numerical Analysis With Algorithms And Computer Programs In C++	Ajay Wadhwa	PHI	-	2012
4	Advanced C and C++ Compiling	Stevanovic Milan	Apress	-	2007

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Course Details:

Class	B. Tech, Sem.-III
Course Code and Course Title	0AEPC252,Applied Thermodynamics Laboratory
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The aim of the course is to	
1	Demonstrate the experimental process to calculate properties of lubricants.
2	Demonstrate working and calculation of efficiency of an air compressor.
3	Demonstrate the process to evaluate the calorific value of any given substance.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC252_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)
0AEPC252_2	Evaluate the isothermal efficiency and volumetric efficiency of an air compressor. (K^3)
0AEPC252_3	Evaluate the calorific value of any given substance. (K^3)
0AEPC252_4	Perform the experiments in a group as a leader as well as a member. (S^2)
0AEPC252_5	Communicate the results and write the report effectively. (S^3)
0AEPC252_6	Pursue professional and ethical principles during laboratory work. (A^3)

Course Contents:

Experiment List	
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.-III
Course Code and Course Title	0AEPC253, Fluid Mechanics Laboratory
Prerequisite/s	0BSES110 – Engineering Mechanics 0BSES159 - Engineering Mechanics Laboratory
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Teach the methods & Techniques that are used for the measurement of fluid properties
2	Explain the verification of the Mathematical Equations of the Fluid Mechanics using Experimental methods
3	Make students use of wind tunnel & load cell system to measure forces acting on the bodies
4	Demonstrate the Fluid Machinery to carry out the performance study

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC253_1	Apply the basic fluid mechanics principles for determining the fluid & flow characteristics using the measuring instruments. (K^3)
0AEPC253_2	Determine the forces acting on the bodies due to fluid flow over them using the Wind Tunnel (K^3)
0AEPC253_3	Verify the fluid mechanics laws using the experimental methods (K^3)
0AEPC253_4	Carry out the Performance study of the Fluid Machinery (K^3)
0AEPC253_5	Effectively record the results and analyze them to provide a conclusion. (S^3)
0AEPC253_6	Learn the best & effective practices for carrying out the experimentation. (S^3)
0AEPC253_7	Follow the professional practices like mainlining a laboratory journal and completion of work on time. (A^3)

Course Contents:

Experiment List	
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

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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 the Flow over a Aerofoil (Model Preparation using Similarity Laws)
7	Determination of the Coefficient of Discharge of the given Venturimeter
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, Sem.-III
Course Code and Course Title	0AEPC254 & Solid Mechanics Laboratory
Prerequisite/s	0BSBS 101 Applied Physics 0BSES 110 Engineering Mechanics
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Make students to measure the stress & strain acting over the structures using the experimental methods
2	Explain the procedures to carry out different experiments in Solid mechanics subject and observe/record/study properties of materials

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC254_1	Explain the behavior of the materials under tension, compression, bending and torsion loading conditions. (K^2)
0AEPC254_2	Calculate the stresses and strains induced in the bodies under the given loading condition. (K^3)
0AEPC254_3	Effectively carry out the experiment and record the results, analyze them to provide a conclusion. (S^3)
0AEPC254_4	Learn the best & effective practices for carrying out the experimentation. (A^2)

Course Content

Experiment List	
1	Direct Tension Test
2	Bending Test on a) Simply Supported Beam b) Cantilever Beam
3	Torsion Test
4	Test on Springs
5	Compression Test on Cube
6	Buckling of Columns with Various End Supports
7	Test on Thin Walled Shells
8	Non Destructive Testing of the Material using Ultra Sound Waves

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Course Details:

Class	S.Y. B. Tech, Sem.-III
Course Code and Course Title	0AEPC255, Aircraft Component Drawing
Prerequisite/s	0BSES105 - Engineering Graphics
Teaching Scheme: Lecture/Tutorial	00/02/00 Per Week
Credits	1
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to	
1	Make students familiarize with the BIS conventions used in machine drawing
2	Understand the functions of various machine components
3	Make students draft simple Aircraft components & assemble the with help of CAD software

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC255_1	Identify different types of conventions, sectional views and simple machine components in the given drawing. (K^2)
0AEPC255_2	Draw the Engineering Drawing on the Sheet with standard procedures (S^3)
0AEPC255_3	Use the CAD Tools to prepare the Detailed Drawing of the Engineering (S^3)
0AEPC255_4	Communicate effectively about laboratory work both orally and in drawing sheets. (S^3)
0AEPC255_5	Follow professional and ethical principles during lab work. (A^2)

Course Content

Experiment List	
1	Drawing sheet on Conventions, sections, Dimensioning
2	Drawing sheet on Limits, Fits, Tolerances
3	Freehand drawing sheet on welded & riveted joints
4	Detailed view of structural components of typical aircraft
5	Isometric 3 D projections Views of typical aircraft assembly
6	Computer aided drafting of Aerofoil – 2D drawing and print out of same
7	Computer aided drafting of four simple components and print out of the same
8	One assignment on drawing of ribs & fuselage modeling
9	One assignment on drafting of one simple component and plotting its details

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Text Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Machine Drawing	K.L .Narayana, P.Kannaiahand K. Venkata Reddy	New Age International Publishers, Mumbai	2nd	2002
2	Air Craft Structures	Bruhn.E.H	New Age International Publishers	-	-
3	Machine Drawing	P.S. Gill	S.K. Kataria and Sons Delhi.	7th	2008
4	Fundamentals of Engineering Drawing	Sadhu Singhand P.L.Sah	Prentice-Hall India, New Delhi	11th	2003

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S.Y. B. Tech Aeronautical Engineering: IV Semester
Teaching and Evaluation Scheme

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	C	Scheme	Theory Marks		Practical Marks	
							Max.	Min. for passing	Max.	Min. for passing
0AEBS206	Numerical Analysis	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC207	Aircraft Production Technology	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC208	Aircraft Materials	3	-	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC209	Aerodynamics I	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC210	Propulsion- I	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEHS211	Environmental Studies	2	--	--	--	ISE	50	Grade	--	--
									--	--
0AEES256	Numerical Analysis using Programming Language	--	--	2	1	ISE	--	--	25	10
0AEPC257	Aircraft Production Technology Laboratory	--	--	2	1	ISE	--	--	50	20
0AEPC258	Aircraft Materials Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC259	Aerodynamics I Laboratory	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC260	Propulsion I Laboratory	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
Total		**17**	**3**	**10**	**23**		**500**		**300**	
Total Contact Hours/ Week=30						**Total Marks=800**				

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	---	3	1	18	--	--	--	--	--
Cumulative Sum	3	22	33	37	--	--	--	--	--

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEBS206 – Numerical Analysis
Prerequisite/s	0AEBS201 – Applied Mathematics III
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce numerical methods for solving linear and non-linear equations
2	Apply the knowledge of these methods to solve practical problems with suitable software.
3	Introduce numerical methods for evaluating definite integrals & Differential equations

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEBS206_1	Analyze the errors and perform the curve fitting & the statistical analysis of the experimental data generated. (K^3)
0AEBS206_2	Solve the mathematical problems involving the algebraic & Transcendal equations (K^3)
0AEBS206_3	Provide solutions for the mathematical problems involving the Linear simultaneous equations (K^3)
0AEBS206_4	Solve the mathematical problems involving the Numerical Integration & Differentiation (K^3)
0AEBS206_5	Obtain the the solutions of Ordinary & Partial Differential Equations with the give 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, Languages interpolating polynomial **Statistics:** Mean and standard deviation, Addition and multiplication laws, Probabilities, Binomial, Poisson and normal distribution
Total Hours: 07
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
Total Hours: 07

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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 Seidal Iteration Method
Total Hours: 07
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 unequally spaced data, Forward difference, Central difference, Backward difference
Total Hours: 07
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.
Total Hours: 07
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.
Total Hours: 07

Text Books

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

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Numerical Methods	E Balguruswamy	Tata McGraw Hill	9th	2002
2	Computer Based Numerical Methods and Statistical Techniques	P. K. De	CBS Publisher	1st	2006
3	Numerical Methods For Engineering	Chapra	Tata Mcgraw Hill Education	5th	2007
4	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI Learning	5th	2012

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC207, Aircraft Production Technology
Prerequisite/s	0BSES111 - Basic Mechanical Engineering
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce the various machining Process involved in manufacturing of component's
2	Explain the principles of Casting, Machining ,Joining and Forming
3	Make students familiarize with Aircraft assembly and Inspection

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC207_1	Describe the technique of manufacturing different parts of aircraft like Casting, Joining, shaping and forming (K^2)
0AEPC207_2	Take a decision on manufacturing technique for manufacturing given components (K^3)
0AEPC207_3	Explain the concept of NDT Used to check the quality of Manufactured Product (K^2)
0AEPC207_4	Comment on the advanced manufacturing technologies used in the Aircraft component Production (K^2)

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.

Total Hours: 06

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, electron beam welding, laser beam welding, defects in welding, soldering and brazing.

Total Hours: 06

Unit 3 MACHINING

General principles and working of **Conventional** machining: Lathe, Shaper, Planer, Milling machine, Drilling machine, Grinding machine and its Types.
General principles and working of **Non-Conventional** machining: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, Electron beam machining and Laser beam machining. Development of **CNC** machines. Principles and operations of CNC Milling and Lathe

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	Total Hours: 13
Unit 4	**FORMING AND SHAPING OF PLASTICS**
Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of Injection moulding - Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermo sets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods	
	Total Hours: 07
Unit 5	**METAL FORMING AND POWDER METALLURGY**
Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning, Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy	
	Total Hours: 05
Unit 6	**ADVANCED MANUFACTUNG TECHNIQUIES**
Computer Integrated Manufacturing, the use of CAD/CAM and computers in manufacturing, Electric Discharge Machining, Water Jet Machining, Introduction to Additive Manufacturing Techniques.	
	Total Hours: 05

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Production technology: Manufacturing Processes, Technology And Automation	R K Jain	Khanna publishers	17th	2014
2	Advanced Manufacturing Technology	David L. Goetsch	Delmar Cengage Learning	-	1989
3	Production Technology (Manufacturing Processes)	P. C. Sharma	Schand	-	2006

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Manufacturing Process	Rajeev Kumar, Maheshwar Dayal Gupta	PHI learning Private Limited	-	2014
2	Aircraft Maintenance and Repair	Michael J Kroes, William A Watkins, Frank Delp, Ronald Sterkenburg	Mc Graw Hill Education	7th	2014
3	Handbook of Advanced Composite & Polymers Manufacturing	Gerrard Brison	Auris Reference Limited	1st	2014

Course Details:

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Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC208 & Aircraft Materials
Prerequisite/s	0BSBS 101 Applied Physics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce basic concepts of crystallography and crystal defects
2	Describe mechanical behavior of different materials under different loading conditions.
3	Explain phase diagram and its use.
4	Explain materials used in aircraft construction
5	Explain the changes in properties and microstructure of alloys using heat treatment processes.
6	Introduce composite materials and its types.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC208_1	Describe the basic concepts of crystallography and crystal defects (K^2)
0AEPC208_2	Describe mechanical behavior of different materials under different loading conditions. (K^2)
0AEPC208_3	Explain different phase diagrams, predict and calculate amount of phases using the phase diagram. (K^3)
0AEPC208_4	Explain use and effect of different heat treatment processes. (K^2)
0AEPC208_5	Explain composition, properties and use of different materials used in aircraft construction. (K^2)
0AEPC208_6	Explain the composite materials, their types and applications. (K^2)

Course Contents:

Unit 1 Introduction To Materials Science And Engineering

Materials classification, Atomic structure and bonding, Primary Secondary bonding-Ionic, metallic, covalent, hydrogen-bonding, Crystallography - SC,FCC,BCC,HCP structures, APF-Miller indices, miller bravais indices, Polymorphism, Imperfections in crystals- point defects, line defects, surface defects

Total Hours: 04

Unit 2 Mechanical Behavior Of Materials

Elastic, visco-elastic, inelastic behavior- Stress and Strain Curves, Plastic Deformation of Metals and Alloys, Mechanisms of plastic deformation, role of Dislocation; slip and twinning- Schmids law, Strengthening mechanisms, grain size reduction, solid solution strengthening, Work hardening, recovery recrystallization and grain growth, Fracture- ductile fracture, brittle fracture, fracture toughness, Fatigue-s-n curve- creep- creep curve.

Total Hours: 06

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Unit 3 Phase Diagram &Heat Treatment
A) Phase Diagram - Solidification of metals and of some typical alloys- Mechanism of crystallization, Nuclear formation, Crystal growth, Hume-Rothery rule of solid solubility, Phase rule and equilibrium diagrams, Equilibrium diagram- Binary isomorphous alloy system, Eutectic System, Partially Eutectic system (Binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature) and also alloy with a peritectic transformation. Equilibrium diagram of a system whose components are subject to allotropic change. Iron carbon Equilibrium diagram, Phase transformation in the iron carbon diagram, Formation of Austenite, Transformation of austenite into pearlite, Martensite transformation in steel, TTT curves. **B) Heat Treatment -** Heat treatment of steels- Annealing, Normalizing, Hardening, Tempering, Chemical heat treatments- Carburizing, Nitriding, Carbo-nitriding, Cyaniding, Hardenability, Jominy test.
Total Hours: 12
Unit 4 Materials In Aircraft Construction
Aluminium and its alloys: Types and identification. Properties - Castings - Heat treatment processes- Surface treatments. Magnesium and its alloys: Cast and Wrought alloys - Aircraft application, features specification, fabrication problems, Special treatments. Titanium and its alloys: Applications, machining, forming, welding and heat treatment. Steels: Plain and low carbon steels, various low alloy steels, aircraft steel specifications , corrosion and heat resistant steels, structural applications. Maraging Steels: Properties and Applications, Copper Alloys - Monel, K Monel, Super Alloys: Use - Nickel base - Cobalt base - Iron base - Forging and Casting of Super alloys - Welding, Heat treatment.
Total Hours: 12
Unit 5 Composites
Introduction to Composite Materials; Classification of composites (based on matrix, reinforcements etc.), Types of materials (Isotropic, Orthotropic, Anisotropic; Homogeneous and Non-Homogeneous) and terminology used. Sandwich and honeycomb structures.
Total Hours: 08
Unit 6 Advanced Materials
Smart Materials & Its Types, Nano Composites, Ceramics.
Total Hours: 04

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Material science	O P Khanna	DhanpatRai	4th	2012
2	Material Science and Metallurgy For Engineers	V.D.Kodgire	Everest Publishers,Pune,	12th	2011
3	Material Science and Engineering	W.D.Callister	Wiley India Pvt. Ltd	05th	2014
4	Mechanics of Composite Materials	Jones, R.M	McGraw-Hill, KogakushaLtd.,Tokyo	02nd	1998

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition

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Reference Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Aircraft Material & Process	Titterton	Pitman Pub	1st	2004
2	Advanced Composite Materials	Lalith Gupta	Himalaya Book House, Delhi	3rd	2006
3	Aircraft Materials and Analysis	Tariq Siddiqui	McGraw-Hill Education	1st	2015
4	Composite Materials for Aircraft Structures	Allen Baker & Murray L. Scott	AIAA	3rd	2016

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC209 – Aerodynamics I
Prerequisite/s	0AEPC203 - Fluid Mechanics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce the concepts of Aerodynamics to the Students of Aeronautical Engineering
2	Explain the students in detail the governing equations of aerodynamics & their characteristics
3	Explain the students the numerical concept the Lift & Drag acting over different profiles.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC209_1	Explain the Fluid properties, & their Governing Equations in various forms. (K^2)
0AEPC209_2	Apply the basics of Fluid Mechanics to derive the Lift & Drag equations acting over the bodies. (K^3)
0AEPC209_3	Calculate the Lift Force Coefficient & Lift Distribution over the Finite Wing of an Aircraft (K^3)
0AEPC209_4	Calculate the Induced & Skin Friction Drag over the Finite Wings & explain the Flow control techniques to control the boundary layer (K^3)
0AEPC209_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.
Total Hours: 08
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.
Total Hours: 10
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.
Total Hours: 10

Unit 4: Finite Wing Theory
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.

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC209 – Aerodynamics I
Prerequisite/s	0AEPC203 - Fluid Mechanics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce the concepts of Aerodynamics to the Students of Aeronautical Engineering
2	Explain the students in detail the governing equations of aerodynamics & their characteristics
3	Explain the students to calculate the Lift & Drag acting over the Fixed Wing & Rotating Wing

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC209_1	Explain the Fluid properties, & their Governing Equations in the Integra Form (K^2)
0AEPC209_2	Apply the basics of Fluid Mechanics to derive the Lift & Drag Equations acting over the bodies. (K^3)
0AEPC209_3	Calculate the Lift Force Coefficient & Lift Distribution over the Finite Wing of an Aircraft (K^3)
0AEPC209_4	Calculate the Induced & Skin Friction Drag over the Finite Wings & Comment on the Flow control techniques to control the boundary layer (K^3)
0AEPC209_5	Explain & Determine the Thrust & Thrust Coeffienct 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,(Integral Form), Vorticity & Circulation, Substantial & Total Derivative, Angular Velocity, Vorticity, Strain & Circulation
Total Hours: 08
Unit 2: Potential Flow Theory
Basics, The Stream Function & Stream Line, The Velocity Potential Function & Equipotential Line, Relationship between the Stream Function & Velocity Potential Function, Fundamental Imaginary Flows Uniform Flow, Source Flow, Sink Flow, Vortex Flow. Superimposed Flows, Source-Sink Pair, Doublet Source-Sink Pair in Uniform Flow, Doublet in Uniform Flow, Spinning Cylinder in Uniform Flow
Total Hours: 10
Unit 3: 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, Computational Methods – Turbulent Methods

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Maximum Lift for Single Element Aerofoil, Multi Element Aerofoil, Boundary Layer Control Methods Reduction in Skin Friction Drag, Form Drag & Induced Drag
Total Hours: 10

Unit 4: Two-Dimensional Wing Theory
Kutta-Zhukovsky Theorem, Kelvin's Circulation Theorem & Staring Vortex, The Kutta Condition, The General Thin Aerofoil Theory, The Symmetrical Aerofoil, The Cambered Aerofoil, Solution of the Thin Flat Plate & Aerofoil, The Flapped Aerofoil, Normal Force & Pitching Moment Derivatives, Super-Critical Aerofoils
Total Hours: 10
Unit 5: Finite Wing Theory
The Downwash & Induced Drag, The Vortex Filament & Horse Shoe Vortex, Helmholtz's Theorem, The Biot-Savrat Law, The Prandtl's Classical Lifting Line Theory, Effect of Aspect Ratio, The Lifting Surface Theory, The General Lift Distribution(Elliptical), Ground Effect on Wings, Swept & Delta Wing Aerodynamics, Introduction to Morphing Wing Aerodynamics
Total Hours: 10
Unit 6: Flow Past Non-Lifting Bodies and Interference Effects
Flow past non-lifting bodies, method of singularities; Wing-body interference; Effect of propeller on wings and bodies and tail unit; Flow over airplane as a whole.
Total Hours: 08

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Aerodynamics for Engineering Students	E. L. Houghton, P W Carpenter, S. H. Collicott & D. T. Valentile	Butterworth – Heinemann (Elsevier)	6th	2013
2	Fundamentals of Aerodynamics	J D Anderson	Mc Graw Hill	5th (SIE)	2010
3	Aerodynamics	L J Clancy	Shroff Pubs& Dists Pvt. Ltd.	1st	2006

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Aerodynamics, Aeronautics & Flight Mechanics	B W McCromick	Wiley	2nd	2015
2	Fundamentals of Modren Compressible Flow	S M Yahya	New Age	5th	2016
3	Experiments In Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2012
4	Applied Aerodynamics	Leonard Bairstow	Nabu Press	-	2011
5	Aerodynamics of the Airplane	Schlitching, H., and Tuckenbroke, E	Mc Graw Hill	2nd	1979

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC210, Propulsion-I
Prerequisite/s	0AEPC202- Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	4
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce of various aircraft propulsive(Air breathing) engines and their working principle in detail
2	Explain in detail the various components of engines, their purpose with design considerations
3	Introduce of various propulsive devices of hybrid configurations and Non Air breathing engines

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC210_1	Differentiate and explain the working principle of air breathing and non-air breathing engines. (K^2)
0AEPC210_2	Distinguish and explain the intakes and exhaust systems and gas turbine combustions used in aircrafts. (K^2)
0AEPC210_3	Apply control volume analysis and the integral momentum equation to estimate the forces produced by Aircraft Propulsion systems (K^3)
0AEPC210_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)
0AEPC210_5	Use velocity triangles to estimate the performance of a compressor or turbine stage (K^3)
0AEPC210_6	Comment of the factors that affect combustion process and design factors of combustion chamber. (K^2)

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.

Total Hours: 07

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.

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	Total Hours: 07
Unit 3: COMPRESSORS	
Principle of operation of centrifugal compressor - Work done and pressure rise - Velocity diagrams - Diffuser vane design considerations - Concept of prewhirl - 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 blade design - Centrifugal and Axial compressor performance characteristics.	
	Total Hours: 07
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	
	Total Hours: 06
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	
	Total Hours: 08
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	
	Total Hours: 07

Text Books

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

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Elements of gas turbine propulsion	J D Mattingly	Mc Graw Hill Edu-Europe	3rd	2005
2	Gas Turbine Propulsion Systems	Bernie MacIsaac & Roy Langton	John Wiley & Sons	-	-
3	Gas Turbines And Jet Rocket Propulsion	V.M. Domkundwar	Dhanpat Rai & Co.	2nd	2013
4	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	0AEES256 – Numerical Analysis using Programming Language
Prerequisite/s	0AEBS206 – Numerical Analysis
Teaching Scheme: Lecture/Tutorial	02/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Introduce numerical methods for solving linear and non-linear equations
2	Apply the knowledge of these methods to solve practical problems with suitable software.
3	Introduce numerical methods for evaluating definite integrals & Differential equations
4	Impart the skill of solving the ODE & PDE Equations using the computer program

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEES256_1	Apply the Numerical Methods/Techniques for find the solutions of simple problems using the computer programs. (K^3)
0AEES256_2	Write Algorithms and Programs for find the solutions of the problems with the knowledge of numerical methods. (K^3, S^3)
0AEES256_3	Debug the programs written in programming language for any syntax and logical errors in the code and run the code (S^3)
0AEES256_4	Follow the professional principles & complete the laboratory work regularly along with the maintenance of lab journal (A^2)

Course Contents:

Experiment List	
1	Error's – Round off & Truncation Errors.
2	Curve Fitting – Least Square Method (Linear Fit & Parabolic Fit)
3	Statistical Analysis – Determination of Mean & Standard Deviation
4	Solution for Algebraic & Transcendal Equations – Bisection & Newton Raphson Method
5	Numerical Solution for System of Linear Algebraic Equations – Iterative Methods
6	Numerical Integration – Simpsons 1/3 and 3/8 Rule
7	Numerical Differentiation – First Order & Second Order FDA, CDA & BDA
8	Numerical Solution to Ordinary Differential Equation
9	Numerical Solution to Partial Differential Equation – Laplace Equation.

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC257, Aircraft Production Technology (Practical)
Prerequisite/s	0BSES160 - Basic Mechanical Engineering Laboratory
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to	
1	Introduce the Lathe machine and various operations performed and Applications to Under Graduate students of the Aeronautical Engineering
2	Perform the operations with given dimension by using various machines available in workshop

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC257_1	Use the Machine shop equipment's to manufacture the given simple components (S^3)
0AEPC257_2	Follow professional and ethical principles during laboratory work (A^2)

Course Contents:

Experiment List	
1	Material Cutting and Facing
2	Plain Turning
3	Step turning
4	Grooving
5	Taper Turning
6	Knurling
7	External threading
8	Boring
9	Internal thread cutting.
10	Plain milling exercise
11	Chamfering
12	Tool sharpening
13	Grinding
14	Drilling

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC258 & Aircraft Materials Lab
Prerequisite/s	0BSBS 101 Applied Physics 0BSES 110 Engineering Mechanics
Teaching Scheme: Lecture/Tutorial/Practical's	00/00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Laboratory Objectives: The course aims to	
1	Describe the study of materials and their behaviors under given test condition.
2	Explain the procedures to carry out different experiments in material science subject and observe/record/study properties of materials

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC258_1	Study the materials and its behavior under given test condition. (K^2)
0AEPC258_2	Effectively carry out the experiment and record the results, analyze them to provide a conclusion (S^3)
0AEPC258_3	Learn the best & effective practices for carrying out the experimentation (S^3)
0AEPC258_4	Follow the professional practices like mainlining a laboratory journal and completion of work on time. (A^2)

Course Content

Experiment List	
1	Brinell's Hardness Test
2	Rockwell Hardness Test
3	Impact Tests
4	Microstructure Examination Of Metals
5	Non Destructive Testing
6	Jominy End Quench Test
7	Fabrication of Laminated Composites
8	Case Study For Ferrous Alloys in Aircraft Industry
9	Case Study For Non-Ferrous Alloys in Aircraft Industry

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC259 – Aerodynamics I Laboratory
Prerequisite/s	0AEPC253- Fluid Mechanics Laboratory
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to	
1	Familiarize the Undergraduate students of Aeronautical Engineering with the Experimental methods of carrying out experiments using the Wind Tunnel, Smoke Tunnel & the concepts of model preparation
2	Impart the skill of representation of the experimental data on the Graph Sheets & also familiarize the use of spreadsheets for the calculation & data representation.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC253_1	Describe and recognize various types of wind tunnels, measuring equipments and their applications. (S^2)
0AEPC253_2	Demonstrate and analyze fluid behavior over the body (K^2, S^2)
0AEPC253_3	Explain and utilize various techniques of pressure, force and velocity measurement. (S^3)
0AEPC253_4	Effectively record the results and analyze in details to provide a conclusion. (S^3)
0AEPC253_5	Follow the professional practices like taking safety measures and maintaining the laboratory journal. (A^3)

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC259 – Aerodynamics I Laboratory
Prerequisite/s	0AEPC253- Fluid Mechanics Laboratory
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to	
1	Familiarize the Under Graduate students of the Aeronautical Engineering with the Experimental methods of carrying out experiments using the Wind Tunnel, Smoke Tunnel & the concepts of model preparation
2	Impart the skill of representation of the experimental data on the Graph Sheets & also familiarize the use of spread sheets for the calculation & data representation.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC253_1	Draft the given aerofoil over a graph sheet and prepare the model (S^2)
0AEPC253_2	Demonstrate the flow visualization over the Aerofoil & Propeller and Explain the flow patterns. (K^2, S^2)
0AEPC253_3	Use the wind tunnel effectively for the carrying out the experimentation over the aerofoil models. (S^3)
0AEPC253_4	Effectively record the results and analyze in details to provide a conclusion (S^3)
0AEPC253_5	Follow the professional practices like mainlining a laboratory journal and completion of work on time. (A^3)

Course Contents:

Experiment List	
1	Drafting the Aerofoil & Preparing the Model using High Density Foam
2	Demonstration of Coanda Effect using the Smoke Flow Visualization
3	Study of the Wind Tunnel & the Calibration of Wind Tunnel & Its Measuring Instruments
4	Comparison of Pressure Distribution over Symmetrical Aerofoil for varying angle of attack (0^0,3^0,6^0,9^0,12^0,15^0& 18^0) at Constant Velocity
5	Comparison of Pressure Distribution over Cambered Aerofoil for varying angle of attack (0^0,3^0,6^0,9^0,12^0,15^0& 18^0) at Constant Velocity
6	Comparison of Lift & Drag Forces & Force Coefficients acting Symmetrical & Cambered Aerofoil at 0^0 angle of attack for varying air velocity

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7	Comparison of Lift & Drag Forces & Force Coefficients acting Symmetrical Aerofoil for varying angle of attack (0^0,3^0,6^0,9^0,12^0,15^0& 18^0) at Constant Velocity
8	Comparison of Lift & Drag Forces & Force Coefficients acting Cambered Aerofoil for varying angle of attack (0^0,3^0,6^0,9^0,12^0,15^0& 18^0) at Constant Velocity
9	Measurement & Comparison of Thrust & Thrust coefficient over propeller by varying the rpm at constant pitch.
10	Measurement & Comparison of Thrust & Thrust coefficient over propellers by varying the Pitch at constant rpm.

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Course Details:

Class	S.Y. B. Tech, Sem.-IV
Course Code and Course Title	0AEPC260, Propulsion Lab
Prerequisite/s	NIL
Teaching Scheme: Practical	00/02
Credits	01
Evaluation Scheme: ISEI/ESE	50/50

Course Objectives: The course aims to	
1	Explain basic components involved in power producing engines and thrust producing engines
2	Demonstrate the propeller performance test
3	Describe the concept of thermal boundary layer using experimental purpose

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC260_1	Explain the various systems of aircraft piston engine, jet engines and Identify the systems on the engines (K^2,S^2)
0AEPC260_2	Use the concept of forced and free convective heat transfer and perform experiment on the heat transfer apparatus (K^2,S^2)
0AEPC260_3	Explain the Heat of combustion of aviation fuel and how to find it using given set up (K^2,S^2)
0AEPC260_4	Effectively record the results and analyze in details to provide a conclusion (S^3)
0AEPC260_5	Follow the professional practices like mainlining a laboratory journal and completion of work on time. (A^3)

Course Contents:

Experiment List	
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, Sem.-IV
Course Code and Course Title	0AEHS211, Environmental Studies
Prerequisite/s	--
Teaching Scheme: Lecture	02
Credits	--
Evaluation Scheme: ISE	50 (Grade)

Course Objectives:	
01	To study the importance and scope of environmental studies.
02	To discuss the importance of public awareness on environmental problems.
03	To study about natural resources and biodiversity.
04	To discuss scientific, technological and economic solutions to environmental problems.
05	To study the pollution control and waste management

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
0AEHS211_1	Know importance and scope of environmental studies. (K^2)
0AEHS211_2	Explain the importance of public awareness on environmental problems. (K^2)
0AEHS211_3	Explain about natural resources and biodiversity. (K^2)
0AEHS211_4	Describe scientific, technological and economic solutions to environmental problems. (K^3)
0AEHS211_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	**05 Hrs**

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	pyramids. Energy flow in the ecosystem, Bio-magnification, Bioaccumulation, ecosystem value.	
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**
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.)**	**08 Hrs**

Assessment Method:

1. Individual field work report – 10 marks
2. Question paper format will be Multiple Choice Questions- 40 Marks

Unit No.	Topic Name	Weightage
1	Nature of Environmental Studies.	4 Marks
2	Natural Resources.	7 Marks
3	Ecosystems	7 Marks
4	Biodiversity and its conservation	7 Marks
5	Environmental Pollution	7 Marks
6	Social Issues and the Environment	8 Marks

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IMPORTANT NOTES:

1. ISE will be conducted in 14th week of EVEN semester.
2. Field work report will be submitted to course coordinator in 10th week of ODD/EVEN semester. (Whichever is applicable.)
3. Students should get minimum 40% marks to get PP (PASS) grade.
4. Students getting less than 40% marks will be offered NP (NOT PASS) grade.
5. To get S.Y. B. Tech. Degree PP grade is mandatory.

Text Books:

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

Reference Books:

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

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Teaching and Evaluation Scheme
B. Tech: V Semester

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	T	P	C	Scheme	Theory Marks		Practical Marks	
							Max.	Min. for passing	Max.	Min. for passing
0AEPC301	Aircraft Structures	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC302	Aerodynamics-II	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC303	Linear Control Theory	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC304	Aircraft Performance	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC305	Propulsion-II	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC351	Aircraft Structures Laboratory	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC352	Aerodynamics-II Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC353	Aircraft Performance Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC354	Non-destructive Testing Laboratory	2	--	2	3	ISE	--	--	25	10
0AEPC355	Computer Aided Drafting Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPR356	Seminar	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEMC306	*Technical English*	2	0	0	--	ISE	--	--	--	--
						ESE	--	--	--	--
Total		**19**	**1**	**12**	**24**		**500**		**300**	
Total Contact Hours/Week = 32						**Total Marks = 800**				

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	--	--	--	23	--	--	1	--	--
Cumulative Sum	3	22	33	61	--	--	1	--	--

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Course Details:

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	0AEPC301, Aircraft Structures
Prerequisite/s	0AEPC204, Solid Mechanics
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Explain basic concept of aircraft structures and loads acting on them
2	Teach the concepts and calculation of bending stresses, shear stresses, shear flow and buckling stresses acting on elements of aircraft parts.
3	Analyze stiffened panels and shells under the action of bending, twisting, axial, and shearing loads.
4	Introduction to the concept of idealization of aircraft structures.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC301_1	Identify the basic elements of aircraft structures and their classifications and explain the basic concepts involved in their structural analysis.
0AEPC301_2	Explain the basic laws of physics, mathematics and engineering to obtain structural response of open/closed thin walled idealized structures under the action of bending, buckling, shear, and twisting loads.
0AEPC301_3	Apply principles of structural analyses to calculate deformations and direct stresses of complex normal/idealized aircraft structural elements under the action of flexural loads.
0AEPC301_4	Apply principles of structural analyses to obtain the shear flow pattern in the open and closed thin walled normal/idealized sections subjected to shear and torsional loads.
0AEPC301_5	Explain the concept of stability and mathematical modelling for the analysis of stiffened panels and shells.

Course Contents:

Unit 1: Introduction to Aircraft Structures

Structural components of aircraft: Fuselage: monocoque and semi-monocoque, Wing, landing gears. Loads acting on aircrafts: Lift, drag, inertia, control surface loads. St. Venant's principal.

Basic elements of structures: Beam, bar, shell, columns. Thin walled structures: Open, closed, combined. Approximations for thin walled sections, calculations of CG and moment of inertia for inclined and curved thin sections.

Load systems acting on aircraft structural elements: Bending, twisting, shear, and buckling.

Structural idealization: Introduction and advantages of mathematical Modeling.

Total Hours: 06

Unit 2: Unsymmetrical bending of beams

Introduction: Prismatic beams, thin walled beams (open, closed, idealized), Shear center and center of twist. Bending of symmetrical sections, Neutral Axis and its properties.

Unsymmetrical bending: Unsymmetrical bending equation and its limitations. Position of neutral Axis. Relationship between load intensity, shear force and bending moments. Deflection of unsymmetrical beam.

Total Hours: 07

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Unit 3: Torsion of thin walled sections
Introduction: Torsion of prismatic sections. Torsion equation and terminologies. CSRD assumption. **Torsion of thin walled sections:** Shear flow, Relation between shear flow and torque, Bredth-Batho equation for thin walled tubes. Equations for angle of twist and torsional constants. Torsion of thin walled multi-cell structures. Torsion of open sections and combined open closed sections: calculations for shear stress angle of twist and torsional constant.
Total Hours: 07
Unit 4: Shear of thin walled sections
Introduction: Shear force, shear center, center of twist and their properties. **Shear Analysis:** Shear flow in thin walled open and closed sections. Shear center in open and closed sections.
Total Hours: 08
Unit 5: Structural Idealization
Introduction: Idealization, advantages and limitations, Booms. **Idealization:** Idealization of thin plates, Calculation of boom areas. Idealization for bending, torsion and shear loads.
Total Hours: 05
Unit 6: Stability Analysis of Stiffened Panels
Introduction: Buckling of columns, various boundary conditions, stiffened panel, thin and thick plates. **Buckling:** Critical load and stress for Thin walled columns, thin plates. Inelastic buckling, local instability. Instability of stiffened panels.
Total Hours: 07

Text Books

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

Reference Books

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

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Class	T.Y B. Tech, Sem.-V
Course Code and Course Title	0AEPC302 - Aerodynamics II
Prerequisite/s	0AEPC202- Applied Thermodynamics 0AEPC203- Fluid Mechanics 0AEPC209- Aerodynamics I
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Objectives: The course aims to develop an ability to	
1	Understand the concept of compressibility
2	Interpret the theory behind the formation of shock waves, Expansions waves at supersonic flows
3	To apply the linearized flow concepts at subsonic, supersonic flow regions
4	Understand the basics of hypersonic flow theory based on Newtonian model.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC302_1	Understand the characteristics of compressible flow in various flow regimes – subsonic, transonic, supersonic and hypersonic. (K^2)
0AEPC302_2	Use Quasi one dimensional theory to analyze compressible flow problems. (K^3)
0AEPC302_3	Estimate the normal and oblique shock properties. (K^3)
0AEPC302_4	Analyze the flow behavior over a convex corner, estimate the flow properties through a constant area duct. (K^3)
0AEPC302_5	Analyze the flow characteristics over different aerodynamic profiles at various flow regimes. (K^4)
0AEPC302_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.
Total Hours: 8

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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
Total Hours: 8
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
Total Hours: 08
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 using Prandtl Gluert transformation.
Total Hours: 06
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
Total Hours: 06
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.
Total Hours: 06

Text Books

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

Reference Books

1	Aerodynamics, Aeronautics and Flight Mechanics	B W McCormick.	John Wiley Publications	2	1995
2	The Dynamics and Thermodynamics of Compressible Fluid Flow	A H Shapiro	John Wiley Publications Vol 1 &2		1953

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TY AE-05/38

Course Details:

Class	T.Y. B. Tech, Sem.-V
Course Code and Course Title	0AEPC303, Linear Control Theory
Prerequisite/s	0BSES110 – Engineering Mathematics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to make students able to	
1	Describe the principles and applications of control systems in day life and be familiar with the linear time–invariant systems.
2	Represent dynamic system into mathematical model by using Engineering mathematics, transfer function and block diagram reduction method and Mason's gain formula.
3	Solve time response analysis and demonstrate their knowledge to frequency response
4	Stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC303_1	Explain the fundamentals of (feedback) control systems. (K^2)
0AEPC303_2	Apply Basic Engineering Mathematics and laws of physics to formulate Mathematical models of any dynamic systems in forms suitable for use in the analysis and design of control systems. (K^3)
0AEPC303_3	Solve system equations in state-variable form (state variable models). (K^3)
0AEPC303_4	Determine the time and frequency-domain responses of first and second-order systems to step and sinusoidal (and to some extent, ramp) inputs. (K^3)
0AEPC303_5	Determine the absolute stability of a closed-loop control system (K^3)
0AEPC303_6	Apply root-locus technique to analyze and design control systems. (K^4)

Course Contents:

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.
Total Hours: 07
Unit 2: Mathematical Modeling of Dynamic Systems
Introduction - Mathematical models – Differential equations, Impulse Response and transfer function.

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Transfer Function Representation - Block diagram representation of systems considering Mechanical systems as examples. Block diagram algebra – – Representation by Signal flow graph - Reduction using Mason's gain formula.

Total Hours: 07

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

Total Hours: 06

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 concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

Total Hours: 08

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.

Total Hours: 08

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.

Total Hours: 06

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Modern Control Engineering	K.Ogata	Prentice hall	4th Edition	2001
2	Automatic Control Systems	Kuo,B.C	Prentice hall	2nd Edition	1992

Reference Books

1	Control Systems	Nagoorkani	RBA	4th Edition	2012
2	Control system Engineering	Norman S Nise	Wiley	7th Edition	2015

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TY AF - 07/28

Class	T. Y. B. Tech, Sem.-V
Course Code and Course Title	0AEPC304- Aircraft Performance
Prerequisite/s	0AEPC209 – Aerodynamics – I, 0AEPC210 – Propulsion - I
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISE I/MSE/ISE II/ESE	10/30/10/50

Course Objectives: The course aims to develop an ability to	
1	Describe the influence of atmosphere and aircraft configuration on aircraft performance.
2	Calculate thrust required and power required of an aero plane in steady level flight.
3	Estimate the time to climb and descent and gives the relation between rate of climb and descent and time to climb and descent at different altitudes.
4	Determine the performance characteristics for accelerated flight.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC304_1	Derive the mathematical expressions of the aircraft flight performance under the operational envelope such as Take-off, climb, cruise, descent, turn, glide and Landing. (K^2)
0AEPC304_2	Calculate the Properties of Atmosphere at a given altitude under the ISA Conditions and Apply them for the calculation of Aircraft Flight Performance. (K^3)
0AEPC304_3	Apply the mathematical expressions for calculating the aircraft flight performance under the different operational envelopes. (K^3)
0AEPC304_4	Analyze the factors/parameters affecting the aircraft flight performance under the various operational conditions. (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.
Total Hours: 07
Unit 2: Steady Level Flight Performance
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

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Maximum Velocity, Effect of Drag Divergence on Maximum Velocity, Stall and High Lift Devices
Total Hours: 06
Unit 3: Climb, Descent, Range and Endurance
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 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.
Total Hours: 08
Unit 4: 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.
Total Hours: 08
Unit 5: Aircraft Takeoff and Landing Performance
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.
Total Hours: 06
Unit 6: Helicopter Performance
Helicopter Nomenclature, Helicopter Configurations, **Dynamics of Hovering Flight**: Actuator Disc Theory, Blade Element Theory, Thrust and Power Coefficients, Calculation of Drag and Torque, Estimation of Hover Ceilings. **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
Total Hours: 07

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Aircraft Performance and Design	Anderson, J.D. Jr	International Edition McGraw Hill	1st Edition	1999
2	Aircraft Performance theory and Practice	Eshelby, M.E	AIAA Education Series, AIAA,	2nd Edition,	2000.

Reference Books

1	Performance, stability, dynamics and control of an airplane	Pamadi, B	AIAA		2004
2	Mechanics of flight	Phillips, W.F	2nd Edition	John Wiley	2010)
3	Introduction to Aircraft Flight	Yechout, T.R. et al	AIAA Education Series, ,	1st Edition	2003

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Course Details:

Class	T.Y B. Tech, Sem.-V
Course Code and Course Title	0AEPC305, Propulsion-II
Prerequisite/s	0AEPC210 - Propulsion-I, 0AEPC202- Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial	03
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to make students able to	
1	Study the types of rockets and their working principles.
2	Characterize the advancement, performance and parameters of rocket engines.
3	Study different type of feed systems used in modern chemical rockets.
4	Explain the basic concepts and working principle of electric and Ion Propulsion

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC305_1	Understand various concepts of advanced propulsion techniques. **(K^2)**
0AEPC305_2	Describe solid, liquid and hybrid rocket motors and their composition. **(K^2)**
0AEPC305_3	Explain the fundamentals of rocket propulsion and working of individual rocket propulsion components. **(K^3)**
0AEPC305_4	Understand various concepts of electric propulsion system in application to electric thrusters. **(K^3)**
0AEPC305_5	Evaluate the various parameters of Electrostatic and Ion thrusters. **(K^3)**

Course Contents:

UNIT 1: History and Principles of Rocket Propulsion **Total Hours: 07**
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.
UNIT 2: Rocket Nozzle Theory **Total Hours : 07**
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,

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performance correction factors and performance parameters.
UNIT 3: Solid Propellant Rocket Engines **Total Hours: 07**
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
UNIT 4: Liquid Propellant Rocket Motors **Total Hours: 07**
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 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 **Total Hours: 07**
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.
UNIT 6: ELECTROSTATIC AND ION THRUSTERS **Total Hours: 07**
Introduction and fundamentals of Ion propulsion: Performance Analysis, Characteristic Velocity, Payload, Specific Power; Electrical Thrust Devices: Ion and Colloid **Electromagnetic thrusters**: Ion propulsion, Electric field and potential, Ion thrust **Ion Rocket Engine**: Ion Sources, Electromagnetic Fields, Charged Colloid Sources

Text Books

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

Reference Books

1	Rocket Propulsion	K. Ramamurthi	Trinity Press	3rd Edition,	2016
2	Introduction to Rocket Science and Engineering	Travis S. Taylor	CRC Press	2nd Edition	2017
3	Aerospace Propulsion Systems	Thomas A. Ward	John Wiley & Sons	1st Edition	2010

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Structure of Course

Class	T.Y. B. Tech, Sem. V
Course Code and Course Title	0AEPC351, Aircraft Structures Laboratory
Prerequisite/s	--
Teaching Scheme: Practical	2
Credits	1
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to:	
01	Explain basic concept of aircraft structures and loads acting on them
02	Performance and calculation of bending stress, shear stress, shear flow by experiments on elements of aircraft parts.
03	Explain how to perform experiments on various structures and to measure the deformations under various loads.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
0AEPC351_1	Recognize the defects present in the materials. (K^2)
0AEPC351_2	Determine the Stresses and Deformations of the specimen by using different loading condition. (K^3)
0AEPC351_3	Determine the sectional properties of the specified structure under various loading conditions. (K^3)
0AEPC351_4	Perform the experiment on given topic and explain with the help of knowledge acquired in theory classes. (S^2)
0AEPC351_5	Perform the experiments in the most effective manner without damaging the apparatus or specimen. (A^3)

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List of Experiments:

Practical Experiments: It should consist of minimum 7 experiments based on following list.	
1.	Dye penetration test.
2.	NDT testing Using ultra-sonic testing machine.
3.	Deflection of beams (Simply supported)
4.	Deflection of beams (Cantilever)
5.	Maxwell's Reciprocal theorem-experiment
6.	Finding Shear center locations on Open sections (C & Z sections)
7.	Finding Shear Center locations on closed section (D-section)
8.	Combined bending and torsion
9.	Stresses in the thin walled cylinder
10.	Shear analysis of a specimen

Text Books

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

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Structure of Course

Class	T.Y. B. Tech, Sem. V
Course Code and Course Title	0AEPC352 , Aerodynamics II Laboratory
Prerequisite/s	0AEPC259 – Aerodynamics-I Lab 0AEPC253 – Fluid Mechanics Lab
Teaching Scheme: Practical	2
Credits	1
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to:	
01	Explain basic concept of Visualization of Shock Waves in Compressible Floes
02	Explain the basic Operating Procedures of the Supersonic Wind Tunnel

Course Outcomes (COs): Upon successful completion of this course, the student will be able to:	
0AEPC352_1	Explain the different types of wind tunnels and experimentations used for aerodynamic studies. **(K^2)**
0AEPC352_2	Conduct simulations on typical test cases moving at supersonic flow. **(S^3)**
0AEPC352_3	Predict the kind of shock waves generated over the test models using computational simulations. **(S^3)**
0AEPC352_4	Explain the different experimentation techniques that can be performed in a supersonic wind tunnel. **(K^3)**
0AEPC352_5	Perform test on supersonic wind tunnel to visualize the shock waves generated over the test model. **(S^3)**
0AEPC352_6	Recognize the needs for wind tunnel testing while designing real world models. **(A^3)**

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List of Experiments:

Exp. No	Title of the Experiment
1	Introduction to wind tunnels and their applications
2	Using simulations, capture a normal shock wave formed ahead of a flat faced body a Mach 2.0.
3	Capture the bow shock wave formed ahead of a hemispherical tip bullet moving at a supersonic speed of Mach 2.0.
4	Add a spike over the blunt hemisphere geometry used in the previous experiment and study the change in the shock wave.
5	Capture the shock waves as well as the expansion fans produced over diamond shaped wedge model at Mach 2.0.
6	Calibration of supersonic wind tunnel.
7	Using shadowgraph flow visualization technique, capture the normal shock generated over a flat faced body at Mach 2.0 and compare with the result obtained from experiment no. 2.
8	Study the flow physics over a blunt hemispherical model at Mach 2.0 using a supersonic wind tunnel and compare the Drag coefficient obtained from the simulation done in experiment no. 3.
9	Study the change in the flow physics over the blunt hemisphere moving at Mach 2.0 when mounted with a sharp spike.

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Course Details:

Class	T.Y. B. Tech, Sem.- V
Course Code and Course Title	0AEPC353 – Aircraft Performance Laboratory
Prerequisite/s	0AEES251 - Computer Programming with C++ 0AEES256 - Numerical Analysis using Programming Language
Teaching Scheme: Lecture/Practical	00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Make students understand the concepts of Aircraft Performance concepts using the MATLAB Programming Language and Aerospace Tool Box.
2	Impart the skill of programing the Aircraft Performance problems using MATLAB.
3	Make students recognize the importance of scientific computing using programing languages.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEES353_1	Apply their knowledge and programming skills to compute the Aircraft Performance Equations. (K^3)
0AEES353_2	Write a MATLAB Codes for the Generating Aircraft Performance Curves. (S^3)
0AEES353_3	Execute & Debug the MATLAB Code for the Syntax & Logical Error (S^3)
0AEES353_4	Follow professional and ethical principles, standards while writing the MATLAB Codes (A^2)
0AEES353_5	Recognize the need for learning the Programming Language for solving complex Problems related to Engineering. (A^3)

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List of Experiments:

1	Basic MATLAB Coding and Generation of Plots : Part 1
2	Basic MATLAB Coding and Generation of Plots : Part 2
3	Introduction to Aerospace Toolbox – Demonstration, International Standard Atmosphere Model
4	Computing the Aerodynamic Forces and G Forces
5	Drag Polar Curve Generation for a Typical Aircraft
6	Aircraft Climb Performance Analysis
7	Aircraft Descent Performance Analysis
8	Calculating the Best Glide Quantities
9	Performance Envelope Calculation
10	Plotting Flight Envelope of an UAV
11	Estimation of the performance of the 1903 Wright Flyer
12	Simulation of Flight Dynamics of Cessana 152 Aircraft

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Course Details:

Class	T.Y. B. Tech, Sem.- V
Course Code and Course Title	0AEPC354, Non Destructive Testing Laboratory
Prerequisite/s	0AEPC204, Aircraft Materials
Teaching Scheme: Lecture/Practical	02/02
Credits	03
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	To study and understand the various Non Destructive testing methods.
2	Explain the principle of various non-destructive techniques and procedures to carry out non destructive test to find out the defects.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC254_1	Learn about various methods of Non Destructive Testing.(K^2)
0AEPC254_2	Locate surface as well as sub surface flaws of the components.(K^3)
0AEPC254_3	Identify use of suitable non destructive method for particular application in industry.(S^3)
0AEPC254_4	Use non destructive techniques in maintenance practices in aerospace industry.(S^3)
0AEPC254_5	Follow the professional practices like mainlining a laboratory journal and completion of work on time.(A^2)

List of Experiments:

Experiment No 1: Microscopic examination of metals
Experiment No 2: Determination of the surface defects using the Visual Testing
Experiment No 3: Determination of the surface defects using the Liquid Penetrant Testing
Experiment No 4: Determination of Surface and Subsurface Defects using the Magnetic Particle Inspection
Experiment No 5: Basic Calibration of the Ultrasonic Testing Machine using Angle beam probes
Experiment No 6: Young's Modulus and Poisson's Ratio Determination using the Trough Transmission Method
Experiment No 7: Calibration of Normal Beam probe and thickness measurement with UT
Experiment No 8: Determination of the defects in the Welded Joints using the UT
Experiment No 9: Demonstration of the Radiography technique using the Radiograph Films

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Text Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year**
1	Nondestructive Testing Techniques	Ravi Prakash	New Age International Publishers		2012
2	Practical Non-destructive Testing	Baldev Raj, T. Jayakumar and M. Thavasimuthu	Woodhead Publishing		2002
Reference Books					
1	Non-destructive Evaluation - A tool in Design, Manufacturing and Service	D.E. Bray and R. K. Stanley	CRC Press,		1996
2	NDT Handbooks Vol 1-17		ASNT Press, OH, USA.		

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Course Details:

Class	T.Y. B. Tech, Sem.-V
Course Code and Course Title	0AEPC355, Computer Aided Drafting Laboratory
Prerequisite/s	0 BSES105 – Engineering Graphics 0 AEPC255 - Aircraft Component Drawing
Teaching Scheme: Lecture/Practical	00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Know the basic fundamentals of computer aided design and manufacturing.
2	Enhance the 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
3	Emphasize the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
AEPC355_1	Prepare solid, assembly and surface models with suitable constraints and 2D drafting. (K^3)
AEPC355_2	Prepare 3 dimensional design of typical aircraft & its component. (K^3)
AEPC355_3	Demonstrate kinematics of assembly for aircraft engine components using CATIA software. (K^3)
AEPC355_4	Communicate effectively, both orally and in writing journals. (K^3)
AEPC355_5	Practice professional and ethical behavior to carry forward in their life. (A^3)
AEPC355_6	Recognize the need of modeling software and utilize it for their project work. (A^3)

List of Experiments:

Experiment List	
1	Introduction to CAD/CAM, Graphical User Interface (GUI) of CATIA
2	Review of 2D Sketcher
3	Review of Part Design
4	Assembly Modeling of aircraft radial engine
5	Solid Modeling of aircraft jet engine
6	Assembly Modeling of aircraft landing gear
7	Surface Modeling aircraft wing ribs with dimensions
8	Surface Modeling of typical aircraft
9	Drafting of typical aircraft

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Teaching and Evaluation Scheme
B. Tech: VI Semester

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory Marks		Practical Marks	
		L	T	P	C	Scheme	Max.	Min. for passing	Max.	Min. for passing
0AEPC307	Computational Fluid Dynamics	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEHS308	Economics & Management	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC309	Aircraft Stability & Control	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC310	Aircraft Design	3	1	--	4	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC311	Composite Materials and Structures	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEMC312	Soft Skills	2	--	--	--	--	--	--	--	--
						--	--		--	--
0AEPC357	Computational Fluid Dynamics Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPC358	Unmanned Aerial Vehicles Laboratory	2	--	2	2	ISE	--	--	50	20
0AEPC359	Composite Materials and Structures Laboratory	--	--	2	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC360	Aircraft Design Laboratory	--	--	2	1	ISE	--	--	25	10
0AEPR361	Mini Project	--	--	4	2	ISE	--	--	50	20
						ESE	--	--	50	20
Total		**18**	**2**	**12**	**24**		**500**		**300**	
Total Contact Hours/ Week=32						**Total Marks=800**				

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	03	--	--	19	--	--	02	--	--
Cumulative Sum	06	22	33	80	--	--	03	--	--

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Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC307, Computational Fluid Dynamics
Prerequisite/s	0AEPC203 - Fluid Mechanics 0AEBS206 – Numerical Analysis
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to make students	
1	Aware about the role of CFD Technique in the Product Design Cycle
2	Familiarize about the process followed in solving the problem using the CFD Approach.
3	Understand the concept of Finite Difference and Finite Volume Discretization
4	To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC307_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)
0AEPC307_2	Discuss the need for grids, types of grid generation techniques & the advancements in the grid generation process. (K^2)
0AEPC307_3	Categorize the Partial Differential Governing Equations applicable for specific fluid flow cases by applying the principles of mathematics. (K^3)
0AEPC307_4	Describe the various Finite Difference & Finite Volume schemes used in the Computational Algorithms & Apply them for solving simple fluid flow cases. (K^3)
0AEPC307_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)
0AEPC307_6	Analyze the Stability characteristics of the various Finite Difference schemes. (K^4)

Course Contents:

Unit 1 : INTRODUCTION
What is CFD? Advantages, Applications and Future Scope, Problem Setup (Pre Processor), Numerical Solution (CFD Solver), Results and Visualization (Post Processor)
(04 Hours)

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Unit 2 : PARTIAL DIFFERENTIAL EQUATION : THE IMPACT ON CFD
Classification of Partial Differential Equations Continuity Equation, Momentum Equation, Energy Equation, and their physical interpretation. Additional equations of turbulence, Physical boundary condition (Drichlet, Neumann and Mixed)
(08 Hours)
Unit 3 : DISCRITIZATION
Essence of discretization, Taylor series approach for the construction of finite-difference quotients, Discretization of parabolic differential equations by FTCS and Crank Nicholson Methods, Von-Neumann Stability Analysis, Discretization of elliptical differential equations by PSOR Methods, Discretization of hyperbolic differential equations by First order Upwind differencing and Lax-Wendroff Method
(08 Hours)
Unit 4 : FINITE VOLUME TECHNIQUES
Introduction to Integral formulations, Finite volume grid, global conservation property, approximation of integrals (volume and surface), methods of interpolation (upwind and linear), Boundary condition, FVM for 1D steady state diffusion and 1D Steady state convection and diffusion.
(08 Hours)
Unit 5 : GRID GENERATION
General considerations, grid cells, requirement imposed on grids, grid size, cell size, grid consistency, grid deformation, consistency with geometry and solution, coordinate transformation, compatibility with numerical methods, Methods of grid generation(Mapping, Algebraic, Differential, Variation), methods of unstructured grid generation, Grid quality parameters
(08 Hours)
Unit 6 : Pressure – Velocity Coupling and TURBULENCE MODELS
Solution algorithms for Pressure – Velocity coupling in steady state flow, SIMPLE, SIMPLE-R, SIMPLE-C, PISO. Introduction to Turbulence, Transition From laminar – turbulent flow, Characteristics of simple turbulent flow, RANS, classical turbulence models, Introduction to LES and DNS.
(06 Hours)

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Computational Fluid Dynamics for Engineers	Klaus A Hoffmann and Steve T, Chiang	Engineering Education System	Volume I and II	-
2	Introduction to Computational Fluid Dynamics	PradipNiyogi, S. K. Chakarbartty, M. K. Laha	Pearson Education Ltd.	First Edition	2006
Reference Books					
1	Numerical Computation of Internal and External Flows	Charles Hirsch	John Wiley and Sons, New York	Volume I and II	-
2	Computational Fluid Dynamics - An Introduction	John F, Wendt	Springer – Verlag	-	1992

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Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEHS308, Economics&Management
Prerequisite/s	-
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Ignite the entrepreneurial spirit or inculcate culture ofentrepreneurship among the students
2	Enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC308_1	Describe the role of economics involved in the decision making process (K^2)
0AEPC308_2	Calculate the rate of return, depreciation charges and taxes. (K^3)
0AEPC308_3	Enumerate different cost entities in estimation, and Explain the importance of finance functions. (K^2)
0AEPC308_4	Describe the significance of Marketing Management and Product Management in the success of an organization. (K^2)

Course Contents:

Unit 1 : Managerial Economics

The Economic Way of Thinking-Demand Analysis 1-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 InformationTypes of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

(06 Hours)

Unit 2 : Indian Economy and Policy

Introduction to the course-Colonialism and development of the Indianeconomy-De-industrialization of Indian economy-Business enterprises-Growth and economic reforms-Poverty and Inequality-Macroeconomic overview and Fiscal and Monetary Policy-Financial sectorperformance and impending reforms-Economic reforms towards more liberalization-Agriculture,industry and services-Government reforms and the emerging energy-economy-environment regulatoryframework

(06 Hours)

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Unit 3 : Financial Reporting, Statements and Analysis
Accounting principles, concepts and conventions,Accounting process, Preparation of Financial statements, Financial Reporting, Reporting practices,Analysis of Financial Statements with managerial perspective. Students should be provided adequatetraining in understanding and analysing published financial statements of a company.
(06 Hours)
Unit 4 : Marketing Management
Introduction to Marketing Management-Analysing Marketing Environmentand Competition- Consumer Behaviour- Market Segmentation- Target Marketing- Positioning forCompetitive Advantage- Product/ Service, Product Classification, Branding- Product Life Cycle, NewProduct Development and Product Extension Strategies- Pricing- Place- Promotion Decisions
(06 Hours)
Unit 5 : Project Management
Project Lifecycle understanding-Project definition. WBS (Work BreakdownStructure), Planning Scope-Planning Schedule-CPM and PERT, Schedule Compressions-Costestimation & Quality definition-Planning Resources & Risks-Stakeholder identification, analysis andcommunication planning-Understanding different fundamental contract types and some of thevariants-Earned value management-Behavioural aspects in project management and project closure
(06 Hours)
Unit 6 : Business Communication
Introduction & Communication Basics-Just-A-Minute PresentationWorkshop-Jam Feedback and overcoming Glossophobia-Presentation–1 (Planning & Preparing)-Presentation–2 (Visual Aids) Presentation–3 (Delivery)-Graded Team Presentations-Group 1-GradedTeam Presentations-Group 2-Reading, listening & Questioning-Writing Business Communicationbasics-Writing Reports, Proposals, Emails, Summaries-Graded Individual Presentations- Group 1-Graded Individual Presentations- Group 2-Presentation feedback, Bios and Resumes.
(06 Hours)

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Principles of Management	Tripathy PC & Reddy PN	Tata McGraw Hill	-	1999

Reference Books

1	Fundamentals of Management	Stephen A. Robbins & David A. Decenzo& Mary Coulter	Pearson Education	7th Edition	2011
2	Management	Stephen P. Robbins & Mary Coulter	Prentice Hall (India) Pvt. Ltd	10th Edition	2009

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Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC309: Aircraft Stability and Control
Prerequisite/s	0BSES110 – Engineering Mathematics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to make students able to	
1	Describe the influence of gust forces and moments on aircraft stability and control.
2	Calculate the geometry of the aircraft for better stability and control.
3	Solve aircraft nonlinear dynamic equations of motion to linearized equations of motion.
4	Stability analysis of Aircraft longitude and lateral motions.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEHS309_1	Describe the necessity of stability for dynamic systems like Aircraft. (K^2)
0AEHS309_2	Apply the rigid body dynamics to aircraft for representing aircraft in mathematical model. (K^2)
0AEHS309_3	Calculate the control surfaces control power for different aircraft configurations. (K^3)
0AEHS309_4	Estimate the longitudinal and directional parameters with the help of the linearized equations of aircraft motion. (K^3)
0AEHS309_5	Analyze the different type of modes in longitudinal, lateral and directional motion of aircraft, and recovery from those modes. (K^4)

Course Contents:

Unit 1: Introduction To Aircraft Stability and control:

Stable, Unstable and neutrally stable states of equilibrium, Types of motions following of disturbance, Static stability and dynamic stability, body axes system, earth fixed axes systems, Basic concepts and terminology on longitudinal, lateral and directional stability, subdivisions of stability analysis. Controllability.

Total Hours: 08

Unit 2: Static longitudinal stability and control

Longitudinal static stability and dynamic stability for un accelerated flight. Criteria for longitudinal static stability and trim condition. Contribution of Principle components. Equations of equilibrium- stick fixed neutral point, elevator angle required to trim. Definition-static margin. Equations of motion in steady, symmetric pull-up maneuver, elevator effectiveness, and elevator hinge moment, neutral point.
Maneuver point, static margin for stick fixed and stick free conditions, control force and control gradient. Trim tabs and types of trim tabs, aerodynamic and mass balancing of control surfaces, forward and aft most limits of CG.

Total Hours: 08

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Unit 3: Static directional and lateral stability and control:
Introduction to lateral-direction stability- aerodynamic forces and moments, aircraft side force due to side slip, aircraft rolling moment due to side slip and aircraft yawing moment due to side slip. Aircraft component contribution on directional static stability, Aircraft component contribution for lateral-directional stability, lateral directional control power, rudder requirements.
Total Hours: 06
Unit 4: Aircraft Equations of Motion and Linearization
Coordinate Systems, Newton's second law of rigid dynamics, Axes system and relevant transforms, Euler angle formula, 6 DoF equations of motion, Aerodynamic, gravitational and thrust forces, Linearized small perturbation equations for longitudinal and lateral motions.
Total Hours: 07
Unit 5: Longitudinal Flight Dynamics and Key Stability Derivatives
Stability characteristic equation for longitudinal motion and its solution ; roots of characteristic equation and types of motions indicated by them, short period oscillation (SPO) and long period oscillation (LPO) or Phugoid, Approximations to modes of longitudinal motion , Influence of stability derivatives on Short period mode and Phugoid mode.
Total Hours: 07
Unit 6: Lateral Flight Dynamics and Key Stability Derivatives:
Lateral Coupled dynamic stability - state variable form of equations, characteristic equation and its roots, motions indicated by roots, - role subsidence, spiral mode, Dutch roll, Approximations to modes of lateral motion.
Total Hours: 06

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, B	AIAA	2nd Edition	2004
Reference Books					
1	Aircraft performance, stability and control	Perkins, C.D. & Hage, R.E.	John Wiley	4th Edition	1949
2	Mechanics of flight	Phillips, W.F	John Wiley	2nd Edition	2010
3	Introduction to Aircraft Flight Mechanics	Yechout, T.R	AIAA Education	1st Edition	2003

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Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC310, Aircraft Design
Prerequisite/s	0AEPC304, Aircraft Performance
Teaching Scheme: Lecture/Tutorial	03/01
Credits	04
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introducedesign methodology involved in the Aircraft Design Process.
2	Teach the concepts and calculationsinvolved in of preliminary Aircraft Design .

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC310_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)**
0AEPC310_2	Describe about various cost factors involved in the operation of an aircraft and about airline economics **(K^2)**
0AEPC310_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 requirements **(K^3)**
0AEPC310_4	Estimate the performance characteristics- take-off, landing level turn, climb for the given aircrafts **(K^3)**
0AEPC310_5	Estimate the Drag characteristics, air loads, V-n diagram gust load diagrams for the Aircrafts **(K^4)**
0AEPC310_6	Perform constrain 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.
Total Hours: 08
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.
Total Hours: 08

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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 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.
Total Hours: 07
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
Total Hours: 07
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.
Total Hours: 06
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.
Total Hours: 06

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Aircraft Design: A Conceptual Approach	Raymer, D.P	AIAA Education Series	5th Edition	1999
2	Aircraft Performance and Design	Anderson, J.D.	McGraw-Hill	3rd Edition	2016
3	Introduction to Aircraft Design	Fielding, J.P.	Cambridge University Press	-	2005

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TY AE 29/28

Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC311, Composite Materials & Structures
Prerequisite/s	0AEPC204, Solid Mechanics
Teaching Scheme: Lecture/Tutorial	03/00
Credits	03
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Introduce composite materials, advantages, limitations, and fabrication processes.
2	Teach the concepts and calculation of micromechanical properties of composite lamina.
3	Explain the macro-mechanical behavior of lamina and laminate and their analyses.
4	Introduction to the concept of smart structures and structural health monitoring methods.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC311_1	Distinctly identify composite materials with their advantages, applications and classification along with nomenclature, types of laminated composites along with their fabrication processes.
0AEPC311_2	Interpret the effect of fiber and matrix content on the composite lamina and laminate subjected to external loads.
0AEPC311_3	Explain the stress strain relations, elastic constants for isotropic, anisotropic and orthotropic composite laminates.
0AEPC311_4	Derive the governing equations for the analysis of general laminated composite plates along with the understanding of hygro-thermal stresses and strains and failure theories of laminated composites.
0AEPC311_5	Explain the concept of smart materials and structural health monitoring.

Course Contents:

Unit 1: Introduction to composite materials
Composite materials: Introduction, phases of composites, advantages, limitations and applications. Types of composites, reinforcements, and matrix materials. **Fabrication techniques:** Initial form of constituents, lay-up, curing of composite. Hand lay-up, Spray lay-up, Compression molding, Injection molding, Filament winding, Pultrusion method of fabrication.
Total Hours: 06
Unit 2: Micromechanics
Introduction: Micro and macro mechanics, importance, methods. **Evaluation of material properties:** In-plane and transverse moduli, Poisson's ratio by mechanics of material approach, Helpin-Tsai equation.
Total Hours: 06
Unit 3: Stress-Strain Relations
Introduction: Isotropic, anisotropic, homogenous, and non-homogenous materials. Stress and strain. **Generalized Hooke's law:** Number of elastic constants for various types of materials, physical significance of compliance coefficients, relation between elastic and engineering constants, relation between compliance and stiffness coefficients, restriction on engineering constants.
Total Hours: 07

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Unit 4: Macromechanics of lamina
Orthotropic Lamina: Stresses and strains for plane stress conditions, stress transformation equations, variation of engineering constants with respect to fiber orientation, strength of a lamina, hygro-thermal stresses and strains. **Failure theories:** Maximum stress failure criterion, maximum strain failure criterion, Tsai-Hill failure criterion, Hoffman failure criterion, Tsai-Wu failure criterion.
Total Hours: 08
Unit 5: Macro-mechanical Analyses of Laminates
Laminate: Introduction, assumptions, laminate code. **Basic Equations:** Shear deformation theories (CPT, FSDT), strain-displacement relations, stress- displacement relations, Law of minimum potential energy, governing differential equations.
Total Hours: 07
Unit 6: Smart Structures
Introduction: Sensors, actuators, and processors. Structural Health Monitoring (SHM), Multi-functional structures. **SHM systems:** Smart patch, Optical fiber sensors, piezzo-transducers. Active smart structures: Vibration suppression, Damage mitigation, and Shape adaptive structures & flow control.
Total Hours: 06

Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Mechanics of Composite Materials	Jones, R.M.	McGraw-Hill	2nd Edition	1998
2	Composite Materials and Aircraft Structures	Alan Baker, Stuart Dutton, Donald Kelly	American Institute of Aeronautics and Astronautics, Inc.	2nd Edition	2004
3	Mechanics of laminated composite plates and shells: Theory and Analysis	J N Reddy	CRC Press.	2nd Edition	2004

Reference Books

1	Mechanics Of Fibrous Composites	M H Datoo	Elsevier Science Publishers LTD	-	1991
2	Mechanics of Composite Materials	K Kaw	CRC Press Taylor & Francis Group	2nd Edition	2006

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Sant Dynaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

An Autonomous Institute

DEPARTMENT OF AERONAUTICAL ENGINEERING

Course Details:

Academic Year	:	**2019 - 2020**
Class	:	**T. Y (Sem - VI)**
Course Code	:	**0AEPC357**
Course Name	:	**Computational Fluid Dynamics Laboratory**
Pre-Requisites	:	**0AEPC203 - Fluid Mechanics** **0AEBS206 – Numerical Analysis**
Teaching Scheme(L/P/T)	:	**00/02/00**
Credits	:	**1**
Evaluation Scheme (ISE/ESE)	:	**25/00**
Course Coordinator	:	**Mr. Noble Sharma**
Designation	:	**Assistant Professor**
Contact Number	:	**9700266337**
E-Mail ID	:	**ns_aero@adcet.in**

Course Outcomes (CO's): **Upon successful completion of this course, the students will be able to**		
0AEPC357_1	Carry out the analysis of complex engineering problems related to Aerodynamics to provide solutions	K_4
0AEPC357_2	Use the Modern Software Tool for solving & simulation the simple fluid flow cases	S_2
0AEPC357_3	Effectively record the analysis reports of the Analysis Report carried out using the software tool and present them orally.	S_3
0AEPC357_4	Recognize the need for life-long learning of the modern tools & techniques used for providing solutions to complex engineering problems	A_3
0AEPC357_5	Follow professional and ethical principles during laboratory work	A_3

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Course Contents:

Experiment List	
1	Introduction to CFD / Need for Programming and Getting to the MATLAB environment with Basic programming
2	Getting to the GUI of ANSYS Fluent
3	Simulation of Laminar Flow through a pipe
4	Simulation of Boundary Layer Flow over a Flat Plate
5	Simulation of Subsonic Flow over an Airfoil
6	Simulation of Steady Flow Past a stationary Cylinder
7	Simulation Turbulent Flow through a pipe
8	Simulation of Flow over a Rotating Cylinder with heat transfer
9	Solve 1-Dimensional Advection (Wave) equation using Explicit Finite difference method
10	Solve 1-Dimensional Advection (Wave) equation using Explicit Lax method
11	Solve 1-Dimensional unsteady heat diffusion equation using Explicit method
12	Solve 1-Dimensional unsteady heat diffusion equation using Implicit method

Text Books:

Sl.No	Title of the Book - Author	Publisher/Edition/Year
1	ANSYS FLUENT User Manual and FLUENT Tutorials	ANSYS, Inc. Release 19.2
2	MATLAB Documentation	MathWorks, Inc. Release 2019

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TY AE - 33138

Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC358, Unmanned Aerial Vehicles Laboratory
Prerequisite/s	-
Teaching Scheme: Lecture/Practical	02/02
Credits	02
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to	
1	Make the students to understand the basic concepts of UAV systems design.
2	Provide students with hands on experience in making and flying the Unmanned Aerial Vehicles

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC358_1	Carryout and analysis the design of UAV Systems and Apply them to make an UAV System as a Team. (K^6)
0AEPC358_2	Use the Modern Software Tool for solving & simulation the UAV Systems. (S^3)
0AEPC358_3	Recognize the need for life-long learning of the modern tools & techniques used for providing solutions to the complex engineering problems. (A^3)
0AEPC358_4	Follow professional and ethical principles during laboratory work (A^3)

List of Experiments:

Experiment List	
1	Introduction to Unmanned Aircraft Systems--models and prototypes – System Composition-applications
2	The Design of UAV Systems : Introduction to Design and Selection of the System- Aerodynamics and Airframe Configurations- Characteristics of Aircraft Types
3	The Design of UAVSystems:Design Standards and Regulatory Aspects-UK,USA and Europe- Design for Stealth--control surfaces-specifications.
4	Avionics Hardware: Autopilot – AGL-pressure sensors-servos-accelerometer –gyros-actuators- power supply-processor
5	Avionics Hardware: Installation, configuration, and testing
6	Communication Payloads and Controls: Payloads-Telemetry-tracking-Aerial photography-controls-PID feedback-radio control frequency range
7	Communication Payloads and Controls: Simulation-ground test-analysis-trouble shooting
8	Waypoints navigation-ground control software- System Ground Testing- System In-flight Testing
9	Case Study on Future Prospects and Challenges on Mini and Micro UAVs
10	Case Study on Future Prospects and Challenges on Mini and Micro UAVs

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Text Books					
Sr. No	**Title**	**Author**	**Publisher**	**Edition**	**Year of Edition**
1	Unmanned Aircraft Systems UAV design, development and deployment	Reg Austin	Wiley	-	2010
2	Flight Stability and Automatic Control	Robert C. Nelson,	McGraw-Hill, Inc	-	1999
Reference Books					
1	Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy	Kimon P. Valavanis	Springer	-	2007
2	Design of Unmanned Air Vehicle Systems	Dr. Armand J. Chaput	Lockheed Martin Aeronautics Company	-	2001

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Course Details:

Class	B. Tech, Sem.-VI
Course Code and Course Title	0AEPC359, Composite Materials & Structures Laboratory
Prerequisite/s	0AEPC311, Composite Materials & Structures
Teaching Scheme: Lecture/Tutorial	00/02
Credits	01
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to	
1	To study the behavior of different composite materials.
2	Explain behavior of isotropic, orthotropic and anisotropic materials.
3	To study the effect of fiber volume fraction and laminate scheme on analysis.
4	Explain the macro-mechanical behavior of composite lamina and laminates.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC359_1	Learn and demonstrate the basic knowledge in MATLAB/SCILAB.
0AEPC359_2	Evaluate the material properties of a composite using experimental/analytical methods.
0AEPC359_3	Demonstrate the macro-mechanical analysis of composite lamina and laminates.
0AEPC359_4	Learn the best & effective practices for carrying out the experimentation
0AEPC359_5	Follow the professional practices like maintaining a laboratory journal and completion of work on time.

Course Contents: (Minimum 7)

Experiment No 1: Rough estimation of fiber volume fraction by microscopic observations
Experiment No 2: Fiber volume fraction estimation using acid bath.
Experiment No 3: Estimation of void volume in the composite.
Experiment No 4: To study the effect of fiber orientation on tensile testing characteristics.
Experiment No 5: To study the effect of lamination scheme on tensile testing characteristics.
Experiment No 6: To study the effect of fiber orientation on bending characteristics.
Experiment No 7: To study the effect of lamination scheme on bending characteristics.
Experiment No 8: Evaluation of elastic constants for orthotropic and anisotropic materials
Experiment No 9: Calculation of elastic constants for a lamina
Experiment No 10: Determine Failure criteria for a composite lamina
Experiment No 11: Evaluation of stiffness matrices for a laminate: Part 1
Experiment No 12: Evaluation of stiffness matrices for a laminate: Part 2
Experiment No 13: Analysis of composite laminate
Experiment No 14: Case study on fabrication of composite laminates

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Text Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Mechanics of Composite Materials	Jones, R.M.	McGraw-Hill	2nd Edition	1998
2	Composite Materials and Aircraft Structures	Alan Baker, Stuart Dutton, Donald Kelly	American Institute of Aeronautics and Astronautics, Inc.	2nd Edition	2004
3	Mechanics of laminated composite plates and shells: Theory and Analysis	J N Reddy	CRC Press.	2nd Edition	2004

Reference Books

Sr. No	Title	Author	Publisher	Edition	Year of Edition
1	Mechanics Of Fibrous Composites	M H Datoo	Elsevier Science Publishers LTD	-	1991
2	Mechanics of Composite Materials	K Kaw	CRC Press Taylor & Francis Group	2nd Edition	2006

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Course Details:

Class	T.Y. B. Tech, Sem.-VI
Course Code and Course Title	0AEPC360, Aircraft Design Laboratory
Prerequisite/s	0AEPC353 - Aircraft Performance Laboratory
Teaching Scheme: Lecture/Practical	00/02
Credits	01
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to	
1	Introducedesign methodology involved in the Aircraft Design Process.
2	Teach the concepts and calculationsinvolved in of preliminary Aircraft Design .

Course Outcomes (COs): Upon successful completion of this course, the student will be able to	
0AEPC360_1	Analyze and Estimate the take-off weight and other dimensional parameters for the aircraft and Estimate the performance characteristics (K^4)
0AEPC360_2	Carry out a conceptual and preliminary design of an Aircraft as a Team. (K^6)
0AEPC360_3	Use the Modern Software Tool for solving & simulation the simple fluid flow cases. (S^2)
0AEPC360_4	Effectively record the analysis reports of the Analysis Report carried out using the software tool and present them orally. (S^3)
0AEPC360_5	Recognize the need for life-long learning of the modern tools & techniques used for providing solutions to the complex engineering problems. (A^3)

List of Experiments:

Sl. No	Name of the Exercise
1	Comparative configuration study of different types of airplanes and Comparative study on specification and performance details of aircraft
2	Comparative graphs preparation and selection of main parameters for the design
3	Preliminary weight estimations, selection of main parameters,
4	Power plant selection, Aerofoil selection, Wing tail and control surface
5	Drag estimation, Detailed performance calculations and stability estimates
6	V-n diagram for the design study, and Gust and manoeuvrability envelopes
7	Critical Structural design study
8	Load estimation of wings and fuselage
9	Balancing and Maneuvering loads on tail plane, Aileron and Rudder loads
10	Detailed structural layouts and Preparation of a detailed design report with drawings

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

Teaching and Evaluation Scheme, B. Tech: VII Semester

Course Code	Course	Teaching Scheme				Evaluation Scheme				
						Scheme	Theory Marks		Practical Marks	
		L	P	T	C		Max.	Min. for passing	Max.	Min. for passing
0AEPC401	Vibrations and Structural Dynamics	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC402	Aircraft General Engineering Maintenance	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC420	Space Mechanics	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEOE403 TO 0AEOE406	Open Elective	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPE407 TO 0AEPE4012	Program Elective- I	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC451	Structural Dynamics Laboratory	--	2	--	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC452	Aircraft Systems Laboratory	--	2	--	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPC453	Virtual Instrumentation Laboratory	--	2	--	1	ISE	--	--	50	10
0AEPC454	Aircraft General Engineering Maintenance Laboratory	--	2	--	1	ISE	--	--	50	20
0AEPR455	Industrial Training	--	--	--	1	ISE	--	--	50	20
0AEPR456	Project Phase-I	--	6	--	4	ISE	--	--	50	10
		15	**14**	**--**	24		**500**		**400**	
Total Contact Hours/ Week = 29						**Total Marks = 900**				

Course Code	Open Electives	Course Code	Open Electives
0AEOE403	Introduction to Flight	0AEOE405	Introduction to Gas Dynamics and Jet Propulsion
0AEOE404	Experimenatal Aerodynamics	0AEOE406	Introduction to UAV

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B.Tech-ST-01/04

Course Code	Program Elective – I	Course Code	ProgramElective – I
0AEPE407	Wind Tunnel techniques	0AEPE410	Engineering Design Optimization
0AEPE408	Heat and Mass Transfer	0AEPE411	Helicopter Theory
0AEPE409	Material Testing and Charecterization	0AEPE412	Lighter-Than-Air Systems

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	--	--	--	13	03	03	05	--	--
Cumulative Sum	6	22	33	93	03	03	08	--	--

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Teaching and Evaluation Scheme, B. Tech: VIII Semester

Course Code	Course	Teaching Scheme				Evaluation Scheme				
		L	P	T	C	Scheme	Theory Marks		Practical Marks	
							Max.	Min. for passing	Max.	Min. for passing
0AEPC419	Avionics & Instrumentation	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC421	Finite Element Analysis	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPE413 TO 0AEPE418	Program Elective-II	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPE422 TO 0AEPE427	Program Elective-III	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPE428 T0 0AEPE433	Program Elective-IV	3	--	--	3	ISE I	10	40	--	--
						MSE	30		--	--
						ISE II	10		--	--
						ESE	50		--	--
0AEPC457	Finite Element Analysis Laboratory	--	2	--	1	ISE	--	--	50	20
						ESE	--	--	50	20
0AEPR458	Project Phase- II	--	8	--	8	ISE	--	--	50	20
						ESE	--	--	50	20
		15	**10**	--	25		**500**	--	**200**	--
Total Contact Hours/ Week = 25						**Total Marks = 700**				

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Course Code	ProgramElective – II	Course Code	ProgramElective – II
0AEPE413	Hypersonic Aerodynamics	0AEPE416	Aircraft Engine Design
0AEPE414	Advanced Propulsion Systems	0AEPE417	Airline and Airport Management
0AEPE415	Advanced Mechanics of Solids	0AEPE418	Lean Six Sigma

Course Code	ProgramElective – III	Course Code	ProgramElective – III
0AEPE422	Automobile and Industrial Aerodynamics	0AEPE425	Navigation, Guidance and Control
0AEPE423	Combustion	0AEPE426	Flight Scheduling and Operations
0AEPE424	Experimental Stress Analysis	0AEPE427	Aircraft Rules and Regulations - DGCA (CAR)

Course Code	ProgramElective – IV	Course Code	ProgramElective - IV
0AEPE428	Turbulence Modeling	0AEPE431	Numerical Heat Transfer and Fluid Flow
0AEPE429	Introduction to Propellant Technology	0AEPE432	Air Traffic Control and Airport Management
0AEPE430	High Temperature Materials	0AEPE433	Probability and Statistics

Course Category	HS	BS	ES	PC	PE	OE	PR	MC	AC
Credits	-	-	-	07	09	-	08	-	-
Cumulative Sum	6	22	33	100	12	03	16	--	--

L: Theory Class	**T:** Tutorial Session
P: Practical/Lab Session	**C:** No. of Credits
ISE I: In-Semester Evaluation I	**ISE II:** In-Semester Evaluation II
MSE: Mid Semester Evaluation	**ESE:** End Semester Evaluation
HS: Humanities and Social Sciences	**PC:** Professional Core
BS: Basic Sciences	**OE:** Open Elective
ES: Engineering Sciences	**PR:**Seminar, Mini-project, Project
MC: Mandatory Course	**AC:** Audit Course

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B. Tech - ST - 04/04

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DEPARTMENT OF AERONAUTICAL ENGINEERING

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC401 - Vibration and Structural Dynamics
Prerequisite/s	0BSES110 – Engineering Mechanics
	0AEPC204 - Solid Mechanics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Explain various linear vibratory models of dynamic systems with changing complexities.
2	Analyze the differential equation of motion of vibratory systems.
3	Identify free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.
4	Illustrate the interaction among the aerodynamic, elastic and inertia forces.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC401_1	Describe the basic concepts of vibration	K2
0AEPC401_2	Explain different vibration measuring instruments	K2
0AEPC401_3	Describe the interaction among the aerodynamic, elastic and inertia forces	K2
0AEPC401_4	Determine natural frequency of mechanical vibrating system/element	K3
0AEPC401_5	Compute the parameters of vibration isolation system	K3
0AEPC401_6	Identify the vibratory response of mechanical system/element	K3

Course Contents:

Unit 1:	**Fundamentals of vibration**	**Total Hours:**	**5**

Basic concepts of vibration, Classification of vibration, Harmonic & Periodic Motion, Vibration Model, Derivation of Equation of Motion with use of Newton's Method and Energy Method, Rayleigh s Energy Method, Free Vibration of an Undamped Translational & Torsional System

Unit 2:	**Free Vibration of Single-Degree-of-Freedom Systems**	**Total Hours:**	**8**

Free Vibration of Single-Degree-of-Freedom Systems – Damping models, Special cases: oscillatory, Non-oscillatory and Critically damped motions, Free Vibration with Viscous Damping, Free Vibration with Coulomb Damping, Logarithmic decrement, Harmonically Excited Vibration – Response of a Damped System a)Under Harmonic Force, b) Under the Harmonic Motion of the Base, c) Under Rotating Unbalance, Vibration Isolation & Transmissibility, Vibration measuring instruments

Unit 3:	**Two-Degree & Multi-Degree of Freedom Systems**	**Total Hours:**	**9**

Two-Degree-of-Freedom Systems - Free Vibration of Two Degree Freedom System, Coordinate Coupling and Principal Coordinates, Vibration Absorber, Using Lagranges Equations to Derive Equations of Motion, Multi-degree-of-Freedom Systems – Derivation of equations of motion, Influence coefficient method, Properties of vibrating systems: flexibility and stiffness matrices, Reciprocity theorem, Modal analysis: Undamped & Damped, Hamilton's principle

Unit 4:	**Approximate Methods**	**Total Hours:**	**8**

Rayleigh's Method- Computation of the Fundamental Natural Frequency, Fundamental Frequency of Beams and Shafts, Holzer's Method – Torsional System, Matrix Iteration Method - Computation of Various Natural Frequencies

Unit 5:	**Continuous System**	**Total Hours:**	**7**

Transverse Vibration of a String or Cable - Equation of Motion, Boundary Conditions, Free Vibration of a String with Both Ends Fixed, Longitudinal Vibration of a Bar or Rod - Equation of Motion and Boundary, Torsional Vibration of a Shaft or Rod & Lateral Vibration of Beams Conditions

Unit 6:	**Aeroelasticity**	**Total Hours:**	**6**

Divergence of Lifting Surface - The phenomenon of divergence, divergence of 2-D wing section, Aero Elastic Instabilities and their Prevention, Steady State Aero-Elasticity Problems in General - Loss and reversal of aileron Control: 2D case, Introduction to Flutter and Buffeting – The Phenomenon of flutter, flutter of a cantilever wing, and its Prevention

Text Books:

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

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Introduction to the study of Aircraft Vibration and Flutter	Scanlan R.H. and Rosenbaum R	John Wiley and Sons. New York	2nd Edition	1982
2	Mechanical Vibrations	Tse. F.S., Morse, I. F., Hinkle, R.T	Prentice Hall, New York	2nd Edition	1984
3	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	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC402 - Aircraft General Engineering and Maintenance
Prerequisite/s	Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Enable Knowledge about Aircraft Maintenance Practices and Ideas about Aircraft Tools
2	Understand plastics and composites in aircraft repair and maintenance through different techniques
3	Understand the piston engine inspection, Maintenance and Testing Procedures
4	Introduce maintenance of different systems in aircraft including landing gear, Hydraulic, Pneumatic, Rain, Fire, Iee protection systems.
5	Introduce importance of aircraft jacking, assembly and rigging of both fixed wing and rotor wing aircraft
6	Summaries Safety practices in maintenance and repair in overall aircraft including furnishings and miscellaneous equipment.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC402_1	Understand Aircraft Maintenance Practices and Tool usages.	K2
0AEPC402_2	Carryout Inspections and maintenance checks on aircraft piston engines	K2
0AEPC402_3	Classify repair procedure that occur in plastic and composite component of an Aircraft	K2
0AEPC402_4	Select the maintenance procedure of various systems of aircraft according to various manuals	K3
0AEPC402_5	Express the safety practices while handling Aircraft hazardous materials	K3

Course Contents:

Unit 1:	**Aircraft Maintenance Practices - An Introduction**	**Total Hours:**	**6**
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			

Unit 2:	**Aircraft Maintenance Tools**	**Total Hours:**	**8**
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			

Unit 3:	**Inspection of Piston Engines**	**Total Hours:**	**8**
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			

Unit 4:	**Aircraft Jacking, Assembly and Rigging**	**Total Hours:**	**6**
Airplane jacking, weighing and C.G. Location, Balancing of control surfaces, Inspection maintenance, Helicopter flight controls. Tracking and balancing of main rotor.			

Unit 5:	**Aircraft System Components and Its Maintenance Practices**	**Total Hours:**	**10**
Trouble shooting and maintenance practices, Service and inspection: Inspection and maintenance of landing gear systems, Inspection and maintenance of air-conditioning and pressurisation 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).			

Unit 6:	**Safety Practices**	**Total Hours:**	**4**
Hazardous materials storage and handling, Aircraft furnishing practices, Aircraft Fuelling and defueling safety procedures, Maintenance briefing and debriefing Procedures. Supportive equipment and emergency operations.			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Aircraft Maintenance and Repair	William J. Watkins, Jr., Ronald Sterkenburg, Kroes, Frank Delp	McGraw Hill, New York	VII	2013
2	Civil Aircraft Inspection Procedures	CAA (Civil Aviation Authority)	CAA	cap 459-part i basic	1992
3	Aircraft Power Plants	Kroes and Wild	McGraw Hill, New York	VII	1994

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Aircraft Repair Manual	Larry Reithmeir	Palamar Books, Marquette,		1992

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B. Tech - AE - 03/81

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC420 - Space Mechanics
Prerequisite/s	0ALPC305- Propulsion-II
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	To make students familiar with terminologies related to space mechanics and solar system.
2	To provide basic knowledge of n-body problems and two body problems and to solve problems associated with n-body and two body problems.
3	To make students aware about satellite injection in orbit and orbit perturbations.
4	To provide students basic understanding of various aspects of interplanetary missions.
5	To make students aware about low thrust trajectories, its need and application.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC420_1	Understand general concepts of space mechanics and solar system.	K2
0AEPC420_2	Interpret n-body problem and solve the two body problems.	K3
0AEPC420_3	Understand general aspects of satellite injection in trajectory and launch vehicle performance.	K2
0AEPC420_4	Apply the knowledge of satellite orbit perturbations to solve the problems.	K3
0AEPC420_5	Demonstrate trajectory selection for interplanetary missions.	K3
0AEPC420_6	Identify the need of low thrust trajectories and describe basic concept of low thrust trajectories.	K2

Course Contents:

Unit 1:	**Basic Concepts**	**Total Hours:**	**6**

The Solar System, References Frames and Coordinate Systems, The Celestial Sphere, The Ecliptic, Motion of Vernal Equinox, Sidereal Time, Solar Time, Standard Time, The Earth's Atmosphere, History of Solar System Discovery and Planetary Motion, Kepler's Laws of Planetary Motion.

Unit 2:	**The Many Body and 2 Body Problem**	**Total Hours:**	**8**

The general N-body problem, Integrals of motion, The Virial theorem, The circular restricted three-body problem, Jacobi's integral, Applications to spaceflight, Relative motion in the N-body problem.
The Two-Body Problem: Equations of motion, General characteristics of motion, Relations between position and time, Expansions in elliptic motion, Orbital elements

Unit 3:	**The Launching of a Satellite**	**Total Hours:**	**6**

Launch vehicle ascent trajectories, The injection of a satellite, General aspects of satellite injection, Dependence of orbital parameters on in-plane injection parameters, Launch vehicle performances, Orbit deviations due to injection errors, Small injection errors

Unit 4:	**Perturbed Satellite Orbits**	**Total Hours:**	**8**

Special and general perturbations, Cowell's method, Encke's method, Method of variation of orbital elements, Lagrange's planetary equations, Modification of the sixth Lagrange equation, Other forms of the planetary equations

Unit 5:	**Interplanetary Missions**	**Total Hours:**	**7**

Basic concepts, Two-dimensional interplanetary trajectories, Hohmann trajectories, Launch opportunities, Fast interplanetary trajectories, The launch of interplanetary spacecraft, Trajectory about the target planet.

Unit 6:	**Low-Thrust Trajectories**	**Total Hours:**	**7**

Equations of motion, Constant radial thrust acceleration, Constant tangential thrust, Characteristics of the motion, Linearization of the equations of motion, Performance analysis

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Rocket Propulsion and Space Dynamics	J. W. Cornelisse, H. F. R. Schoyer, K. F. Wakker	Pitman Publishing Ltd	1st Edition	1979
2	Orbital Mechanics for Engineering Students	Howard D. Curtis	Elsevier Butterworth-Heinemann	1st Edition	2005

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B.Tech – AE – 04/61

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Space Vehicle Design	Michael D. Griffin, James R. French	AIAA Education Series	2nd Edition	2004
2	Spacecraft Dynamics and Control, A Practical Engineering Approach	Marcel J. Sidi	Cambridge University Press	1st Edition	1997
3	Space Flight Dynamics	William E. Wiesel	Irwin McGraw-Hill	2nd Edition	1995
4	Space Vehicle Dynamics and Control	Bong Wie	AIAA Education Series	2nd Edition	2008

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Course Details:

	Class	B. Tech, Sem.-VII
	Course Code and Course Title	0AEOE403 - Introduction to Flight
	Prerequisite/s	NIL
	Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
	Credits	3
	Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to	
1	Explain the students historical developments in the Aeronautical Engineering & Current Trends
2	Make student understand the basic components, systems & subsystems of the Aircraft and their functions
3	Provide students the fundamental knowledge on the Verticals of Aeronautical Engineering – Aerodynamics, Propulsion, & Structures
4	Explain the students the basics of Air Transportation & Airport Operations

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

	0AEOE403_1	Explain the historical developments in the Aeronautical Engineering, Current Trends in the Aviation Industry	K2
	0AEOE403_2	Comment & Explain in detail the basic components, systems & subsystems of the Aircraft and their functions	K2
	0AEOE403_3	Explain the fundamentals of Aerodynamics, Propulsion, Structures & Their classifications	K2
	0AEOE403_4	Comment & Explain in detail the basics of Air Transportation & Airport Operations	K2
	0AEOE403_5	Comment & Explain on the material requirements for Aeronautical applications	K2
	0AEOE403_6	Identify & Comment on the various configurations of the aircraft	K2

Course Contents:

Unit 1:	**Introduction & Basic Anatomy of Aerospace Vehicles**	**Total Hours:**	**7**
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			

Unit 2:	**Propulsion - Air Breathing and Non Air Breathing Engines**	**Total Hours:**	**7**
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			

Unit 3	**Aircraft Maintenance and Repair**	**Total Hours:**	**8**
General Aircraft Repairs- A, B, C, D Checks - Starting procedures of Turbo Prop, Turbo Fan and Turbojet Engines- Flight Inspection Procedures - Tools used in Aircraft Maintenance- MRO Sector - Indian MRO Sector - Various job roles involved in the maintenance sector.			

Unit 4:	**Aviation - Air Transportation systems**	**Total Hours:**	**6**
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 involved in the Aviation Sector - Flight Scheduling in brief.			

Unit 5:	**Aerodynamics**	**Total Hours:**	**7**
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.			

Unit 6:	**Materials and Aircraft Structures**	**Total Hours:**	**7**
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			

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

Reference Books:					
Sr.No	**Title**	**Author**	**Publisher**	**Edition**	**Year**
1	Introduction to Aerospace Engineering with a Flight Test Perspective	Stephen Corda	Wiley	1st	2011
2	Aviation. An Introduction to the Elements of Flight	Algernon Edward Berriman	Nabu Press	1st	2010
3	Aircraft Propulsion and Gas Turbine Engines	Ahmed F El-Sayed	Taylor and Francis	2nd	-
4	Experiments in Aerodynamics	Samuel Pierpont Langley	Nabu Press	-	2010
5	Aircraft Communication & Navigation System	Mike Tooley & David Wyatt	Routledge (SIE)	1st	2007

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B. Tech – AE – 07/61

Course Details:

Class	B. Tech, Sem-VII
Course Code and Course Title	0AEOE405 : Gas Dynamics and Jet Propulsion
Prerequisite/s	0AEPC252 - Engineering Thermodynamics
Teaching Scheme: Lecture/Tutorial/Practical	3/0/0
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/30/50

Course Objectives: The course aims to

1	Interpret the flow pattern in flow and nonflow systems
2	To understand the phenomenon of shock waves and its effect on flow.
3	To impart in depth knowledge about jet propulsion and Rocket Propulsion.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEOE405_1	Discuss the effects of variable area duct under the effect of varying back pressure.	K3
0AEOE405_2	Estimate the flow parameters over convex and concave corner and comment on the downstream flow	K3
0AEOE405_3	Give an insight into advanced jet & rocket propulsion systems and compare one another	K3
0AEOE405_4	Perform the engine cycle analysis for all thermodynamic cases	K4
0AEOE405_5	Interpret and design various propulsive systems suitable for the application and operation	K4

Course Contents:

Unit 1:	**Introduction to Isentropic compressible flows**	**Total Hours:**	**6**

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.

Unit 2:	**Concept Of Shocks & Flow Through Constant Area Ducts**	**Total Hours:**	**7**

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.

Unit 3:	**Parametric Cycle Analysis of Ideal Engines**	**Total Hours:**	**7**

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

Unit 4:	**Liquid Propellant Rocket Engines**	**Total Hours:**	**8**

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-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**	**Total Hours:**	**6**

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.

Unit 6:	**Electric & Nuclear propulsion**	**Total Hours:**	**8**

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.

Text Books:

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

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B.Tech - AE - 09/61

Course Details:

Class	B. Tech, Sem.-VII
Course Code and Course Title	0AEOE404 - Experimental Aerodynamics
Prerequisite/s	0AEPC203 – Fluid Mechanics 0AEPC209 – Aerodynamics-I 0AEPC302 – Aerodynamics-II
Teaching Scheme: Lecture/Tutorial/Practical	03/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Make the students understand various experimental techniques complying with aerodynamics.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEOE404_1	Describe and recognize various types of wind tunnels, measuring equipments and their applications.	K2
0AEOE404_2	Explain various techniques of pressure, force and velocity measurement.	K2
0AEOE404_3	Analyze qualitative and quantitative flow behavior over various bodies.	K3
0AEOE404_4	Select data acquisition system for the aerodynamic characteristic measurements.	K3
0AEOE404_5	Design and develop models to be tested on wind tunnels.	K4

Course Contents:

Unit 1:	**Introduction to Wind Tunnels**	**Total Hours:**	**8**
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.			

Unit 2:	**Flow Visualization**	**Total Hours:**	**6**
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).			

Unit 3:	**Pressure and Velocity Measurement**	**Total Hours:**	**8**
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			

Unit 4:	**Force and Moment Measurement**	**Total Hours:**	**6**
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			

Unit 5:	**Unsteady Measurement**	**Total Hours:**	**8**
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.			

Unit 6:	**Data Acquisition System**	**Total Hours:**	**6**
ADC Cards; Amplifiers; Signal Conditioners; I² C Based Data Acquisition System; Error Analysis; Uncertainty Analysis and its uses; Experimental aerodynamics for industrial applications.			

Text Books:

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

Reference Books:

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

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B.Tech - A-E - 08/61

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	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	B. Tech, Sem-VII
Course Code and Course Title	0AEOE406 - Introduction to UAV
Prerequisite/s	NILL
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: This course will enable students to

1	Comprehend the history UAV systems.
2	Acquire the knowledge of basic aerodynamics, performance, stability and control
3	Appreciate the use of Navigation system design and senors used in fligh path planning
4	Design/ Differntiate the importance of payload system in UAV

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEOE406_1	Classsify the UAV's and will be equipped with kowledge of Design process involved	K2
0AEOE406_2	Explai the basic aerodynamics and performance concepts associated with Fixed wing UAV	K3
0AEOE406_3	Derieve the Equations of motion of an UAV and explain the PID control strategry associated with it	K3
0AEOE406_4	Derieve and explain the mathematics associated with Launch and recovery systems	K3
0AEOE406_5	Explain the PID control strategy involved in altitude hold of a quadcopter	K4

Course Contents:

Unit 1:	**Introduction to UAV Systems**	**Total Hours:**	**7**
Aviation history, Over view of UAV systems, mission and classification based on air vehicle type; Design Process-Conceptual Design, Preliminary Design and Detail Design			

Unit 2:	**The Air Vehicle and Performace fundamentals**	**Total Hours:**	**6**
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			

Unit 3:	**Fundamentals of Autopilot Design**	**Total Hours:**	**9**
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			

Unit 4:	**Navigation and Guidance systems**	**Total Hours:**	**8**
Navigation system Design: Introduction, Coordinate systems used, Inertial Navigation system, Global positioning system, Position fixed naviagtion system; Inertial Navigation sensors-Accelcromcter, Gyroscope, Airspeed indicator, Altimeter, Design considerations; Guidance: Fundamentals of Guidance, Guidance laws, LOS, PN guidance, Way point navigation and Seeker			

Unit 5:	**Launch and Recovery systems**	**Total Hours:**	**6**
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			

Unit 6:	**Case Study: Quadcopter controller deisgn**	**Total Hours:**	**6**
Case study: Case study -Altitude and position controller of an Quadcopter using PID controller			

Text Books:

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

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Unmanned Aircraftsystems UAVs design, development and Deployment	Reg Austin	Wiley & Sons Ltd	1	2010
2	Aircraft Performance and Design	John D. Anderson, Jr	Tata McGraw Hill	5	2012
3	Small Unmanned Fixed-Wing Aircraft Design. A Practical Approach	Andrew J. Keane, Andras Sobester, James P. Scanlan	Wiley & Sons Ltd	1	2017
4	Introduction to Multicopter Design and Control	Quan Quan	Springer	1	2017

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B.Tech-AE-12/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPE407 - Experimental Aerodynamics
Prerequisite/s	0AEPC203 – Fluid Mechanics 0AEPC209 – Aerodynamics-I 0AEPC302 – Aerodynamics-II
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Make the students understand various experimental techniques complying with aerodynamics.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE407_1	Describe and recognize various types of wind tunnels, measuring equipments and their applications.	K2
0AEPE407_2	Explain various techniques of pressure, force and velocity measurement.	K2
0AEPE407_3	Analyze qualitative and quantitative flow behavior over various bodies.	K3
0AEPE407_4	Select data acquisition system for the aerodynamic characteristic measurements.	K3
0AEPE407_5	Design and develop models to be tested on wind tunnels.	K4

Course Contents:

Unit 1:	**Introduction to Wind Tunnels**	**Total Hours:**	**8**
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.			

Unit 2:	**Flow Visualization**	**Total Hours:**	**6**
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).			

Unit 3:	**Pressure and Velocity Measurement**	**Total Hours:**	**8**
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			

Unit 4:	**Force and Moment Measurement**	**Total Hours:**	**6**
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			

Unit 5:	**Unsteady Measurement**	**Total Hours:**	**8**
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.			

Unit 6:	**Data Acquisition System**	**Total Hours:**	**6**
ADC Cards; Amplifiers; Signal Conditioners; P C Based Data Acquisition System; Error Analysis; Uncertainty Analysis and its uses; Experimental aerodynamics for industrial applications.			

Text Books:

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

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B. Tech – AE- 13/6|

Reference Books:

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

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B. Tech - AE - 14/61

Sant Dynaneshwar Shikshan Sanstha's

Annasaheb Dange College of Engineering and Technology, Ashta

DEPARTMENT OF AERONAUTICAL ENGINEERING

An Autonomous Institute

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.- VII
Course Code and Course Title	0AEPE408 - Heat and Mass Transfer
Prerequisite/s	0AEPC202 - Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Demonstrate the basic knowledge of heat transfer and differentiating between steady and unsteady states of heat transfer by conduction
2	Develop the ability among students to understand the concept of Convection and empirically corelate Forced and Free Convections
3	Make the students understand the various laws of Radiation and their application to estimate the heat flow rates
4	Understand the heat transfer in Phase changes and applying the principles of heat transfer in design of Heat Exchangers
5	Provide the basic knowledge of Mass Transfer and the application of the law governing Mass Transfer

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE408_1	Apply the concept of one dimensional steady state heat conduction to solve problems in Plane, Cylindrical and Spherical coordinates	K3
0AEPE408_2	Explain the Heat Transfer through Fins and the significance of Dimensional Analysis in unsteady state conduction	K3
0AEPE408_3	Analyze the empirical corelations for Forced and Free Convection in Laminar and Turbulent Flows	K4
0AEPE408_4	Apply the various laws governing and the concept of Radiation Heat Transfer	K3
0AEPE408_5	Explain the general aspects of Boiling and Condensation Heat Transfer; and design considerations for Heat Exchangers	K4
0AEPE408_6	Explain the basic concepts of Mass Transfer	K3

Course Contents:

Unit 1:	Introduction to Heat Transfer and Steady State Heat Conduction	Total Hours:	8

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)

Unit 2:	Heat Transfer from Extended Surfaces and Unsteady State Heat Conduction	Total Hours:	6

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- Problems.

Unit 3:	Convection Heat Transfer	Total Hours:	8

Introduction to Convection:- Concept of Hydrodynamic and thermal 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	Total Hours:	8

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 rerediation and Radiosity- Radiation shields- Problems

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Unit 5:	Boiling and Condensation, Heat Exchangers	Total Hours:	8

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.

Unit 6:	Mass Transfer	Total Hours:	4

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

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Heat and Mass Transfer	R K Rajput	S. Chand & Company Ltd	Fifth	2012
2	Heat and Mass Transfer- Fundamentals & Applications	Yunus A Cengel/ Afshin A Ghajar	Mc Graw Hill Education	Fifth	2015

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Heat Transfer	J P Holman	Mc Graw Hill Educatiom	Tenth	2010
2	Fundamentals of Heat and Mass Transfer	Incropera/Dewitt/ Bergman/Lavine	John Wiley & Sons	Sixth	2007

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPE409 - Material Testing and Characterisation
Prerequisite/s	0AEPC208 - Aircraft Materials
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Provide an introduction to materials testing and characterization and its importance
2	select appropriate characterization methods to the analysis and characterization of materials.
3	Discuss different types of testing and characterization techniques and their uses.
4	Provide basic knowledge of thermal analysis techniques.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE409_1	Prepare the specimens as per standards for respective test.	K3
0AEPE409_2	Select the appropriate test depending on material and its application.	K2
0AEPE409_3	Understand, correlate and interpret the results.	K2
0AEPE409_4	Select the characterization tool for specific application	K3
0AEPE409_5	Understand basics of thermal analysis techniques.	K2
0AEPE409_6	Identify and justify the selection of the techniques to evaluate a particular sample	K4

Course Contents:

Unit 1:	**Introduction to Material Testing**	**Total Hours:**	6

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.

Unit 2:	**Tension and Compression Testing**	**Total Hours:**	10

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.

Unit 3:	**Bending/Flexural Testing and Environmental tests for composites**	**Total Hours:**	6

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.

Unit 4:	**Creep and Fatigue Testing**	**Total Hours:**	10

Creep Testing- Introduction, Creep behavior and creep curve, Methods and equipments 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**	**Total Hours:**	6

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.

Unit 6:	**Thermal Analysis**	**Total Hours:**	4

Instrumentation, experimental parameters, Different types used for analysis, Differential thermal analysis(DTA), Differential Scanning Calorimetry (DSC), Thermogravimetry (TGA), Dilatometry.

Text Books:

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

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Reference Books:

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

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPE410 - Engineering Design Optimization
Prerequisite/s	0AEBS201- Applied Mathematics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Introduce the theory of optimization, basic definitions, classifications, and need of optimization in engineering.
2	Introduce the classical methods of optimization for single and multivariable optimization problems in engineering sciences
3	Introduce the sufficient theory and mathematical treatment to solve, constrained, unconstrained Linear and Non linear programming optimization problems
4	Introduce the fundamentals of optimal control and optimality conditions along with modern optimization techniques

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE410_1	Define objective function, explain the terms related to optimization problem, classify them	K2
0AEPE410_2	Understand and apply the techniques of classical optimization single and multivariable optimization with equality and inequality constraints	K3
0AEPE410_3	Understand and apply the techniques of linear (Simplex) and non linear (Elimination and Interpolation) programming to the optimization problems	K3
0AEPE410_4	Understand and apply techniques of unconstrained optimization through different methods	K3
0AEPE410_5	Apply the concepts of optimal control, optimality criteria, genetic algorithm, neural network and need of adaptive control	K3

Course Contents:

Unit 1:	**Introduction to Optimization methods**	**Total Hours:**	5
Review of differntial calculus and matrix operations. Optimzation problem definition, components. Classification and applications in aeronautical engineering			

Unit 2:	**Classical optimization Techniques**	**Total Hours:**	7
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.			

Unit 3:	**Linear Programming Problem-Simplex and Dual Simplex method**	**Total Hours:**	8
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			

Unit 4:	**Nonlinear Programming-One dimensional Minimization Methods**	**Total Hours:**	8
Definition of unimodal function, **Elimination Methods:** unrestrictive search, exhaustive search, fibonacci Method, Golden Section Method; **Interpolation methods:** Direct Root Methods- Newton Method, Quasi Newton Method, Secant method, Practical Considerations			

Unit 5:	**Unconstrained Optimization Techniques**	**Total Hours:**	7
Indirect search (Descent Methods)-Gradient of a function, Steepest descent, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Marquardt Method			

Unit 6:	**Optimal control, optimality critera and Modern methods in optimization**	**Total Hours:**	7
Calculus of variations, Applications to engineering domain, Lagrangian multipliers and constraints, optimal control and necessary condition for optimal control. **Modern method of optimization:** need of adaptive control for performance evaluation, Genetica algorithm fundamentals, applications in aeronautical engineering, Neural networks			

Text Books:

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

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Reference Books:

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

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPE411 - Helicopter Theory
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Provide students with a basic understanding of helicopter aerodynamics, dynamics, and performance
2	Provide students with a basic understanding of helicopter stability, control and vibration.
3	Provide students with a basic understanding of main rotor system and the maintainance checks in the main rotor system

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE411_1	Explain the basic configurations of helicopter, main rotor and tail rotor - working principles, maintenance and inspection	K2
0AEPE411_2	Apply the principles of momentum theory and balde element theory for the Aerodynamics calculation of Rotor blade	K3
0AEPE411_3	Analyze the power requirements in forward flight and associated stability problems of helicopter.	K3
0AEPE411_4	Analyze the factors/parameters affecting the helicopter performance under the various operational conditions.	K4

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**5**
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.			

Unit 2:	**Helicopter Aerodynamics**	**Total Hours:**	**8**
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.			

Unit 3:	**Helicopter Performance - Hovering**	**Total Hours:**	**7**
Dynamics of Hovering Flight: Thrust and Power Coefficients, Calculation of Drag and Torque, Estimation of Hover Ceilings, Power-Ground effect in Hover			

Unit 4:	**Helicopter Performance - Forward Flight**	**Total Hours:**	**8**
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			

Unit 5:	**Stability and Control**	**Total Hours:**	**8**
Helicopter Trim, Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability.			

Unit 6:	**Main Rotor System**	**Total Hours:**	**6**
Head maintenance – blade alignment – Static main rotor balance – Vibration – Trackin– 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 ollective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box –Gradient unit control boosts – Maintenance & Inspection control rigging.			

Text Books:

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

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Basic Helicopter Aerodynamics	J. Seddon	Blackwell scientificpublications	AIAA Education series	1990
2	Helicopter Engineering	Lalit Gupta	Himalayan Books, New Delhi	-	1996

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B.Tech - AE - 22/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPE412 - Lighter-Than-Air Systems
Prerequisite/s	NILL
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Discuss in general the history of LTA systems and their configurations
2	Discuss the principles of aerostatics and their application in designing the airships and aerostats
3	Create awarness among the students about the current challenges and future developments of lighter than air systems

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE412_1	Understand the differences between HTA and LTA systems	K2
0AEPE412_2	Comment on current developments and future trends of LTA systems	K2
0AEPE412_3	Describe the properties and structure of atmosphere, and state the aerostatic principles	K3
0AEPE412_4	Comment on the technological challenges in design, development and operation of an LTA system	K4
0AEPE412_5	Estimate the static lift generated by an LTA system, given its type, size and operating scenario	K5
0AEPE412_6	Carry out conceptual layout and sizing of an LTA system	K6

Course Contents:

Unit 1:	**Introduction to Lighter-Than-Air Systems**	**Total Hours:**	**6**
Introduction to LTA Systems, Types of LTA vehicles-Airship, Acrostat, Hot Air balloon, Historical Developments, Key Subsystems and Components of LTA Systems.			

Unit 2:	**Principles of Aerostatics**	**Total Hours:**	**8**
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.			

Unit 3:	**Aerodynamics**	**Total Hours:**	**8**
Basic Assumptions, Drag, Dynamic Forces, Slender Body Theory, An EstimationMethod for Overall Aerodynamic Forces and Moments, Unsteady Aerodynamics, Aerodynamic Parameter Estimation			

Unit 4:	**Airship Technology**	**Total Hours:**	**6**
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			

Unit 5:	**Aerostat Technology**	**Total Hours:**	**8**
Methodology for sizing of Acrostat sub-systems, Equilibrium and Stability analysis of acrostats, Design and Development of Tethered Acrostats, Numerical problems			

Unit 6:	**Current and Future Developments**	**Total Hours:**	**6**
Challenges in design of LTA Systems, Hybrid LTA Systems, Stratospheric Airships, Airships/Acrostats for Planetary Exploration, Current Trends and Recent Developments.			

Text Books:

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

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Course Material for Design and Development of LTA systems	Pant, R. S.	Curriculum Development Program, IIT Bombay	-	2010
2	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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B. Tech - AE - 23/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC451 - Structural Dynamics Laboratory
Prerequisite/s	0BSES110 – Engineering Mechanics 0AEPC204 - Solid Mechanics
Teaching Scheme: Lecture/Tutorial/Practical	00/02
Credits	1
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to

1	Explain various linear vibratory models of dynamic systems with changing complexities.
2	Analyze the differential equation of motion of vibratory systems.
3	Identify free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.
4	Illustrate the interaction among the aerodynamic, elastic and inertia forces.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC451_1	Illustrate and Carry out measurement of various vibration parameters.	K3
0AEPC451_2	Determine the behavior of system under different vibratory conditions.	K3
0AEPC451_3	Analyze the vibration phenomena as a mathematical model & evaluate its response.	K3
0AEPC451_4	Carry out the Performance study of the vibration of plate and beam.	K3
0AEPC451_5	Effectively record the results and analyze them to provide a conclusion.	S3
0AEPC451_6	Follow the professional practices like maintaining a laboratory journal and completion of work on time.	A3

List of Experiments:

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

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B. Tech - AE - 24/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC452 - Aircraft Systems Laboratory
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to

1	To train the students "ON HAND" experience in basic maintenance of aircraft
2	Train the students on Maintenance of various airframe systems in aircraft
3	Ability to rectify the common snags

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC452_1	Incorporate FAA/DGCA/EASA guidelines used in maintenance & repair, layouting, markings and sketching	K3
0AEPC452_2	Perform the Basic maintenance and rigging operation on cessna 152	S3
0AEPC452_3	Calibrate various aircraft instruments like altimeter	S3, K3
0AEPC452_4	Sketch the various flight control panels in the aircraft confined to the various regulations	S3, K3
0AEPC452_5	Read the technical drawing and adher necessary information from the diagram	S3, K3
0AEPC452_6	Prepare & present a maintenance log for all the experiments, with suitable procedures, diagrams, layouts, sketches, adhering to the norms and regulations of FAA/DGCA/ EASA	S3, A3

List of Experiments:

Exp No 1	Aircraft "Jacking Up" procedure
Exp No 2	Aircraft "Levelling" procedure
Exp No 3	Control System "Rigging check" procedure
Exp No 4	Aircraft "Symmetry Check" procedure
Exp No 5	Altimeter Calibration procedure
Exp No 6	Aircraft walk around inspection, 50 hrs and 100 Hrs Mianetenece check- Fuelling and defuelling procedures
Exp No 7	Maintenance and rectification of snags in hydraulic and fuel systems
Exp No 8	Sketch the Layout the Cockpit flight instrument for Airbus A 380, Boeing 747 with acronyms as per the FAA/DGCA/EASA standards
Exp No 9	Draw a schematic of an autopilot system of an aircraft with description of its components, functions, operations
Exp No 10	Prepare a avionics planning worksheet with reference to manuals, diagrams and installation drawings.
Exp No 11	Sketch the various symbols/ Call signs used in aircraft instrumentation with detailing about the associated components and FAA/DGCA/ EASA regulations
Exp No 12	Read and comprehend the wiring diagram of an aircraft and suggest effective changes to improve space utilization.

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B. Tech – AE-25/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC453 - Virtural Instrumentation Laboratory
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to

1	Demonstrate the working of LabVIEW, Explain the various types of structures used in LabVIEW.
2	Analyze and design different type of programs based on data acquisition.
3	Demonstrate the use of LabVIEW for Control System Design

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC453_1	Define virtual instrumentation concepts, Compare traditional and virtual instrumentation.	K2
0AEPC453_2	Discuss operating systems required for virtual instrumentation, Illustrate implementation methods for instrumentation.	K3
0AEPC453_3	Familiarize the basics and interfacing of Virtual Instrumentation using LabVIEW	S3
0AEPC453_4	Effectively record the results and analyze them to provide a conclusion.	S3
0AEPC453_5	Follow the professional practices like mainlining a laboratory journal and completion of work on time.	A3

List of Experiments:

	Exp No 1	Introduction to Virtual Instrumentation, Basics of LabVIEW I
	Exp No 2	Basics of LabVIEW II
	Exp No 3	Serial Transmission & Reception
	Exp No 4	Design of Programmable DVM & PFG
	Exp No 5	Instrument Control using GPIB
	Exp No 6	Instrument Control using ARDUINO
	Exp No 7	Instrument Control using ETHERNET
	Exp No 8	DAQ Interfacing
	Exp No 9	Control Systems Design Tools using LabVIEW
	Exp No 10	Virtual Instrumentation using MATLAB

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	NI Educational Laboratory Virtual Instrumentation Suite II Series (NI ELVISTM II Series) User Manual	National Instruments	-	-	2011
2	LabVIEW Graphical Programming	Gary W. Johnson, Richard Jennings	McGraw-Hill Professional Publishing	3rd	-

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B. Tech - AE - 26/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPC454, Aircraft General Engineering Maintenance Laboratory
Prerequisite/s	Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	1
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to

1	Enable Knowledge about Aircraft Maintenance Practices and Ideas about Aircraft Tools.
2	Enrich Knowledge into Cessna 152 Maintenance and Start-up procedures.
3	Develop detail knowledge into Maintenance and Start up procedures of more aircrafts.
4	Summaries Safety practices in maintenance and repair in overall aircraft including furnishings and miscellaneous equipment.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC454_1	Carryout the Aircraft Maintenance, start up and Tools identification knowledge on Cessna 152.	K3
0AEPC454_2	Utilize suitable tools to carryout maintenance and repair on aircraft components.	S2
0AEPC454_3	Demonstrate the inspection procedures as per DGCA norms.	S3
0AEPC454_4	Effectively Record the observations of Inspection, maintenances through check list and logs.	S3
0AEPC454_5	Follow the Professional practices like punctuality and following safety procedures.	A3

List of Experiments:

Exp No 1	Prepare check list, Aircraft Health report, Break down and preventive maintenance log, Maintenance report and Precaution list.
Exp No 2	Identification of tools, Listing tools according to the maintenance procedure and prepare tools usage log
Exp No 3	Airframe inspection and Maintenance on Cessna 152 – Lubrication on movable components and Choking of Landing Gears
Exp No 4	Jacking and Mooring of Cessna 152
Exp No 5	Landing Gear inspection – Tyre quality and pressure check, break check, strut, suspension and shimmy check.
Exp No 6	Controls and Control systems inspection and maintenance.
Exp No 7	Fuelling- Inspection and maintenance of fuel tank and Fuel Quality check. Defueling and Fuelling.
Exp No 8	Inspection and Maintenance of Cabin, Cowling, Propeller, Batteries.
Exp No 9	Engine oil Quality and Quantity Check and Rigging
Exp No 10	Battery Installation and Cessna 152 Start-up procedure.
Exp No 11	Case Study-1: Passenger airplane start up procedure
Exp No 12	Case Study-2 : Air crash Investigation

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B. Tech - AE - 27/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPR455 - Industrial Training
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/00
Credits	1
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to

1	Familiar the students to realize an industrial work.
2	Improve the interpersonal skills and professional behavious in the industrial work place

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPR455_1	Effectively use the modern tool/ techniques to investigate the problem statement effectively and Recognize the need for continuously updating their modern tool usage skills	S3
0AEPR455_2	Recognize and follow the professional and ethical responsibility as an Individual and also contribute to the team work for the success of the project	A3
0AEPR455_3	Effectively record the reports based on the work carried and present them orally, with reasoning and justification	A3
0AEPR455_4	Manage a project, leading to the successful completion of the work within the deadlines and budget constraints	A3

Industrial Training

The students have to undergo an industrial training of minimum two weeks in an industry preferably dealing with Acronautical engineering during the semester break after Sixth semester and complete within 15 calendar days before the start of seventh semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.
It is expected that students should undertake small assignment or work related to any of the course related aspect. Report is based on compilation of work carried out related to facility and layout planning, Industrial engineering- time study and motion study, Line efficiency evaluation and improvement, process capability evaluation, Industrial automation, process or machinery modification as identified.

Industrial Training - Assesment

The Industrial Training Assesment will be carried out using the rubric developed based on the following criteria	
1	Nature of Training & Work Carried Out
2	Modern Tool/ Technique Usage
3	Professional and ethical responsibility (To be assessed by the Feed Back From Industry by E-Mail/Telephonic Conversation)
4	Communication/ Presentation Skill (To be assessed by the Feed Back From Industry by E-Mail/Telephonic Conversation)
5	Independent & Life-Long Learning

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B.Tech - AE - 28/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPR456 - Project Phase I
Prerequisite/s	NIL.
Teaching Scheme: Lecture/Tutorial/Practical	00/00/06
Credits	4
Evaluation Scheme: ISE/ESE	50/00

Course Objectives: The course aims to

1	Devlop the ability to design and conduct experiments, as well as to analyze and interpret data
2	Understand impact of engineering solutions in a global, economic, environmental and societal context
3	Develop the Professional practices like punctuality and following safety procedures.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPR456_1	Identify a problem statement related to their area of interest, carry out an detailed literature review and arrive at an research gap	K4
0AEPR456_2	Develop an methodology for designing a solution for the problem identified	K5
0AEPR456_3	Develop and Conduct Experiments on setups (or) Carry out computer simulation analysis and Interpret of Data from experiments (or) computer simulations	S3
0AEPR456_4	Effectively use the modern tool/ techniques to investigate the problem statement effectively and Recognize the need for continuously updating their modern tool usage skills	S3
0AEPR456_5	Recognize and follow the professional and ethical responsibility as an Individual and also contribute to the team work for the success of the project	A3
0AEPR456_6	Effectively record the reports based on the work carried and present them orally, with reasoning and justification	A3
0AEPR456_7	Manage a project, leading to the successful completion of the work within the deadlines and budget constraints	A3

Project Phase I

A batch of maximum three groups of four to five students per group, shall work under one Faculty member of Aeronautical Engineering Department.
The project phase I work can be a design project / experimental project and or computer simulation project on Aeronautical engineering or any of the topics related with Aeronautical Engineering stream. The project phase I work is allotted in groups on different topics.
The students groups are required to undertake the project phase-I during the seventh semester and the same is continued in the eighth semester (Phase-II). Project Phase-I consists of reviews of the work carried earlier and the submission of preliminary report. Report should highlight scope, objectives, methodology, approach and tools to be used like software and others, outline of project and expected results and outcome along with timeframe.

Project Phase 1 - Assesment

The Project Phase 1 Assesment will be carried out using the rubric developed based on the following criteria	
1	Identification of problem
2	Literature Review
3	Design of Solution to Problem Identified
4	Modern Tool/ Technique usage
5	Impact of proposed work
6	Professional and ethical responsibility
7	Team Work and Presentation Skills

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPC419 - Avionics and Instrumentation
Prerequisite/s	0AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Introduce the basic of avionics and its need for civil and military aircrafts
2	Impart knowledge about the avionic architecture and various avionics data buses
3	Create awarness about the various avionics subsystems

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC419_1	Identify the various cockpit controls and Describe the principle and working of different aircraft systems.	K2
0AEPC419_2	Distinguish between the features and working of various flight control systems.	K3
0AEPC419_3	Using the components of a fuel system illustrates the operation of integrated civil aircraft fuel systems and in- flight refueling and also troubleshoot the snags.	K3
0AEPC419_4	Prepare process chart for installation, inspection & troubleshooting procedures of avionics & elctrical components	K3

Course Contents:

Unit 1:	**Introduction to Avionics and Instrumentation**	**Total Hours:**	**6**
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 – 420 – ARINC – 629, Control and display technologies: CRT, LED, LCD, ET. and plasma panel , Touch flight display – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.			

Unit 2:	**Flight Control Systems**	**Total Hours:**	**7**
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, Auto pilot system, Fly by wire system, fly by optics system, Autonomous taxi, Neural sensing			

Unit 3:	**Introduction to Communication and Navigation systems**	**Total Hours:**	**7**
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.			

Unit 4:	**Fuel System & Engine Control Systems**	**Total Hours:**	**9**
Characteristics of aircraft fuel systems, Airframe Fuel system components - Fuel transfer pumps, Fuel booster pumps, Fuel transfer valves, Non return valves. Fuel quantity measurement systems, Level sensors, Fuel gauging probes. Fuel system operation, Fuel pressurization, Engine feed, Fuel transfer, Use of fuel as heat sink, External fuel tanks, Fuel jettison, The engine control System- Fuel flow control, Air flow control, Control system parameters, Example systems, esign criteria, Engine starting, Fuel control, Ignition control, Engine rotation, Throttle levers, Engine indications, DECU,			

Unit 5:	**Auxiliary systems**	**Total Hours:**	**7**
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			

Unit 6:	**Installation , Test & Troubleshooting of Avionics systems**	**Total Hours:**	**6**
Planning the Installation, Mounting Avionics, Connectors, wiring the airplane,panel labels & Abbreviations, Test and troubleshooting of ADF, Autopilot, COM Receivers, DME, ELT, Transponder, Wiring and connectors			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration,	Moir, I. and Sea bridge, A.,	AIAA (American Institute of Aeronautics and Astronautics)	-	2001
2	Avionics Training Systems, Installation and Troubleshooting	Len Buckwalter	Avionics Communications Inc	2	-
3	Airframe & Powerplant Handbook	FAA	U.S. Department of Transportation	-	-

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Reference Books:

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

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B. Tech - AE - 31/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPC421 - Finite Element Analysis
Prerequisite/s	0AEPC204 - Solid Mechanics 0AEPC401 - Vibrations & Structural Dynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Understand fundamentals of Finite Element Analysis/Methods and importance of FEM.
2	Understand the type of analysis, element to be used, boundary conditions and importance of symmetry.
3	Understand different co-ordinate systems, shape functions, stiffness matrices.
4	Study higher order element formulation and field problems.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC421_1	Illustrate the fundamental concepts, equations of equilibrium, Stress-strain relations and the principle of potential energy and approximations of differential equations.	(K2)
0AEPC421_2	Compute the key concepts of finite element formulations by considering the 1D problem, just as Shape function, element stiffness and boundary conditions.	(K3)
0AEPC421_3	Apply the finite element formulations for two dimensional plane stress and plane strain problems using constant strain triangle	(K3)
0AEPC421_4	Demonstrate the modeling aspects of axisymmetric solids subjected to axisymmetric loading	(K3)
0AEPC421_5	Use the Galerkin formulation for steady state heat transfer, torsion and potential flow.	(K3)

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	6
Introduction–General, General Description of the Method, Brief Explanation of FEA for a Stress Analysis Problem, Finite Element Method vs. Classical Method, FEM vs. FDM, A Brief History of FEM, Need for Studying FEM, Warning to FEA Package Users			
Basic Equations in Elasticity - Introduction, Stresses in a Typical Element, Equations of Equilibrium, Strains, Strain Displacement Equations, Linear Constitutive Law			

Unit 2:	**Matrix Displacement Formulation& Element Characteristics**	**Total Hours:**	8
Matrix Displacement Formulation–Introduction, Matrix Displacement Equations, Solution of Matrix Displacement Equations, Techniques of Saving Computer Memory Requirements			
Element Shapes, Nodes, Nodal Unknowns and Coordinate Systems – Introduction, Element Shapes, Nodes , Nodal Unknowns, Coordinate Systems			

Unit 3:	**Shape Functions**	**Total Hours:**	8
Introduction, Polynomial Shape Functions, Convergence Requirements of Shape Functions, Derivation of Shape Functions Using Polynomials, Finding Shape Functions Using Lagrange Polynomials, Shape Functions for Serendipity Family Elements, Hermite Polynomials as Shape Functions, Construction of Shape Functions by Degrading Technique			

Unit 4:	**Strain Displacement Matrix & Assembling Stiffness Equation**	**Total Hours:**	7
Strain Displacement Matrix- Introduction, Strain—Displacement Matrix for Bar Element, Strain Displacement Matrix for CST Element, Strain Displacement Relation for Beam Element			
Assembling Stiffness Equation – a) Direct Approach b) Galerkin's Method, Virtual Work Method c) Variational Method			

Unit 5:	**: Discritization of a Structure & Isoparametric Formulation**	**Total Hours:**	5
Discritization of a Structure – Introduction , Nodes as Discontinuities, Refining Mesh, Use of Symmetry, Finite Representation of Infinite Bodies, Element Aspect Ratio, Higher Order Element vs Mesh Refinement, Numbering System to Reduce Band Width			
Isoparametric Formulation – Introduction, Coordinate Transformation, Basic Theorems of Isoparametric Concept, Uniqueness of Mapping, Isoparametric, Superparametric and Subparametric Elements, Assembling Stiffness Matrix, Numerical Integration, Numerical Examples			

Unit 6:	**Finite Element Analysis of Bars and Trusses, Plane Stress and Plane Strain, Beams and Rigid F**	**Total Hours:**	9
Bars and Trusses- Introduction, Tension Bars/Columns, Two Dimensional Trusses (Plane Trusses), Three Dimensional Trusses (Space Trusses)			
Plane Stress and Plane Strain Problems - Introduction, General Procedure when CST Elements are Used, Use of Higher Order Elements			
Analysis of Beams and Rigid Frames – Introduction, Beam Analysis Using two Noded Elements, Analysis of Rigid Plane Frame Using 2 Noded Beam Elements, A Three Dimensional Rigid Frame Element, Timoshenko Beam Element			
Standard Packages and Their Features- Introduction, Commercially Available Standard Packages, Structure of a Finite Element Analysis Program, Pre and Post Processors, Desirable Features of FEA Packages			

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Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Finite Element Analysis	S. S. Bhavikatti	New Age International Publisher	4th Edition	2005
2	Introduction to Finite Elements in Engineering	Tirupathi.R. Chandrapatha and Ashok D. Belegundu	Prentice Hall of India	4th Edition	2012
3	Text Book of Finite Element Analysis	P. Seshu	Prentice Hall of India Private Limited	2nd Edition	2003

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	An Introduction to Finite Element Method	Reddy J.N	Tata McGraw-Hill	2nd Edition	2000

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Course Details:

Class	B. Tech (Acronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE413 - Hypersonic Acrodynamics
Prerequisite/s	0AEPC203 – Fluid Mechanics 0AEPC209 – Acrodynamics-I 0AEPC302 – Acrodynamics-II
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Introduce the basic concept of fluid dynamics at a flow moving at a hypersonic speed.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE413_1	Define the fundamental of hypersonic flow physics	K2
0AEPE413_2	Explain the theories related to analysis of hypersonic flow	K2
0AEPE413_3	Analyze the hypersonic shock theories.	K3
0AEPE413_4	Develop the viscous effect in hypersonic flow.	K3
0AEPE413_5	Impliment similarity rule on various bodies moving at hypersonic speed.	K3

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**5**
Hypersonic Flow; Shock Layer; Entropy Layer; Viscous Interaction; High Temperature Flows; Low Density Flows; Velocity Altitude Map.			

Unit 2:	**Hypersonic Shock- Expansion Theory**	**Total Hours:**	**8**
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.			

Unit 3:	**Hypersonic Inviscid Flowfields (Approximate Methods)**	**Total Hours:**	**7**
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.			

Unit 4:	**Hypersonic Inviscid Flowfields (Exact Methods)**	**Total Hours:**	**8**
General Thoughts; Method of Characteristics; The Hypersonic Blunt- Body Problem; Correlations for Hypersonic Shock- Wave Shapes; Modern Computational Hypersonics			

Unit 5:	**Viscous Hypersonic Flow**	**Total Hours:**	**8**
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.			

Unit 6:	**Similarly Rules**	**Total Hours:**	**6**
Prandtl- Glauert and Goethert Similarly Rules, Karman Similarity and 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
1	Hypersonic and High Temperature Gas Dynamics	John D. Anderson	AIAA	--	2000

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Super- and Hypersonic Acrodynamics and Heat Transfer	G. K. Mikhailov, V. Z. Parton	CRC Press	--	1992

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B-Tech – AE – 84/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE414 - Advanced Propulsion Systems
Prerequisite/s	Rocket Propulsion
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	To understand the concept of various types of advanced propulsion system
2	To apply the concept of the different combustion systems used in scramjet, ramjet propulsion and hypersonic propulsion
3	To analyse the characteristics of nuclear propulsion and the hazards associated with it
4	To interpret the various micro-propulsion systems developed and emerging technologies involved

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE414_1	To understand the concept of various types of advanced chemical propulsion system and its application to real systems	K2
0AEPE414_2	To demonstrate the utilization of combustion systems in scramjet, ramjet propulsion and hypersonic propulsion.	K2
0AEPE414_3	Toinfer the concept of nuclear rockets and evaluate the performance, operation parameters and handling hazard involved	K2
0AEPE414_4	To differentiate between electro-thermal and pure electric thrusters and interpret the concept for power generation in space.	K3
0AEPE414_5	To appraise the various micro-propulsion systems developed and emerging technologies involved.	K3
0AEPE414_6	Understand the concepts of hybrid propulsion systems	K2

Course Contents:

Unit 1:	**Advanced Chemical Propulsion System**	**Total Hours:**	5

High Performance Chemical Propulsion Systems, Tripropellants; Metalized Propellants; Free Radical Propulsion; Flight Hybrid Rocket Propulsion Systems.

Unit 2:	**Scramjet Propulsion**	**Total Hours:**	7

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.

Unit 3:	**Hypersonic Propulsion**	**Total Hours:**	6

Introduction to Hypersonic Propulsion; Developments in High Speed Vehicle Propulsion System; Aerodynamic Shape of a Hypersonic Vehicle with an Air Breathing Engine;

Unit 4:	**Nuclear Propulsion System**	**Total Hours:**	8

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.

Unit 5:	**Electric Propulsion System**	**Total Hours:**	8

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; Electric Power Generation in Space.

Unit 6:	**Micropropulsion System**	**Total Hours:**	8

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.

Text Books:

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

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B-Tech - AE - 35/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE415 - Advanced Mechanics of Solids
Prerequisite/s	0BSES110 - Engineering Mechanics 0AEPC204 - Solid Mechanics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Impart concepts of stress and strain analyses in a solid.
2	Study the methodologies in theory of elasticity at a basic level
3	Acquaint with the solution of advanced bending problems
4	Get familiar with energy methods for solving structural mechanics problems.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE415_1	Understand the basic concepts of stress,strain and deformation	K2
0AEPE415_2	Analyze the elastic and plastic behavior of materials, stress invariants, principal stresses and their directions.	K3
0AEPE415_3	Analyze strain in variants, principal strains and their directions.	K3
0AEPE415_4	Develop constitutive relationships between stress and strain for linearly elastic solid.	K3
0AEPE415_5	Apply the concepts of energy methods in solving structural problems.	K3
0AEPE415_6	Analyze theories of failure and design considerations for safe operations	K4

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**6**

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.

Unit 2:	**Analysis of Stress**	**Total Hours:**	**9**

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.

Unit 3:	**Analysis of strain**	**Total Hours:**	**9**

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.

Unit 4:	**Stress-Strain relations for Linearly Elastic Solids**	**Total Hours:**	**6**

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**	**Total Hours:**	**6**

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.

Unit 6:	**Energy Methods**	**Total Hours:**	**6**

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.

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B. Tech - AE - 36/61

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Advanced Mechanics of Solids	L. S. Sreenath	McGraw Hill	-	2008
2	Solid Mechanics	S. M. A. Kazimi	McGraw Hill	-	2008
3	Mechanical metallurgy	G. E. Dieter	McGraw Hill	3rd Edition	1988

Reference Books:

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

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B.Tech- AE- 37/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE416 - Aircraft Engine Design
Prerequisite/s	0AEPC410 - Aircraft Design
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Provide preliminary design parameters for jet engine subsystems.
2	Create awarness among the conceptual design procedure of the jet engine

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE416_1	Provide preliminary design parameters for compressors and turbines and characterize their performance based on a mean line approach.	K3
0AEPE416_2	Evaluate the operation and performance of a jet engine based on compressor and turbine maps for different operating conditions.	K4
0AEPE416_3	Provide preliminary design parameters and define key design issues, constraints and architectures for main combustors in jet engines.	K5
0AEPE416_4	Carryout the conceptual design of the Jet Engine	K6

Course Contents:

Unit 1:	**The Design Process, Constraint and Mission Analysis**	**Total Hours:**	**6**
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			

Unit 2:	**Engine Selection**	**Total Hours:**	**8**
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			

Unit 3:	**Engine Component Design: Global and Interface Quantities**	**Total Hours:**	**6**
Concept, Design Tools, Engine Systems Design, Example Engine Global and Interface Quantities			

Unit 4:	**Engine Component Design: Turbomachinery**	**Total Hours:**	**8**
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			

Unit 5:	**Engine Component Design: Combustion Systems**	**Total Hours:**	**6**
Concept, Design Tools - Main Burner, Afterburners, Example Engine Component Design: Combustion Systems			

Unit 6:	**Engine Component Design: Inlets and Exhaust Nozzles**	**Total Hours:**	**8**
Concept, Inlets, Exhaust Nozzles, Engine Component Design: Inlet and Exhaust Nozzle			

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
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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B.Tech - AE - 38/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE417 - Airline and Airport Management
Prerequisite/s	0AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Learn about the Airline industry in detail
2	Understand the Arline management
3	Organizational structure of airlines
4	Safety and security of an Airline and Airport

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE417_1	Understand about the airline industry and its regulatory bodies	K2
0AEPE417_2	Understand the characteristics of Airline Industry and its characteristics	K2
0AEPE417_3	Understand the organisational structure of the airline industry	K2
0AEPE417_4	Understand the security, navigation and traffic control	K2
0AEPE417_5	Understand the importance of safety and security	K2

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**5**
Airline Industry – Scope – Types – Scheduled and Non Scheduled Flights – Air Cargo Transport – Economic and Social impact – Regulatory Bodies – Key Performance indicators			

Unit 2:	**Characteristics of Airline Industry**	**Total Hours:**	**8**
Airline Profitability – Main Industry - Characteristics of Passenger airlines – Service Industry – Characteristics			

Unit 3:	**Organisational Structure**	**Total Hours:**	**7**
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			

Unit 4:	**Airports and its services**	**Total Hours:**	**8**
Airports – Personnel – Processing Passengers and Freight – Airport Security – Air Navigation Services – Air Traffic Control – Airplanes – Manufacturers – Types of Aircraft			

Unit 5:	**Airline Marketing**	**Total Hours:**	**8**
Marketing Environment, Customer Oriented Organisation, Marketing Conceptual Framework, Marketing Mix, Stages in application of marketing principles to airline management			

Unit 6:	**Safety and security**	**Total Hours:**	**6**
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			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Stephen Shaw " Airline Marketing and Management "	Ashgate	Wiley	Sixth Edition.	2003
2	Marketing management	PhlipKortler	Prentice Hall of India P (ltd)	Millenium edition	2001

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Marketing Management	Boyd Walker	McGraw Hill	-	2002
2	Marketing Management and Information Technology	Keith Flether	Prentice Hall	-	1998

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B. Tech - AE - 39/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.- VIII
Course Code and Course Title	0AEPE418 - Lean Six Sigma
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Develop the Quality standards in a process
2	Understand the importance of Quality checks
3	Provide a deep learning into various examples of Quality checks and analysis

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE418_1	Understand the concept of Lean principles and Six sigma	K2
0AEPE418_2	Predict the various process mapping for the quality standards to be maintained	K2
0AEPE418_3	Solve Minitabs and the project Charter	K3
0AEPE418_4	Solve various problems on conceptual knowledge of DMAIC	K3
0AEPE418_5	Categorize Various phases under DMAIC	K4

Course Contents:

Unit 1:	**Lean Basics and Principles**			**Total Hours:**	4
History of Lean; Types of Production; Toyota Production System- Toyota Management Principles; Key Principles of Lean; PDCA approach to Problem Solving.					

Unit 2:	**Value addition, Process Waste and Process Mapping**	**Total Hours:**	6
Concept of Value Addition in Six Sigma; Financial Imperatives; Process Waste; TPS Challenges to become Lean- TIMWOODS method to identify waste; Process Mapping- Levels of Mapping; versions of a process; Stages of process mapping.			

Unit 3:	**Six Sigma**	**Total Hours:**	4
History of Six Sigma; Basic Concept of Six Sigma; Five principles for Six Sigma; Six Sigma – Definitions; Design for Six Sigma (DFSS); Structured Designing (DMADV); Lean Six Sigma Optimisation; Problems and Goal Statements.			

Unit 4:	**Define & Measure Phase**	**Total Hours:**	12
Activities of Define Phase - y=f(x) model, Six sigma objectives, identify customer requirements, kano model, customer focus and process outputs, structuring customer requirements, problem annd goal statements, effective teams, stakeholder analysis, Measure- considerations for measurements, use of statistics , classification of data, central tendency and variation, data- PGA, measures of dispersion, calculating Z values, attribute agreement analysis, potential capability, calculate yield.			

Unit 5:	**Analyze & Improve Phase**	**Total Hours:**	12
objectives, Root cause Analysis, funneling effect, analyze tools, 7 basic tools , cause and effect diagrams, Regression analysis, Hypothesis testing,- steps in hypothesis testing in detail, ANOVA, FMEA, Improve Phase- basics and objectives, Brainstorming, Poka Yoke, DOE, OFAT approach			

Unit 6:	**Control Phase**	**Total Hours:**	4
Control plans , Visual controls, Types of control charts, control plan checklist, project charter, Intoduction to minitabs.			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	The Lean Six Sigma Pocket Toolbook	Michael L. Jones and John Maxey	Mcgraw Hill	1st	2017
2	The Six Sigma Way: How to Maximize the Impact of Your Change and Improvement Efforts	Peter S. Pande, Robert P. Neuman, and Roland Cavanagh	Mcgraw Hill	1st	2017

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Six Sigma: A Complete Step-by-Step Guide: A Complete Training & Reference Guide for White Belts, Yellow Belts, Green Belts, and Black Belts	Craig Joseph Setter & The Council for Six Sigma Certification	Mcgraw Hill	1st	2016

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B-Tech - AE - 40/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE422 - Automobile & Industrial Acrodynamics
Prerequisite/s	0AEPC203 – Fluid Mechanics 0AEPC209 – Acrodynamics-I
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	To understand the concept of atmosphere boundary layer
2	To familiarize with non-aeronautical applications of aerodynamics

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE422_1	Describe the atmospheric wind and its elements.	K2
0AEPE422_2	Explain wind energy harvesting using different methods	K3
0AEPE422_3	Develop flow control techniques for vehicle acrodynamics	K3
0AEPE422_4	Explain effects of wind loading on building and urban planning.	K3
0AEPE422_5	Explain wind structure induced vibration	K3

Course Contents:

Unit 1:	Atmosphere	Total Hours:	5

Types of winds, Causes of variation of winds, Atmospheric boundary layer, Effect of terrain on gradient height, Structure of turbulent flows.

Unit 2:	Wind Energy Collectors	Total Hours:	6

Horizontal axis and vertical axis machines, Power coefficient, Betz coefficient by momentum theory – Piezo wind energy collectors – various bladeless wind energy harvesting methods.

Unit 3:	Vehicle Acrodynamics	Total Hours:	7

Power requirements and drag coefficients of automobiles, Effects of cut back angle, Acrodynamics of trains and Hovercraft, Various drag reduction and optimization techniques,flow control and its applications.

Unit 4:	Building Aerodynamics	Total Hours:	8

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.

Unit 5:	Flow Induced Vibrations	Total Hours:	8

Effects of Reynolds number on wake formation of bluff shapes, Vortex induced vibrations, Galloping and stall flutter, Vibration of stay cables under wind load.

Unit 6:	Meteorological Aerodynamics	Total Hours:	8

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

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
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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B. Tech – AE – 41/61

Course Profile

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE423- Combustion
Prerequisite/s	1AEES204- Applied Thermodynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Understand the concept of thermochemistry, enthalpy, adiabatic flame temperature, combustion products and their application to combustion related problems
2	Apply the concept of chemical rates of reaction, collision theory and Arrhenius equation for analysing the different types of reactions.
3	Comprehend subsonic and supersonic combustion phenomenon, their transition and properties related to Detonation
4	Interpret the various combustion processes that takes place in a jet engine, solid rocket motor, liquid rocket engine and the hybrid rocket motor.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE423_1	Apply the basic concept of thermochemistry to combustion related problems.	K3
0AEPE423_2	Demonstrate the utilization of the concept of chemical kinetics in combustion reactions.	K3
0AEPE423_3	Distinguish between premixed and diffusion flames including their properties, and their use in combustion devices and rockets.	K3
0AEPE423_4	Differentiate between deflagration and detonation process and interpret the concept for computation and analysis of the transition phenomenon.	K3
0AEPE423_5	Evaluate the combustion processes taking place in different types of chemical rockets.	K4
0AEPE423_6	Understand the effects of pollutant emissions and able to quantify it.	K3

Course Contents:

Unit 1:	Thermochemistry:	Total Hours:	6

Stoichiometry; Absolute Enthalpy and Enthalpy of Formation; Enthalpy of Combustion and Heating Value; Laws of Thermochemistry; Pressure and Temperature Effect on Enthalpy of Formation; Adiabatic Flame Temperature; Chemical and Equilibrium Products of Combustion; Some Applications; Sample Calculations.

Unit 2:	Combustion Kinetics:	Total Hours:	8

Rate and Order of Reaction; First, Second and Third Order Reaction, Reversible Reactions; Arrhenius Equation; Molecular Kinetics: Molecularity and Order, Theories of Collision; Chain Reaction, Explosion Limits Equilibrium constants and their Relationship; Dissociation and Reassociation; Combustion Products in Equilibrium; Gibbs phase rule

Unit 3:	Flames:	Total Hours:	7

Concept of Flame; Definition, Classification and Properties of Premixed Flames; Properties of Diffusion Flames; Measurement of Burning Velocity; Flame Stabilization; Quenching; Flame Temperature Measurement Techniques.

Unit 4:	Detonation:	Total Hours:	7

Detonation Wave and their Characteristics; Deflagration to Detonation Transition; Derivation of Rankine- Hugoniot equation; Chapman- Jouguet States and their Properties; Computation of Detonation Velocity.

Unit 5:	Combustion Processes in Jet and Rocket Engines	Total Hours:	10

Some Applications; Droplet evaporation and burning, Model of Droplet Combustion; Solid Propellant Combustion- Composite and Double Base Propellants, Combustion in a Liquid Propellant Rocket Motor; Combustion in a Hybrid Rocket Motor, Various Process of Ignition and Extinction in Chemical Rockets.

Unit 6:	Pollutant Emissions	Total Hours:	4

Overview; Effects of Pollutants; Quantification of Emissions; Emissions from Premixed Combustion; Emissions from Non-Premixed Combustion.

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	An Introduction to Combustion - Concepts and Applicatio	S. R. Turn	McGrawHill	3	2012
2	Principles of Combustion	K. K. Kuó	John Wiley and Sons	.	1986
3	Combustion Theory	F. A. Williams	The Benjamin/Cummings	2	1985

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Combustion, Flames and Explosions of Gases	B. Lewis and G. von Elbe	Academic Press, Orlando	3	1987
2	Flames: Their Structure, Radiation and Temperature	A. G. Gaydon and H. D. Wolfhard	Springer	3	1970

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPC424 - Experimental Stress Analysis
Prerequisite/s	0AEPC204 - Solid Mechanics 0AEPC401 - Vibrations & Structural Dynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Get acquaint with the basics of measurement.
2	Bring awareness on experimental method of finding the response of the structure to different types of load.
3	Study the various experimental techniques involved for measuring displacements, stresses, strains in structural components.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE424_1	Study the instruments for measurement	K2
0AEPE424_2	Determine the stress-strain values in material and structure subjected to static and dynamic forces & loads	K3
0AEPE424_3	Acquiring information's the usage of strain gauges and photo elastic techniques of measurement.	K3
0AEPE424_4	Formulate and solve general three dimensional problems of stress-strain analysis especially fundamental prob	K3
0AEPE424_5	Analyze the strain gauge data under various loading condition by using gauge rosette method	K3
0AEPE424_6	Understand elastic behavior of solid bodies using coating techniques	K2

Course Contents:

Unit 1:	**Extensometers And Displacement Sensors**	**Total Hours:**	**5**

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.

Unit 2:	**Stress-Strain Relationships**	**Total Hours:**	**12**

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

Unit 3:	**Transmission Photoelasticity- I**	**Total Hours:**	**7**

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

Unit 4:	**Transmission Photoelasticity- II**	**Total Hours:**	**7**

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 Photoelasticity, Overview of Digital Photoelasticity

Unit 5:	**Photoelastic Coatings and Brittle Coatings**	**Total Hours:**	**5**

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

Unit 6:	**Strain Gauges**	**Total Hours:**	**9**

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

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Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Experimental Stress Analysis	J.W. Dally and W. F. Riley	McGraw-Hill	2nd Edition	1991
2	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
1	Digital Photoelasticity – Advanced Techniques and Appli	K. Ramesh	Springer	3rd Edition	2000
2	Springer Handbook of Experimental Solid Mechanics	W.N. Sharpe (Ed.)	Springer	4th Edition	2008

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B. Tech - AE - 45/61

Course

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE425 - Navigation, Guidance and Control
Prerequisite/s	0AEBS201 (Applied Mathematics) 0AEPC303 (Linear control Theory)
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISE1/MSE/ISE11/ESE	10/30/10/50

Course Objectives: The course aims to

1	Introduce the fundamentals of navigation, guidance and control for aerospace applications
2	Introduce the students to Radar technology, mathematics and their role aerospace systems and solve problems on doppler shift
3	Introduce the students with working of navigation system such as INS, GPS etc.
4	Introduce the students with LTI system in time and frequency domain and solve problems associated with aerospace application.
5	Provde an platform for students who are willing to pursue higher education in the field of guidance and control

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE411_1	Explain and fundamentals of Radars, missile guidance, navigation systems, and describe the behaviour of 1 and 2 order linear time invariant systems	K2
0AEPE411_2	Apply the concept of frequency response & laplace transform to describe the stability in time domain and frequency domain using bode plot and root locus techniques	K3
0AEPE411_3	Apply the concept of radar equation and doppler shift to evaluate the minimum detectable distance	K3
0AEPE411_4	Apply the guidance laws to a missile to hit a specified target using classical and modern guidance laws	K3

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**6**
Over view of Navigation, guidance and control of an aerospace system;Principles of RADARS: Introduction, Radar equation, Operation and Radar block diagram, Radar operating frequencies, application of radar, Range performance of radar, minimum detectable distance and noise effects			

Unit 2:	**Continuous wave and Frequency Modulated Radar**	**Total Hours:**	**7**
Continuous wave radar, doppler shift, CW radar technology, applications of CW radar, frequency modulated CW radar, Moving target indicator (MTI) and pulse dopler radar description and operation, block diagram representation			

Unit 3:	**Guidance**	**Total Hours:**	**8**
Guided missiles, classification, description of tactical missiles, guidance phases during flight. Categories of homing and command guidance. kinematic equations. Guidance classification: Classical guidance laws and modern guidance laws			

Unit 4:	**Navigation**	**Total Hours:**	**7**
Introduction, kinds of navigation- Position fixded and Dead-Reckoning. Long range navigation system (LORAN), DECCA, OMEGA, very high frequency omni directional range (VOR). Celestial and GPS based navigation. Inertial navigation system			

Unit 5:	**Control system design**	**Total Hours:**	**5**
Classical time invariant system, transfer function, stability and time domain characteristics, PID controller design for aerospace systems			

Unit 6:	**Frequency Response**	**Total Hours:**	**8**
Root locus, Nyquist and bode plot, their application to controller design to aerospace application. State space matrix: State equation, state transition matrix, Controllability and Observability, application to control design of aerospeace applications			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Introduction to Radar Systems	M.I. Skolnik	Tata McGraw-Hill	1	2007
2	Missile Guidance and Control system	George M. Siouris	Springer	NA	2004

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Tactical and Strategic missile guidance	P. Zarchan	AIAA	NA	2007
2	Control systems engineering	Norman S. Nise	John Wiley & Sons, Inc.	6	2011

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B. Tech - AE- 46/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE426 - Flight Scheduling and Operations
Prerequisite/s	-
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Discuss airline network flows for minimum and maximum cost flow problem.
2	Understand mathematical formulation-decision variables, objective function, constraints and methods of solution for airline scheduling.
3	Understand the importance fleet assignment and crew and manpower scheduling.
4	Demonstrate assignment and aircraft boarding strategy.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE426_1	Describe the complexity of airline planning, operations and dispatch.	K2
0AEPE426_2	Calculate the shortest path flow for minimum cost flow problem.	K3
0AEPE426_3	Understand the maximum path flow for multi commodity flow problem.	K2
0AEPE426_4	Analyse the Integer programming models- set covering/ partitioning problems, traveling salesman problem	K4
0AEPE426_5	Differentiate and analyze the problems in aircraft routing and management for maintenance of regular operations.	K4
0AEPE426_6	Analyze the role of solution for constructing flight scheduling and operations.	K4

Course Contents:

Unit 1:	**Network Flows and Integer Programming Models**	**Total Hours:**	**5**
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.			

Unit 2:	**Aircraft Routing and Management of Irregular Operations**	**Total Hours:**	**8**
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.			

Unit 3:	**Flight Scheduling**	**Total Hours:**	**7**
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.			

Unit 4:	**Fleet Assignment**	**Total Hours:**	**8**
Purpose of fleet assignment. Fleet types, fleet diversity, and fleet availability-performance measures, Formulation of the fleet assignment problem- decision variables, objective function, constraints, and solution. Scenario analysis, fleet assignment models.			

Unit 5:	**Crew and Manpower Scheduling**	**Total Hours:**	**8**
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			

Unit 6:	**Gate Assignment and Aircraft Boarding Strategy**	**Total Hours:**	**6**
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			

Text Books:

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

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Reference Books:

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

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B. Tech – AE – 48/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE427 - Aircraft Rules and Regulations - DGCA (CAR)
Prerequisite/s	-
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Learn various CAR series under DGCA
2	understand the cockpit checklist of an aircraft
3	provide an understanding on the Aircraft Maintenance programmes
4	Provide knowledge of Aircraft type rating

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE427_1	Understand various Air worthiness requirements for Civil Aviation	K2
0AEPE427_2	Understand various Series of CAR	K2
0AEPE427_3	Interpret various Aircraft maintenance programmes under CAR	K2
0AEPE427_4	Understand the various process of registration of aircraft	K2
0AEPE427_5	Understand the various documents to be carried on an Indian registered aircraft	K2

Course Contents:

Unit 1:	**Introduction C.A.R. SERIES 'A'**	**Total Hours:**	5

PROCEDURE FOR CIVIL AIR WORTHINESS REQUIREMENTS AND RESPONSIBILITY OPERATORS Vis-à-vis AIR WORTHINESS DIRECTORATE 8 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.

Unit 2:	**C.A.R. SERIES 'B'**	**Total Hours:**	6

ISSUE APPROVAL OF COCKPIT CHECK LIST, MEL, CDL: Deficiency list (MEL & CDL); Preparation and use of cockpit checklist and emergency list.

Unit 3:	**C.A.R. SERIES 'C'**	**Total Hours:**	7

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.

Unit 4:	**C.A.R. SERIES 'D' – AND AIRCRAFT MAINTENANCE PROGRAMMES**	**Total Hours:**	8

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.

Unit 5:	**C.A.R. SERIES 'F'**	**Total Hours:**	8

AIR WORTHINESS AND CONTINUED AIR WORTHINESS: 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.

Unit 6:	**C.A.R. SERIES 'T'&'X' 12**	**Total Hours:**	8

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.

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Civil Aviation Requirements with latest Amendment (Section 2 Airworthiness)	DGCA	The English Book Store	-	-

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Aircraft Manual (India) Volume	DGCA	The English Book Store	-	-

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B. Tech - AE - 49/61

Course Curriculum

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE428 - Turbulence Modelling
Prerequisite/s	0AEPC203- Fluid Mechanics 0AEPC209- Aerodynamics I 0AEPC302- Aerodynamics II 0AEPE408- Heat and Mass Transfer
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	To provide basic theoretical knowledge on turbulence
2	To design of turbulence models and their applicability
3	To provide skills in the analysis of turbulent flows.
4	Develop the ability to choose an appropriate turbulence model for a given flow case.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE428_1	Describe the physical mechanisms of the transition from laminar to turbulent flow for a simple flow case	K3
0AEPE428_2	Explain Kolmogorov's theory, including the basic assumptions and the validity of the theory	K3
0AEPE428_3	From a phenomenological perspective, assess if a flow is turbulent	K3
0AEPE428_4	Describe the character of the turbulence in different flow situations with respect to the properties and development of the turbulence	K4
0AEPE428_5	Explain how the differences between these flow situations are reflected in the modelling	K4

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**5**
Nature of turbulent flows, irregularity, diffusivity, three dimensional motions, dissipation, wide spectrum, origin of turbulence, eddy motions and length scales.			

Unit 2:	**Statistical Description of Turbulence**	**Total Hours:**	**8**
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			

Unit 3:	**Turbulent Transport of Moment and Heat**	**Total Hours:**	**8**
Reynolds decomposition, turbulent stresses, vortex stretching, Reynolds equations, mixing-length model, Reynolds' analogy, dynamics of turbulence.			

Unit 4:	**Free Shear Flows**	**Total Hours:**	**6**
Mixing Layer, Turbulent Wakes and Jets, Grid Turbulence.			

Unit 5:	**Wall-Bounded Turbulent Flows**	**Total Hours:**	**8**
Channel and pipe flows, Reynolds stresses, turbulent boundary layer equations, logarithmic-law of walls, turbulent structures.			

Unit 6:	**Turbulence Modelling**	**Total Hours:**	**6**
Introduction, eddy-viscosity hypothesis, algebraic model, k-ε and k-ω model, Reynolds-stress model, near-wall treatment,introduction to LES and DNS.			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Turbulent Flows	Stephen B. Pope	Cambridge University Press	-	2000
2	A First Course in Turbulence	H. Tennekes and J. L. Lumley	MIT Press	-	

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B. Tech - AE - 50/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE429 - Introduction to Propellant Technology
Prerequisite/s	NIL
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	To comprehend the knowledge about constituents of different types of solid propellant systems in processing of each category and determining key properties.
2	To understand the fundamentals of solid propellant grain design
3	To use grain design fundamentals in design of grains for static and flight rockets
4	To differentiate between various types of liquid propellants and to analyse the related aspects of ignition, combustion and performance evaluation
5	To identify cryogenic substance and examine its characteristics in cryogenic environments.
6	To analyze the concept of propellant loading in liquid rocket tanks, and their effective utilization including specific technical issues related to cryogenic propellants.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE429_1	Demonstrate the processing of different types of solid propellants and effect of processing on the vital properties of solid propellants.	K2
0AEPE429_2	To comprehend the fundamentals of solid propellant grain design.	K2
0AEPE429_3	Design solid propellant grain for static and flight rocket motors.	K3
0AEPE429_4	Evaluate the ignition delay and combustion parameters of a liquid rocket engine for different combustion chamber configurations	K3
0AEPE429_5	To demonstrate the characteristics of the cryogenic fluid and the challenges acquired in achieving it.	K3
0AEPE429_6	Evaluate the technical problems associated with propellant loading and other design issues associated with a liquid rockets engine.	K4

Course Contents:

Unit 1:	**Solid Propellant**	**Total Hours:**	**5**
Classification – Double Base, Composite, Composite Modified Double Base, Fuel- rich and Metallized Propellants; Ingredients; Composition and Processing; Mechanical and Ballistic Properties; Ageing Characteristics.			

Unit 2:	**Grain Design Fundamentals**	**Total Hours:**	**8**
Classification of Solid Propellant Grains; End Burning, Radial Burning and Non- cylindrical Burning Grains; Fundamental Characteristics; Various Configurations; Internal Burning Star Configuration; Segmented Grains; Grain Clustering; Burning Surface Area Evaluation; Design Criteria; Dual Thrust Grains; Free- standing and Case- bonded Grains; Inhibitors and Insulators.			

Unit 3:	**Grain Design**	**Total Hours:**	**7**
Design Parameters; Performance Parameters; End Burning and Radial Burning Grain Design as applicable to Static Motors and Flight Rockets; Sample Calculations; Stress Analysis in Solid Propellant Grains.			

Unit 4:	**Liquid Propellant**	**Total Hours:**	**8**
Classification – Mono-; Bi- and Tri- Propellants; Non Hypergolic and Hypergolic Systems; Gel Propellant Systems; Essential Characteristics of Liquid Propellants; Physical Properties; Ignition Characteristics; Ignition Delay; Ignition and Combustion Properties; Performance of Selected Bipropellant Systems; Factors affecting the Performance.			

Unit 5:	**Cryogenic Propellant**	**Total Hours:**	**8**
Cryogenic fluid, Materials at low temperature mainly for cryogenic propulsion, Thermo physical and fluid dynamic properties of liquid and gas hydrogen and oxygen, Liquefaction systems of hydrogen and oxygen gases, Joule Thomson effect and inversion curve; Adiabatic and isenthalpic expansion with their comparison. Cryogenic heat exchangers.			

Unit 6:	**Propellant Loading**	**Total Hours:**	**6**
Cryogenic Propellants, Performance Considerations; Loading Concepts; Outage – Prediction and Control; Calibrated and Propellant Utilization Systems; Tank Ullage; Propellant Slosh; Estimation of Sloshing Mass; Frequency and Stiffness of an Equivalent System; Cavitation Drop- out and Vortexing; Design of Tank Outlet.			

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Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Fundamental Aspects of Solid Propellant Rockets	Williams, F.A., Barrère, M., Huang, N.C.	The Advisory Group for Aerospace Research and Development of N.A.T.O., [by] Technivision Services		1969
2	Solid Rocket Technology	Shorr, M., Zaehringer, A.J.,	John Wiley New York		1967

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Rocket Propulsion	Barrere, M., Jaumotte, A., Fraeijs de Veubeke, B., Vandenkerckhove, J.	Elsevier Publishing Company		1960
2	Internal Ballistics of Solid-Fuel Rockets: Military Rockets Using Dry-Processed Double-Base Propellant as Fuel	Wimpress, R.N., Sage, B.H.	ReInk Books		2017

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B. Tech – AE – 52/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE430 - High Temeprature Materials
Prerequisite/s	0AEPC208 - Aircraft Materials
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Learn charactersticks related to high temperature such as creep, oxidation and material degradation.
2	Understand behaviour of materials at higher temperatures.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE430_1	Explain processing, characterization and properties of high temperature materials.	K2
0AEPE430_2	Determine failure of material is due to creep or fatigue.	K3
0AEPE430_3	Apply knowledge of creep resistance in design of material.	K3
0AEPE430_4	Anlyse damage mechanism and failure of components at elevated temperatures	K4
0AEPE430_5	Discuss factors influencing the oxidation and hot corrosion.	K2
0AEPE430_6	Choose the material for high temperature application.	K3

Course Contents:

Unit 1:	**Introduction**	**Total Hours:**	**6**
Characteristics of high-temperature materials, Factors influencing functional life of components at elevated temperatures, Heat resistant alloys - general properties, metallurgical structure, processing, applications and limitations, Ceramics and polymers for high temperature applications.			

Unit 2:	**Creep and Fatigue**	**Total Hours:**	**6**
Creep, definition of creep curve, various stages of creep, metallurgical factors influencing various stages, effect of stress, temperature and strain rate, Fatigue, thermal fatigue, ageing, structural changes.			

Unit 3:	**Design for creep resistance**	**Total Hours:**	**6**
Design of transient creep time, hardening, strain hardening, expressions of rupture life of creep, ductile and brittle materials, Monkman-Grant relationship.			

Unit 4:	**Fracture**	**Total Hours:**	**8**
Various types of fracture, brittle to ductile from low temperature to high temperature, cleavage fracture, ductile fracture due to micro void coalescence-diffusion controlled void growth; fracture maps for different alloys and oxides.			

Unit 5:	**Oxidation and hot corrosion**	**Total Hours:**	**8**
Oxidation, Pilling, Bedworth ratio, kinetic laws of oxidation- defect structure and control of oxidation by alloy additions, hot gas corrosion deposit, modified hot gas corrosion, fluxing mechanisms, effect of alloying elements on hot corrosion, methods of combat hot corrosion.			

Unit 6:	**Superalloys and other materials**	**Total Hours:**	**8**
Iron base, Nickel base and Cobalt base super alloys, composition control, solid solution strengthening, precipitation hardening by gamma prime, grain boundary strengthening, TCP phase, embrittlement, solidification of single crystals, Intermetallics.			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Mechanical behaviour of materials	Krishan Chawla and Marc A. Meyers	Cambridge university press	2nd edition	1998
2	Flow and Fracture at Elevated Temperatures	Raj R.	American Society for Metals, USA,	1st edition	1985
3	Deformation and Fracture Mechanics of Engineering materials	Hertzberg R. W	John Wiley, USA	4th edition	1996

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	ASM Specialty Handbook: Heat-Resistant Materials	J.R. Davis	ASM Internationla	--	1997
2	Creep and Fatigue in High Temperature Alloys	Bressers. J	Elsevier Science Ltd	--	1981

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Course Profile

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE431-Numerical Heat transfer and Fluid Flow
Prerequisite/s	0AEBS206 - Numerical Analysis 0AEPC307 - Computational Fluid Dynamics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Introduce the fundamentals of general transport equation, applicability to other physics, calssification of differential equation, and choice of coordinate as per physics
2	Introduce the concept of steady/ unsteady -1D/2D- discretization equation for generic pure diffusion and diffusion+convection governing equations
3	Introduce various schemes to discretize the derivatives and solve the pressure velocity coupled equations using various algorithms to determine the flow field
4	Introduce the various methods of discretization eg. FVM, FDM, FEM

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE431_1	Derieve the general transport equation and use it for physical process of interest, apply the FDM and FVM methods to tranport equation	K3
0AEPE431_2	Understand and Apply the concept of FVM to steady/ unsteady 1D and 2D Heat diffusion equation	K3
0AEPE431_3	Understand and Apply the concept of FVM to steady/ unsteady 1D and 2D Diffusion and Convection equation	K3
0AEPE431_4	Undestand and apply the iterative solving method to the sytem of linear equations	K3
0AEPE431_5	Understand and apply the concept of various schemes to solve the diffusion and convection equation	K3

Course Contents:

Unit 1:	**Mathematical Modelling of physical phenomena**	**Total Hours:**	**5**
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			

Unit 2:	**Discretization methods**	**Total Hours:**	**8**
The Nature of numerical methods: Task, Discetization 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			

Unit 3:	**Heat conduction (Diffusion Equation)**	**Total Hours:**	**7**
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, overrelaxation and underrelaxation			

Unit 4:	**Diffusion Equation a closer Look**	**Total Hours:**	**8**
Diffusion on Orthogonal Meshes, Non-Orthogonal Meshes, Boundary conditions, Gradient calculation- Structured and Unstructured me			

Unit 5:	**Convection and Diffusion Equation**	**Total Hours:**	**8**
Steady one dimensional Convection and Diffusion Equation- Preliminary equation, Upwind scheme, Exact solution, Exact solution, Exponential scheme, Hybrd scheme, Power law scheme. Discretization of two dimensional equation, False Diffusion			

Unit 6:	**Calculation of Flow Field**	**Total Hours:**	**6**
Difficulties in evaluation of flow field, Remedy-Staggered Grid, Momentum Equations, Presure velocity coupling, SIMPLE Algorithm, SIMPLER Algorithm, SIMPLEC			

Text Books:

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

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Reference Books:

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

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B. Tech - AE- 56/61

Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE432 - Air Traffic Control and Airport Management
Prerequisite/s	0AEPC205 - Introduction to Aerospace Engineering
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to

1	Gain knowledge on Air Traffic Control and management
2	To study the procedure of the formation of aerodrome and its design and air traffic control.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE432_1	Understand the requirement of air traffic control systems and types of air traffic control system.	K2
0AEPE432_2	Understand flight information systems and rules of air traffic systems.	K2
0AEPE432_3	Understand indirection indicator systems for air navigation	K2
0AEPE432_4	Identify the Various Navigation Services	K2
0AEPE432_5	Understand the various Airport Lighting systems	K2

Course Contents:

Unit 1:	BASIC CONCEPTS	Total Hours:	5

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.

Unit 2:	AIR TRAFFIC SYSTEMS	Total Hours:	8

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

Unit 3:	FLIGHT INFORMATION SYSTEMS	Total Hours:	7

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 – Co-ordination and emergency procedures – Rules of the air.

Unit 4	AERODROME DATA	Total Hours:	8

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.

Unit 5:	NAVIGATION SERVICES	Total Hours:	8

Visual aids for navigation Wind direction indicator – Landing direction indicator – Location and characteristics of signal area – Markings, general requirements – Various markings – Lights, general requirements

Unit 6:	AIRPORT LIGHTING	Total Hours:	6

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.

Text Books:

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

Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Aircraft Manual (India) Volume I	DGCA	The English Book Store	-	-
2	"PANS – RAC – ICAO DOC 4444"	DGCA	The English Book Store	-	-

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B. Tech – AE – 57/61

Course Details

Class	B. Tech (Aeronautical Engineering), Sem.-VIII
Course Code and Course Title	0AEPE433 - Probability and Statistics
Prerequisite/s	Engineering Mathematics
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	3
Evaluation Scheme: ISEI/MSE/ISEII/ESE	10/30/10/50

Course Objectives: The course aims to give students

1	The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
2	The basic ideas of statistics including measures of central tendency, correlation and regression.
3	The statistical methods of studying data samples.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPE433_1	Apply the basic rules and theorems of probability theory, to determine probabilities that help to solve engineering problems.	K3
0AEPE433_2	Appropriately choose, define and/or derive probability distributions such as the Binomial, Poisson and Normal etc. to model and solve engineering problems.	K3
0AEPE433_3	Formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.	K3
0AEPE433_4	Demonstrate how regression analysis can be used to develop an equation that estimates how two variables are related and how the analysis of variance procedure can be used to determine if means of more than two populations are equal	K3
0AEPE433_5	Solve queuing theory problems for Pure Birth process and Death Process M/M/1 Mo	K3
0AEPE433_6	Apply the concepts of Markov Chains and Stochastic Matrix to solve engineering problems.	K3

Course Contents:

Unit 1:	**PROBABILITY**	**Total Hours:**	**5**
Sample space and events, Probability, The axioms of probability, Some Elementary theorems - Conditional probability, Baye's theorem, Random variables, Discrete and continuous.			

Unit 2:	**DISTRIBUTIONS**	**Total Hours:**	**5**
Binomial , Poisson and normal distributions related properties, Sampling distributions, Sampling distribution of means (σ known and Unknown)			

Unit 3:	**TESTING OF HYPOTHESIS**	**Total Hours:**	**10**
TESTING OF HYPOTHESIS- I Tests of hypothesis point estimations, Interval estimations Bayesian estimation. Large samples, Null hypothesis, Alternate hypothesis, type I and type II errors Critical region confidential interval for mean testing of single variance, Difference between the mean. TESTING OF HYPOTHESIS - II Confidential interval for the proportions, Tests of hypothesis for the proportions single and difference between the proportions.			

Unit 4:	**SMALL SAMPLES and CORRELATION and REGRESSION**	**Total Hours:**	**10**
SMALL SAMPLES Confidence interval for the t- distribution, Tests of hypothesis, t-distributions, F- distributions distribution, Test of Hypothesis. CORRELATION and REGRESSION Coefficient of correlation, Regression Coefficient, The lines of regression, The rank correlation			

Unit 5:	**QUEUING THEORY**	**Total Hours:**	**4**
Arrival Theorem - Pure Birth process and Death Process M/M/1 Model.			

Unit 6:	**STOCHASTIC PROCESSES**	**Total Hours:**	**6**
Introduction to Stochastic Processes, Markov process classification of states, Examples of Markov Chains, Stochastic Matrix, limiting probabilities.			

Text Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	A FIRST COURSE IN PROBABILITY	Sheldon Ross	Pearson Prentice Hall	Eighth Edition	2010
3	Miller & Freund's Probability and Statistics for Engineers	Richard Arnold Johnson and Irwin Miller	Pearson Education India;	Eighth Edition	2015

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Reference Books:

Sr.No	Title	Author	Publisher	Edition	Year
1	Basic Statistics	B L Agarwal	New Age International	Fourth	2006
2	Operations Research: An Introduction	Hamdy A. Taha	Pearson Prentice Hall	Nineth edition	2013

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Course Details:

Class	B. Tech, Sem.-VIII
Course Code and Course Title	0AEPC457, Finite Element Analysis Laboratory
Prerequisite/s	0BSFS110 – Engineering Mechanics 0AEPC204 - Solid Mechanics
Teaching Scheme: Lecture/Tutorial/Practical	00/02
Credits	1
Evaluation Scheme: ISE/ESE	25/00

Course Objectives: The course aims to

1	Understand fundamentals of Finite Element Analysis/Methods and importance of FEM.
2	Understand the type of analysis, element to be used, boundary conditions and importance of symmetry.
3	Understand different co-ordinate systems, shape functions, stiffness matrices.
4	Study higher order element formulation and field problems.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPC457_1	Explain Past, Present and Future of FEA and Types of meshing.	(K2)
0AEPC457_2	Formulate and solve one dimensional structural problem.	(K3)
0AEPC457_3	Solve static structural, steady state thermal analysis 1D, 2D problems.	(K3)
0AEPC457_4	Communicate effectively, both orally and writing journals.	(S3)
0AEPC457_5	Follow professional and ethical principles during laboratory work.	(A3)

List of Experiments:

	Exp No 1	Experiment on Analysis of 1-D bar element with axial loading
	Exp No 2	Experiment on BMD and SFD Using ANSYS
	Exp No 3	Experiment on Analysis of a Bicycle Frame
	Exp No 4	Experiment on Analysis of a Truss
	Exp No 5	Experiment on Analysis of tensile-Loaded Thin Plate With a Central Hole
	Exp No 6	Experiment on Analysis of 2-D Frame With Multiple Materials and Element Types
	Exp No 7	Experiment on Analysis of Simple 2-D Heat Transfer
	Exp No 8	Experiment on Analysis of 3-D Static Stress Analysis
	Exp No 9	Experiment on Eigen Value Buckling Analysis
	Exp No 10	Experiment on Solid Model Creation & Modal Analysis of a Spring-Mass System
	Exp No 11	Steady State Thermal Analysis of a Fin
	Exp No 12	Transient Thermal Analysis of a Fin

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Course Details:

Class	B. Tech (Aeronautical Engineering), Sem.-VII
Course Code and Course Title	0AEPR458 - Project Phase II
Prerequisite/s	NILL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/08
Credits	8
Evaluation Scheme: ISE/ESE	50/50

Course Objectives: The course aims to

1	Devlop the ability to design and conduct experiments, as well as to analyze and interpret data
2	Understand impact of engineering solutions in a global, economic, environmental and societal context
3	Develop the Professional practices like punctuality and following safety procedures.

Course Outcomes (COs): Upon successful completion of this course, the student will be able to

0AEPR458_1	Identify a problem statement related to their area of interest, carry out an detailed literature review and arrive at an research gap	K4
0AEPR458_2	Develop an methodology for designing a solution for the problem identified	K5
0AEPR458_3	Develop and Conduct Experiments on setups (or) Carry out computer simulation analysis and Interpret of Data from experiments (or) computer simulations	S3
0AEPR458_4	Effectively use the modern tool/ techniques to investigate the problem statement effectively and Recognize the need for continuously updating their modern tool usage skills	S3
0AEPR458_5	Recognize and follow the professional and ethical responsibility as an Individual and also contribute to the team work for the success of the project	A3
0AEPR458_6	Effectively record the reports based on the work carried and present them orally, with reasoning and justification	A3
0AEPR458_7	Manage a project, leading to the successful completion of the work within the deadlines and budget constraints	A3

Project Phase II

Project phase-II is a continuation of project phase-I started in the seventh semester. Before the end of the eighth semester, there will be two reviews, one at start of the eighth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre-qualifying exercise for the students for getting approval for the submission of the thesis. The final evaluation of the project will be external evaluation.

Project Phase II - Assesment

The Project Phase II Assesment will be carried out using the rubric developed based on the following criteria

1	Development of Experiments (or) Setups (or) Components/Analysis of Data/Interpretation of Data
2	Modern Tool/ Technique Usage
3	Professional and ethical responsibility
4	Team Work and Presentation Skill
5	Project Management & Finance
6	Independent & Life-Long Learning

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