ANNASAHEB DANGE COLLEGE OF ENGINEERING AND TECHNOLOGY, ASHTA

An Empowered Autonomous Institute

(Affiliated to Shivaji University, Kolhapur)

02 Revision Curriculum and Syllabus : III Year and Semester VI

Bachelor of Technology in Aeronautical Engineering

Annasaheb Dange College of Engineering and Technology Ashta

Department of Aeronautical Engineering

Teaching and Evaluation Scheme

T. Y. B. Tech Semester VI

Course Code	Course Name	Teaching Scheme				THEORY							PRACTICAL						GRAND TOTAL
						ISE		MSE+ ESE			Total	Min	ISE		MSE + ESE		Total	Min	
		L	T	P	Credits	Max	Min	MSE	ESE	Min			Max	Min	Max	Min			
2AEPC313	Composite Materials and Structures	2	-	2	3	40	16	30	30	24	100	40	50	20	-	-	50	20	150
2AEPC314	Rocket Propulsion	2	1	-	3	40	16	30	30	24	100	40	-	-	-	-	-	-	100
2AEPE3**	Professional Elective - III	2	-	-	2	40	16	30	30	24	100	40	-	-	-	-	-	-	100
2AEPE3**	Professional Elective - IV	-	-	4	2	-	-	-	-	-	-	-	50	20	50	20	100	40	100
2AEEL323	Aircraft Design Project	-	-	4	2	-	-	-	-	-	-	-	50	20	50	20	100	40	100
2AEVS324	Predictive Maintenance and Condition Monitoring	-	-	2	1	-	-	-	-	-	-	-	25	10	25	10	50	20	50
2AECC325	Aptitude and Reasoning Part - IV	-	-	2	1	-	-	-	-	-	-	-	50	20	-	-	50	20	50
2AEHS326	Universal Human Values	2	-	-	2	50	20	-	-	-	50	20	-	-	-	-	-	-	50
2*******	Minor Stream Course 3	3	-	-	3	40	16	30	30	24	100	40	-	-	-	-	-	-	100
2*******	Open Elective 2	3	-	-	3	100	40	-	-	-	100	40	-	-	-	-	-	-	100
		14	1	14	22														900
	Total Contact Hours/Week	29																	

Professional Elective - III	
2AEPE315	Helicopter Engineering
2AEPE316	Lighter-Than-Air Systems
2AEPE317	Wind Energy Engineering
2AEPE318	Space Dynamics

Professional Elective - IV	
2AEPE319	Explicit Dynamic Analysis
2AEPE320	Multiphase Flow Analysis
2AEPE321	Flight Controller for Drones
2AEPE322	AR and VR in Aircraft Maintenance

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DOCUMENT NUMBER: ADCET/ACAD/5, Rev:00, 01/01/2020

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPC313 - Composite Materials and Structures**
Prerequisite	2AEPC212 - Aircraft Structures
Teaching Scheme: Lecture/Tutorial/Practical	02/00/02
Credits	03
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To introduce the fundamental concepts, classifications, and mechanical behavior of composite materials, focusing on polymer and natural composites, along with their manufacturing processes and applications in Aeronautical engineering.
2. To equip students with the knowledge of micromechanics and macromechanics of lamina and laminates, enabling them to evaluate material properties, analyze stress-strain relationships, and predict failure under various loading conditions.
3. To develop hands-on skills in fabricating, testing, and characterizing composite materials using standard methods, while integrating theoretical principles with experimental validation for real-world applications.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPC313_1	Classify and characterize composite materials based on their mechanical behavior and manufacturing method.
2AEPC313_2	Evaluate the elastic modulus and strength of unidirectional laminas using micromechanical principles with theoretical and experimental comparisons under controlled fabrication settings.
2AEPC313_3	Analyze the stress-strain behavior of orthotropic laminas for plane stress conditions and transform them for arbitrary orientations using theoretical models and experimental data.
2AEPC313_4	Compute the stiffness matrix of symmetric and asymmetric laminates based on laminate theory and validate theoretical predictions with experimental results under specified ply orientations.
2AEPC313_5	Perform mechanical testing of CFRP/GFRP laminates and green composites under ASTM standards for tensile, flexural, and compressive behavior.

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Course Contents:

Unit 1	**Introduction to Composite Materials and its Manufacturing process**	**04 + 04**
Classification – Constituent Materials – Mechanical behaviour – Manufacturing methods of fiber reinforced composite materials: hand layup, Vacuum bag moulding, Resin transfer moulding, Filament winding – Curing process – Advantages and application of composite materials. Identification and characterization of composite samples.		
Unit 2	**Micromechanical Behavior of Lamina**	**04 + 04**
Volume fraction, Mass fraction, Density & void content – Evaluation of Elastic moduli – Strength of Unidirectional lamina. Fabrication of CFRP/GFRP composite lamina with different volume fraction. Comparison of theoretical and experimental values of elastic modulus.		
Unit 3	**Macromechanical Analysis of a Lamina**	**05 + 04**
Stress-Strain relations for Anisotropic, Monoclinic, Orthotropic, Isotropic material – Engineering Constants – Stress-Strain relations for plane stress in an orthotropic material – Transformation of stresses and strains for arbitrary orientations (Hooke' law 2-D angle lamina). Determination of strength for any lamina and validating with experimental results.		
Unit 4	**Laminate Theory**	**04 + 04**
Laminate code – Classical Lamination theory – Laminate stiffness matrix – Fabrication of symmetric and asymmetric laminates with specified ply orientations.		
Unit 5	**Green Composites and Sandwich Composites**	**04 + 04**
Synthetic and Green Composites Comparison – Factors affecting the properties of Green Composites – Treatment of natural fiber – Mechanical Performance of Natural Resin & Green Composites - Natural fiber polymer composites – Challenges in the use of Natural fiber composites – Applications - Materials used for sandwich construction – Simply Supported Sandwich Beam - Shear due to bending in a sandwich beam.		
Unit 6	**Material Testing and Characterization**	**05 + 04**
ASTM Standards – Mechanical Behaviour of Non-metallic materials: Polymers and composites – Deformation and Strengthening mechanism – Mechanical testing of Polymers: Tensile, Compression, Flexural, Toughness and Hardness. Mechanical testing of a CFRP/GFRP unidirectional composite laminate (with and without fiber orientation) subjected to a uniaxial load.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Mechanics of Composite Materials	Autar K. Kaw	CRC Press. Taylor and Francis group	2nd	2006

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Sl.No	Title	Authors	Publisher	Edition	Year
2	Mechanics of Composite Materials	Robert M Jones	Taylor and Francis	2nd	1999
3	Mechanics of Composite Materials & Structures	Madhujit Mukhopadhyay	Universities press	-	2017

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Green Polymer Materials	Amar Singh Singha Vijay Kumar Thakir	SP LLC	-	-
2	Composite Materials: Design and Applications	Danial Gray	CRC Press. Taylor and Francis group	3rd Edition	-
3	Natural Fibre Composites and Their Applications: A Review	Paulo Peças, Hugo Carvalho, Hafiz Salman, Marco Leite	Journal of Composite Science	-	2018
4	Processing of Green Composites	Pawan Kumar Rakesh Inderdeep Singh	Springer	-	2019

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	20	16	40 %
2	ISE : PA	☑	☑	☑	☑	☑	50	20	
3	MSE	☑	☑	☑	☐	☐	30	24	60 %
4	ESE	☐	☐	☐	☑	☑	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, PA - Practical Assessment

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CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	-	-	-	2	1	-	-	-	1	-	1	1	-
2	3	3	-	2	1	-	1	-	1	2	-	2	2	2
3	3	3	-	2	1	-	-	-	1	2	-	2	2	2
4	3	3	-	2	1	-	-	1	1	2	-	2	2	1
5	2	1	-	2	1	2	1	2	1	2	-	2	2	-
Avg	**3**	**3**	**-**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**-**	**2**	**2**	**2**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPC314 - Rocket Propulsion**
Prerequisite	2AEPC213 - Airbreathing Propulsion
Teaching Scheme: Lecture/Tutorial/Practical	02/01/00
Credits	03
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. Understand the fundamental aspects of rockets and the current trends in rocket propulsion.
2. Interpret the theory behind operating principles and design aspects of solid propellant, liquid propellant for the design of rocket engines.
3. To apply the pump and turbine feed system for the design of a rocket thruster engine.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPC314_1	Understand the fundamental equations and concepts in Rocket propulsion to apply these equations and concepts to solve propulsion problems, involving one-dimensional equation of motion
2AEPC314_2	Solve problems in the pump and turbine feed system and calculate the efficiency of turbine feed system
2AEPC314_3	Interpret the effectiveness of solid propellant and liquid propellant by calculating the burn rate,combustion instability, applicable to rocket engines.
2AEPC314_4	Design the injector and rocket nozzle to the application of the rocket engines, and calculate thrust coefficient and specific impulse and other parameters at supersonic and hypersonic speeds.
2AEPC314_5	Analyze the burn rate of the rocket engine working collaboratively and integrate individual contributions into a coherent solution, using the simulation tools / experimentation

Course Contents:

Unit 1	**Fundamentals of Rocket Propulsion**	**3 + 2**
Introduction – A Brief History of Rocket Propulsion & ISRO –Types of Rocket Engine – Fundamentals of Aero-thermodynamics – Control Volume Analysis & Governing Equations		
Unit 2	**Ideal Rocket Engine**	**5 + 2**
Adiabatic Steady 1-D flow & Speed of Sound – Basics of Thermochemistry, Adiabatic Flame Temperature & Chemical Equilibrium – Ideal Rocket Engine – Thrust Equation and Performance Parameters, Performance Parameters of Rocket Engine		

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Unit 3	**Characteristics parameter of Rocket Nozzle**	**5+2**
Ideal nozzle, Rocket nozzle – Area Ratio of Nozzles: Under Expansion and Over Expansion – Convergent divergent nozzle and shock wave reflections – Unconventional Nozzles and Problems in Nozzles – Effect of Back pressure and Thrust coefficient, characteristic velocity , Thrust effectiveness and combustion efficiency		
Unit 4	**Types of Propellants**	**3+2**
Propellants – Criterion for Choice of Chemical Propellants – Choice of Fuel-Rich Propellants – Performance Prediction Analysis – Factors Influencing Choice of Chemical Propellants – Low energy liquid propellants and Hybrid propellants,		
Unit 5	**Solid Propellant Rockets,**	**5+2**
Introduction to Solid Propellant Rockets – Burn Rate of Solid Propellants and Equilibrium Pressure in Solid Propellant Rockets – design Aspects of Solid Propellant Rockets – Burning Surface Area of Solid Propellant Grains, Ignition of Solid Propellant Rockets.		
Unit 6	**Liquid Propellant Rockets**	**5+2**
Introduction to Liquid Propellant Rockets – Feed System Cycles for Pump Fed Liquid Propellant Rockets – Analysis of Gas Generator and Staged combustion cycles and introduction to injectors, Injectors, Cooling of chambers and mixture ratio distribution – Efficiencies due to mixture ratio distribution and incomplete vaporization – Pumps and Turbines: Propellant Feed System at Zero "g" Conditions – Review of Liquid bi-propellant Rockets and Mono-propellant Rockets – Combustion instability in Liquid Propellant Rockets.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Rocket Propulsion Elements	George P Sutton	John Wiley	Seventh	2000
2	Understanding Aerospace Chemical Propulsion	Prof. H. S. Mukunda	TechSar Pvt. Ltd	First	2017
3	Rocket Propulsion	K Ramamurthi	Laxmi Publications Pvt. Ltd	Second	2016

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Rocket Propulsion and Spaceflight Dynamics.	J.W. Cornelisse	Pitman	First	1979
2	Mechanics and thermodynamics of propulsion	Philip Hill, Carl Peterson	Pearson	Second	2009

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Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	20	16	40 %
2	ISE : TA	☑	☑	☑	☑	☑	20		
3	MSE	☑	☐	☐	☑	☐	30	24	60 %
4	ESE	☐	☑	☑	☐	☑	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	-	-	-	-	-	1	-	-	1	-	-
2	2	2	2	1	1	-	1	-	1	-	-	-	1	1
3	3	3	3	1	1	1	1	-	2	-	-	2	2	1
4	3	2	3	2	1	1	1	-	2	-	-	2	2	2
5	3	2	3	3	2	2	-	-	2	-	-	2	2	2
Avg	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**-**	**2**	**-**	**-**	**2**	**2**	**2**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE315 - Helicopter Engineering**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	02
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To provide students with a fundamental understanding of helicopter configurations, the working principles of main and tail rotors, and their maintenance and inspection procedures.
2. To equip students with the ability to apply momentum and blade element theories for aerodynamic calculations of rotor blades and overall helicopter performance.
3. To empower students to analyze the impact of various factors on helicopter performance under different operational conditions.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE315_1	Explain the basic principles of helicopter flight, including rotor aerodynamics, helicopter configurations, key components, and control systems, and describe the different types of rotorcraft.
2AEPE315_2	Apply momentum theory and blade element theory to analyze rotor aerodynamics in hover and forward flight, considering factors such as induced velocity, ground effect, compressibility, and vortex effects.
2AEPE315_3	Predict helicopter performance in various flight conditions (hover, forward flight, climb, descent) by calculating power requirements, considering factors such as altitude, temperature, weight, parasite drag, and autorotation.
2AEPE315_4	Describe the components and operation of main and tail rotor systems, explain rotor balance principles, and outline common maintenance and inspection procedures for helicopter rotor systems.

Course Contents:

Unit 1	**Introduction**	**04**
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.		

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Unit 2	**Helicopter Aerodynamics**	**05**
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**	**04**
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**	**04**
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**	**04**
Helicopter Trim, Static stability – Incidence disturbance, forward speed disturbance, angular velocity disturbance, yawing disturbance, Dynamic Stability.		
Unit 6	**Main Rotor System**	**05**
Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking– Span wise dynamic balance – Blade sweeping –Electronic balancing – Damper maintenance – Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box –Gradient unit control boosts – Maintenance & Inspection control rigging.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Aerodynamics of the Helicopter	A. Gessow and G.C.Meyers	Macmillan and Co	-	1982
2	Fundamentals of Helicopter Dynamics	C. Venkatesan	CRC Press	1st	2017
3	Helicopter Aerodynamics	E. Rathakrishnan	PHI Learning Pvt. Ltd.	1st	2019
4	Helicopter Maintenance	Jeppesen	Jeppesen and Sons Inc	-	2000

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Reference Books:

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

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes				Marks		Weightage
		1	2	3	4	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	40	16	40 %
2	MSE	☑	☑	☑	☐	30	24	60 %
3	ESE	☐	☐	☑	☑	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	-	-	-	-	-	-	-	-	-	-	3	1
2	3	3	1	2	2	-	-	-	-	-	-	-	3	1
3	3	3	1	2	2	-	-	-	-	-	-	-	3	1
4	3	2	1	1	1	-	-	-	-	-	-	-	3	2
Avg	**3**	**2**	**2**	**2**	**2**	-	-	-	-	-	-	-	**3**	**1**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE316 - Lighter-Than-Air Systems**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	02
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To develop a comprehensive understanding of the fundamental principles governing lighter-than-air (LTA) systems, including aerostatics, buoyancy, and Archimedes' principle.
2. To develop the ability to perform calculations for estimating LTA system performance metrics like payload capacity, range, and endurance.
3. To foster an understanding of emerging trends and potential future applications of LTA technology in the aerospace industry.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE316_1	Apply the principles of aerostatics and buoyancy to analyze the static lift characteristics of different LTA configurations.
2AEPE316_2	Calculate static lift, pressure height, and other key performance parameters for given LTA system designs.
2AEPE316_3	Analyze the influence of environmental factors (temperature, pressure, humidity) on LTA system performance.
2AEPE316_4	Evaluate the selection and application of appropriate envelope materials and ground handling techniques for different LTA systems.
2AEPE316_5	Apply design methodologies for the development of aerostats and airships, considering factors like shape, size, and internal structure.
2AEPE316_6	Analyze the design considerations and challenges associated with high-altitude airships and hybrid LTA systems.

Course Contents:

Unit 1	**Introduction to Lighter-Than-Air (LTA) systems**	**04**
Definition and classification of LTA systems (airships, balloons, aerostats), Applications of LTA systems: Transportation, surveillance, communication, research, entertainment, advertising. Early developments: Hot air balloons, hydrogen balloons. Evolution of airships: Rigid airships, semi-rigid airships, non-rigid airships.		

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Unit 2	**Principles of Aerostatics**	**05**
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 of LTA Systems**	**04**
Basic Assumptions, Drag, Dynamic Forces, Slender Body Theory, An Estimation Method for Overall Aerodynamic Forces and Moments, Unsteady Aerodynamics, Aerodynamic Parameter Estimation		
Unit 4	**Envelope Materials for LTA Systems**	**04**
Envelope Materials, Key Considerations for Envelope Materials, Common Envelope Materials, Common Sealing Techniques, Key Considerations for sealing. Emerging Envelope Materials and Sealing Techniques		
Unit 5	**Aerostat and Airship Design**	**05**
Design and Development of Tethered Aerostats, Methodology for airship conceptual design, Equilibrium and Stability analysis of aerostats, Aerodynamics & Stability analysis of Airships, Ground Handling and Mooring systems, Design & Development of Remotely Controlled Airships.		
Unit 6	**Recent Trends and Future Developments in LTA systems**	**04**
Challenges in design of LTA Systems, Hybrid LTA Systems, Stratospheric Airships, Airships/Aerostats for Planetary Exploration, Current Trends and Recent Developments.		

Text Books:

Sl.No	Title	Authors	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	-	2012

Reference Books:

Sl.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

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Sl.No	Title	Author	Publisher	Edition	Year
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

E-Resources/Reference Papers:

1. Liao, L., & Pasternak, I. (2009). A review of airship structural research and development. Progress in Aerospace Sciences, 45(4-5), 83-96.
2. Manikandan, M., & Pant, R. S. (2021). Research and advancements in hybrid airships—A review. Progress in Aerospace Sciences, 127, 100741.
3. Babu, K. K., & Pant, R. S. (2020). A review of Lighter-than-Air systems for exploring the atmosphere of Venus. Progress in Aerospace Sciences, 112, 100587.
4. Wang, X. L., Fu, G. Y., Duan, D. P., & Shan, X. X. (2010). Experimental investigations on aerodynamic characteristics of the ZHIYUAN-1 airship. Journal of aircraft, 47(4), 1463-1468.
5. Li, Y., Nahon, M., & Sharf, I. (2011). Airship dynamics modeling: A literature review. Progress in aerospace sciences, 47(3), 217-239.

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes						Marks		Weightage
		1	2	3	4	5	6	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	☑	40	16	40 %
3	MSE	☑	☑	☑	☐	☐	☐	30	24	60 %
4	ESE	☐	☐	☐	☑	☑	☑	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	-	-	3	-	-	-	-	-	-	-	-	-
2	3	3	-	-	3	-	-	-	-	-	-	-	-	-
3	3	3	-	3	3	-	-	-	-	-	-	-	-	-
4	3	-	3	-	3	2	-	-	-	-	-	-	3	-
5	3	3	3	-	3	-	-	-	-	-	-	-	3	3
6	3	3	-	3	-	2	-	-	-	-	-	2	-	3
Avg	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**			**2**	**3**	**3**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE317 - Wind Energy Engineering**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	02
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To provide an understanding of the fundamentals of wind energy and its characteristics, wind turbines, and the impact of wind resources as an alternative.
2. To understand and apply the techniques and tools for wind resource assessment and modeling for site selection and optimization.
3. To develop knowledge about wind turbine components, materials, and aerodynamic principles underlying their design and operation

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE317_1	Relate the fundamental aspects of wind resources and their characteristics, and energy conversion systems to develop alternate energy systems for global economic significance.
2AEPE317_2	Infer the basic aerodynamic principles of blades of the wind energy conversion systems to design and optimize the systems subjected to elemental and momentum theory.
2AEPE317_3	Associate the structural and material properties to improve the feasibility and reliability of the energy conversion systems.
2AEPE317_4	Estimate the wind resource assessment to enhance power extraction at specific locations using statistical methods, CFD, and microscale models.
2AEPE317_5	Appraise the use of wind energy and power to improve the sustainable energy development.
2AEPE317_6	Correlate conventional power production methods with wind power to analyze the environmental and ecological impacts.

Course Contents:

Unit 1	**Wind Energy**	**04**
Introduction of wind engineering, the generation of wind and its nature, geographical variation in the wind resource; wind energy & Power - historical development, current status of wind power worldwide, worldwide business of wind energy and its benefits.		

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Unit 2	Wind Characteristics	05
Introduction; General Characteristics of the Wind Resource, Atmospheric Boundary Layer (ABL) Characteristics; Wind Data Analysis and Resource Estimation- Statistical Distribution of Wind Speed, Weibull Distribution; Wind Shear- Understanding Wind Shear, Power and Air density.		
Unit 3	**Wind Resource Assessment**	**04**
Overview of Wind Resource Assessment; Definitions, Phases of Resource Assessment, Preliminary Wind Resource Assessment, Wind Resource Map Lookup; Resource Estimation Models- Mesoscale Models, CFD Models, WAsP, a Microscale Model; Introduction to Advanced resource assessment.		
Unit 4	**Wind Turbine**	**04**
Materials and composites-Principal Components, materials and its fatigue; Design and testing- Design Procedure, Wind Turbine Topologies, Standards, Technical Specifications, and Certification, Design Loads and Scaling.		
Unit 5	**Wind Turbine Aerodynamics**	**05**
Introduction on aerodynamics on horizontal axis wind turbines; Blade Design - 1D Momentum Theory and the Betz Limit, Momentum Theory and Blade Element Theory; Horizontal Axis Wind Turbine with Wake Rotation, Airfoils and General Concepts of Aerodynamics, Blade Shape for Ideal Rotor with and without Wake Rotation, General Rotor Blade Shape Performance and Rotor Design Procedures.		
Unit 6	**Environmental Aspects and Impacts**	**04**
Introduction - Impact of Wind Farms on Wildlife; Wind Turbine Noise- Mitigation of Noise, Low-Frequency Noise, Electromagnetic Interference Effects, Land-Use Environmental Impacts, Visual Impacts, Aesthetic Impact; Framework for Analyzing Environmental Impact, Temporal and Spatial Scale, Cumulative Effects; Quick Comparison of Wind Versus Fossil Fuel–Based- Electricity Production.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Wind energy engineering.	Jain, P	McGraw-Hill, Inc.	First	2011
2	Wind energy explained: theory, design and application.	Manwell, J.F., McGowan, J.G. and Rogers, A.L.	John Wiley & Sons.	Second	2010

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Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Wind energy handbook.	Burton, T., Jenkins, N., Sharpe, D. and Bossanyi, E.	John Wiley & Sons.	Second	2011
2	Wind power in power systems.	Ackermann, T. ed.	John Wiley & Sons.	Second	2012

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes						Marks		Weightage
		1	2	3	4	5	6	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	☑	20	16	40 %
2	MSE	☑	☐	☐	☑	☑	☐	30	24	60 %
3	ESE	☑	☑	☑	☐	☐	☑	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	-	-	-	2	2	-	-	-	-	2	2	2
2	3	3	3	2	2	-	-	-	-	-	-	2	3	3
3	3	2	3	2	-	-	-	-	-	-	-	2	3	3
4	3	2	-	3	2	-	-	-	-	-	-	2	2	-
5	-	-	-	-	-	3	3	-	-	-	-	2	-	2
6	3	2	-	-	-	2	2	-	-	-	-	2	2	-
Avg	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE318 - Space Dynamics**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	02
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To develop a strong foundation in the principles of celestial mechanics, encompassing planetary motion, reference frames, and gravitational forces.
2. To analyze and solve complex orbital problems, including two-body and many-body scenarios, utilizing mathematical and physical principles to predict trajectories.
3. To acquire in-depth knowledge of orbital maneuvers, interplanetary trajectories, and perturbation techniques relevant to space flight and mission design.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE318_1	Demonstrate a thorough understanding of the fundamental principles of celestial mechanics, including Kepler's laws and Newton's laws of motion and gravitation.
2AEPE318_2	Analyze and solve two-body problems to determine orbital parameters and predict the characteristics of circular, elliptical, parabolic, and hyperbolic orbits.
2AEPE318_3	Apply the concepts of the restricted three-body problem to identify Lagrange points and calculate Jacobi constants, demonstrating their significance in space flight applications.
2AEPE318_4	Evaluate the impact of disturbing forces on orbital motion by utilizing perturbation theories and methods like Cowell's method and Variation of Parameters (VOP).
2AEPE318_5	Design and analyze optimal orbital maneuvers and interplanetary trajectories, including Hohmann and non-Hohmann transfers and planetary flybys, considering real-world constraints and mission objectives.

Course Contents:

Unit -1	**Fundamentals of Celestial Mechanics**	**04**
The solar system, Reference Frames and Coordinate Systems, The celestial Sphere, The ecliptic, Motion of Vernal Equinox, Particle Kinematics, Newton's laws of Gravitation, Newton's laws of motion, Kepler's Laws of Planetary Motion		

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Unit -2	**Two Body Problem**	**04**
Equations of motion in an inertial frame, Equations of relative motion, Angular momentum and the orbit formulas, The energy law, Circular orbits, Elliptical orbits, Parabolic trajectories, Hyperbolic trajectories, The Lagrange coefficients		
Unit -3	**Many Body Problem**	**05**
Restricted Three Body Problem: Circular and Elliptical restricted problem, Lagrange points and Jacobi Constants, Applications to space flight Many Body Problem: The many body concept and its application, The General N-body problem, Integrals of motion, The Virial theorem		
Unit -4	**Perturbation Theory**	**05**
Special perturbation techniques: Introduction to perturbations, Cowell's Method, Enacke's method, Disturbing forces - Gravity field of a central body, Atmospheric drag, Third-body perturbations, Solar-radiation pressure General perturbation techniques: The method of perturbations, Variation of parameters - Lagrangian VOP, Gaussian VOP, Hamilton's formulation		
Unit -5	**Orbital Maneuvers**	**04**
Impulsive maneuvers, Hohmann transfer Bi-elliptic Hohmann transfer, Phasing maneuvers, Non-Hohmann transfers with a common apse line, Apse line rotation, Chase maneuvers, Plane change maneuvers		
Unit -6	**Interplanetary Trajectories**	**04**
Interplanetary Hohmann transfers, Rendezvous opportunities, Sphere of influence, Method of patched conics, Planetary departure, Planetary rendezvous, Planetary flyby, Planetary ephemeris, Non-Hohmann interplanetary trajectories		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Orbital Mechanics for Engineering Students	Howard D. Curtis	Elsevier	4th	2021
2	Space Flight Dynamics	Craig A. Kleuver	Wiley	1st	2018
3	Fundamentals of Astrodynamics	Roger R. Bate, Donald D.	Dover	2nd	1971

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Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Fundamentals of Celestial Mechanics	J.M.A. Danby	Willmann-Bell	2nd	1988
2	The Foundations of Astrodynamics	Archie E. Roy	Dover	2nd	1988
3	An Introduction to the Mathematics and Methods of Astrodynamics	Richard H. Battin	AIAA	Revised	1999

E-Resources/Reference Papers:

1. NASA Technical Reports Server (NTRS) - https://ntrs.nasa.gov/
2. AIAA Digital Library - https://arc.aiaa.org/
3. JPL Technical Reports - https://trs.jpl.nasa.gov/

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	20	16	40 %
2	MSE	☑	☑	☑	☐	☐	30	24	60 %
3	ESE	☐	☐	☐	☑	☑	30		

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- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	-	-	-	2	-	-	2	2	3	-	1	-	-
2	3	2	-	2	3	-	-	3	3	3	-	3	-	2
3	3	2	-	2	2	-	-	3	3	3	-	2	-	-
4	3	2	-	1	3	-	-	2	2	3	-	2	-	1
5	3	2	-	2	3	-	-	3	3	3	-	3	-	2
Avg	**3**	**2**	**-**	**2**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**2**	**-**	**2**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE319 - Explicit Dynamic Analysis**
Prerequisite	2AEPE214 - Introduction to Finite Element Methods, 2AEPE304 - Analyzing Aircraft Structures using FEA
Teaching Scheme: Lecture/Tutorial/Practical	00/00/04
Credits	02
Evaluation Scheme : ISE/MSE+ESE	50/50

Course Objectives:

1. To develop students' proficiency in using simulation tools for explicit dynamics, focusing on real-world applications such as crash analysis, impact tests, penetration tests, and crashworthiness assessments of materials and structures.
2. To enhance students' ability to model, analyze, and interpret the behavior of structures under extreme loading conditions, promoting innovative problem-solving approaches to engineering challenges in aerospace and related industries.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE319_1	Analyze crash and impact scenarios using explicit dynamics tools to evaluate energy absorption and deformation behavior of structures under predefined loading conditions.
2AEPE319_2	Simulate tensile and ballistic tests to analyze material behavior and failure characteristics under high-strain loading conditions.
2AEPE319_3	Evaluate drop test scenarios on fuel tanks or fuselage structures, ensuring performance and safety compliance through accurate stress analysis.
2AEPE319_4	Simulate bird strike impacts on aircraft components, predicting structural damage and validating results against research data for performance and safety compliance.
2AEPE319_5	Conduct crashworthiness analysis to optimize aircraft structures, through enhancement of performance parameters by 50% over baseline models.

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Course Contents:

Sl.No	Title of the Exercises
1	**Introduction:** • Introduction to Explicit and Transient Analysis. • Difference between Implicit and Explicit Analysis.
2	Crash Analysis of Rectangular Tube
3	Explicit Dynamics Analysis of Tensile Analysis of Specimens
4	Impact Analysis of Bicycle Frames
5	Drop Test Analysis on a Fuel Tank / Fuselage Structures of an Airplane
6	Ballistic Penetration Test on Aircraft Skin
7	Simulation of Bird Strike on an Aircraft components
8	Crashworthiness Analysis of an Aircraft Structure.

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Introduction to the Explicit Finite Element Method for Nonlinear Transient Dynamics	Shen r. Wu and Lei Gu	A John Wiley & Sons, Inc.	1st	2012

E-Resources/Reference Papers:

1. https://www.ansys.com/training-center/course-catalog/structures/ansys-explicit-dynamics#tab1-1'
2. https://skill-lync.com/mechanical-engineering-courses/basics-fea-explicit-implicit-fea

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	20	20	50 %
2	ISE : PA	☑	☑	☑	☑	☑	30		
4	ESE : OE	☑	☑	☑	☑	☑	20	20	50 %
5	ESE : PE	☑	☑	☑	☑	☑	30		

- ISE - In-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, PA - Pactical Assessment, OE - Oral Examination, PE - Practical Examination

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CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	-	-	3	-	2	-	-	-	-	-	3	3
2	3	-	-	3	3	-	-	-	-	-	-	-	3	3
3	2	-	3	-	3	2	2	-	-	-	-	-	3	2
4	2	2	-	2	3	3	-	-	2	-	-	-	3	3
5	2	-	2	-	3	-	-	-	3	-	-	2	3	3
Avg	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**2**	**3**	**3**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE320 - Multiphase Flow Analysis**
Prerequisite	2AEPE215 - Introduction to Computational Fluid Dynamics 2AEPE305 - Internal and External Flow Analysis using CFD
Teaching Scheme: Lecture/Tutorial/Practical	00/00/04
Credits	02
Evaluation Scheme : ISE/MSE+ESE	50/50

Course Objectives:

1. To develop skills in modeling and simulating multiphase flows using computational tools
2. To analyze the behavior of multiphase flows in various engineering applications

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE320_1	Identify and classify different types of multiphase flow regimes (e.g., bubbly, slug, annular) and their characteristics.
2AEPE320_2	Describe the underlying physics and limitations of the Volume of Fluid (VOF), Discrete Phase Model (DPM), and Eulerian-Eulerian models for multiphase flow simulations.
2AEPE320_3	Utilize CFD software to simulate various multiphase flow phenomena, including tank flushing, spray evaporation, bubble columns, and fluidized beds.
2AEPE320_4	Analyze and interpret simulation results, including flow patterns, pressure drops, and heat transfer, to understand the behavior of multiphase systems.
2AEPE320_5	Apply the knowledge of multiphase flow analysis to solve real-world engineering problems in areas such as chemical, petroleum, mechanical, aerospace, and environmental engineering.

Course Contents:

Sl.No	Title of the Exercises
1	Introduction to Multiphase Flows
2	Volume of Fluid Model (VOF)
3	Simulating the flushing of a tank with a liquid, analyzing the flow patterns and mixing characteristics.
4	Discrete Phase Model (DPM)

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Sl.No	Title of the Exercises
5	Simulating the spray of liquid droplets and their evaporation in a gas environment.
6	Eulerian Model
7	Simulating the behavior of gas bubbles rising in a liquid column.
8	Simulating the flow of particles in a fluidized bed reactor.
9	Simulating the motion of gas bubbles in a suspension of solid particles in a liquid.
10	Large Eddy Simulation (LES) for multiphase flows

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Multiphase Flow Handbook	Clayton T. Crowe,	CRC Press	1st	2005
2	Fundamentals of Multiphase Flow	Christopher E. Brennen	Cambridge University Press	1st	2005

E-Resources/Reference Papers:

1. https://onlinecourses.nptel.ac.in/noc25_ch35/preview
2. https://onlinecourses.nptel.ac.in/noc25_me35/preview
3. https://www.ansys.com/training-center/course-catalog/fluids/ansys-fluent-multiphase-flow-modeling#tab1-4

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	20	20	50 %
2	ISE : PA	☑	☑	☑	☑	☑	30		
4	ESE : OE	☑	☑	☑	☑	☑	20	20	50 %
5	ESE : PE	☑	☑	☑	☑	☑	30		

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CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	1	2	2	1	1	-	-	1	-	1	2	1
2	2	3	1	2	3	1	1	-	-	1	-	1	2	1
3	2	3	3	3	3	1	1	-	2	2	2	2	3	2
4	2	3	2	3	3	1	1	-	2	2	2	2	3	2
5	3	3	3	3	3	2	2	1	2	2	2	3	3	3
Avg	**2**	**3**	**2**	**3**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**2**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE321 - Flight Controller for Drones**
Prerequisite	2AEPE216 - Introduction to Unmanned Aerial Vehicles 2AEPE306 - Autonomous Navigation and Flight Control
Teaching Scheme: Lecture/Tutorial/Practical	00/00/04
Credits	02
Evaluation Scheme : ISE/MSE+ESE	50/50

Course Objectives:

1. To provide hands-on experience with configuring and programming drone flight controllers.
2. To develop the ability to integrate sensors and peripherals with flight controllers for autonomous drone operations.
3. To troubleshoot, analyze, and optimize the performance of flight control systems for UAVs.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE321_1	Use essential sensors (IMU, GPS, barometer, etc.,) and peripherals with various UAV flight controllers (i.e., Pixhawk Cube Orange +, Jiyi K++) for application based operation
2AEPE321_2	Configure UAV flight controllers and optimize UAV performance for various flight modes on Pixhawk Cube Orange + Flight Controller
2AEPE321_3	Analyze flight controller performance issues and resolve them with Herelink & T12 C2 Link by using Dataflash & Telemetry logging techniques
2AEPE321_4	Develop flight control algorithms and implement fail-safe mechanisms for reliable UAV operations by modifying open source code

Course Contents:

Sl.No	Title of the Exercises
1	Introduction to Open Source Flight Controllers and Ground Control Stations
2	Calibration of Sensors using Herelink Controller with QGCS / Mission Planner
3	Herelink & T12 - Radio Transmitter and Receiver Configuration
4	Auto PID Tuning for Flight Stability for Different Airframes
5	Flight Modes and Switching using T12 Controller & Herelink Controller
6	Autonomous Mission Planning & Uploading to Vehicle through Mavlink

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Sl.No	Title of the Exercises
7	Fail-safe and Safety Mechanisms - Master-Slave Trainer / Buddy system for T12 controllers
8	Real Time Data Logging and Post flight analysis
9	GPS and Compass Interference Mitigation
10	Sensor Integration and Fusion of 360° LIDAR, Downfacing RADAR & Airspeed Sensor
11	Real-Time Flight Control Algorithms & Custom codes into Pixhawk using Raspberry Pi & Jetson

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Designing Purpose-Built Drones for Ardupilot Pixhawk 2.1: Build drones with Ardupilot	Ty Audronis	Packt Publisher	1st	2017
2	Theory, Design, and Applications of Unmanned Aerial Vehicles	A R Jha Ph D	CRC Press	1st	2020
3	Handbook of unmanned aerial vehicles	Valavanis K. P.; Vachtsevanos, G. J.	Springer reference	1st	2015
4	A first course in aerial robots and drones	Sebbane, Y. B.	CRC Press	1st	2022

E-Resources/Reference Papers:

1. https://oscarliang.com/flight-controller/
2. https://docs.px4.io/main/en/hardware/reference_design.html
3. https://docs.qgroundcontrol.com/master/en/qgc-user-guide/index.html
4. https://ardupilot.org/planner/docs/mission-planner-building.html
5. https://docs.cubepilot.org/user-guides/herelink/herelink-user-guides

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes				Marks		Weightage
		1	2	3	4	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	20	20	50 %
2	ISE : PA	☑	☑	☑	☑	30		
3	ESE : OE	☑	☑	☑	☑	20	20	50 %
4	ESE : PE	☑	☑	☑	☑	30		

- ISE - In-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, PA - Pactical Assessment, OE - Oral Examination, PE - Practical Examination

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CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	1	1	1	3	-	-	-	1	3	-	-	1	-
2	3	1	1	1	3	-	-	-	1	3	-	-	2	-
3	3	2	2	3	3	3	1	-	2	3	1	3	2	1
4	3	3	3	3	3	3	-	-	2	3	1	2	3	3
Avg	**3**	**2**	**2**	**2**	**3**	**3**	**1**	**-**	**2**	**3**	**1**	**3**	**2**	**2**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEPE322 - AR and VR in Aircraft Maintenance**
Prerequisite	2AEPE217 - Introduction to Aircraft Maintenance 2AEPE307 - Airframe and Aero Engine Maintenance
Teaching Scheme: Lecture/Tutorial/Practical	00/00/04
Credits	02
Evaluation Scheme : ISE/MSE+ESE	50/50

Course Objectives:

1. Familiarize students with AR/VR technologies and their applications in aviation maintenance.
2. Develop proficiency in using AR/VR tools to perform essential maintenance tasks.
3. Enhance diagnostic and troubleshooting skills using AR/VR-based simulations.
4. Assess the advantages and limitations of AR/VR in aircraft maintenance training and operations.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEPE322_1	Set up and operate AR/VR hardware and software for aviation maintenance tasks with accuracy, using Oculus-based systems provided in the lab environment.
2AEPE322_2	Perform basic maintenance procedures, such as bolt-tightening and component replacement, following procedural guidelines without errors, in a virtual environment simulated using AR/VR tools.
2AEPE322_3	Identify and troubleshoot aircraft faults in a VR simulation, achieving a resolution success rate of at least 85%, under instructor-supervised laboratory conditions.
2AEPE322_4	Analyze the advantages and limitations of AR/VR technologies in enhancing maintenance efficiency, using case studies and hands-on experience, and submit a report meeting evaluation criteria for accuracy and depth.

List of Experiments:

Sl.No	Title of the Exercises
1	**Week 1-2**: **Familiarization with AR/VR Technology** **Objective**: Introduce students to AR/VR concepts and the Oculus system. **Sessions:** Day 1: Overview of AR/VR in aviation maintenance, safety protocols, and hardware setup. Day 2: Hands-on exploration of the Oculus system and software navigation.
2	**Week 3-4: Performing Basic Maintenance Procedures in VR** Objective: Teach basic tasks such as bolt-tightening and tool selection in VR. Sessions:

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Sl.No	Title of the Exercises
	Day 1: Simulate a bolt-tightening task using VR tools with guided steps. Day 2: Practice selecting tools and performing basic component replacements.
4	**Week 5-6: Virtual Assembly and Disassembly of Aircraft Components** Objective: Enable students to assemble and disassemble key aircraft components virtually. Sessions: Day 1: Simulate the disassembly of an aircraft engine in VR. Day 2: Simulate the reassembly process with AR overlays as guidance.
5	**Week 7-8: Using AR for Aircraft Inspection and Diagnostics** **Objective:** Train students in inspecting aircraft parts using AR tools. **Sessions:** Day 1: Use AR overlays to identify surface defects like cracks or corrosion. Day 2: Perform a guided inspection task and document findings.
6	**Week 9-10: Troubleshooting Aircraft Faults in a VR Environment** **Objective:** Develop fault diagnosis and troubleshooting skills in VR. Sessions: Day 1: Identify faults in simulated aircraft systems (e.g., electrical or hydraulic). Day 2: Apply corrective measures and assess the effectiveness of repairs.
7	**Week 11: Advanced Maintenance Scenarios** **Objective:** Handle complex and time-sensitive maintenance scenarios in VR. Sessions: Day 1: Practice maintenance under time constraints. Day 2: Collaborate on troubleshooting scenarios with peers in a VR environment.
8	**Week 12: Project and Assessment** **Objective:** Evaluate students' ability to integrate AR/VR skills in maintenance. Sessions: Day 1: Perform a maintenance task using AR/VR and present findings. Day 2: Final assessment and feedback.

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Aircraft Powerplants	Michael J. Kroes and Thomas W. Wild	Aviation Maintenance Technician Handbook – Airframe by FAA	-	-

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Sl.No	Title	Author	Publisher	Edition	Year
2	Cessna 152 Maintenance Manual	Cessna Aircraft Company	Cessna Aircraft Company	-	-
3	Lycoming Engine Operator's Manual	Lycoming Engines	Lycoming Engines	-	-
4	FAA Advisory Circulars	Federal Aviation Administration (FAA)	U.S. Department of Transportation (FAA)	-	-

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes				Marks		Weightage
		1	2	3	4	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	20	16	50 %
5	ESE : POE	☑	☑	☑	☑	30	24	50 %

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, PA - Pactical Assessment, POE - Practical and Oral Examination

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	-	-	-	3	3	1	1	3	3	-	1	3	-
2	1	-	-	-	3	3	1	1	3	3	-	1	3	-
3	1	-	-	-	3		2	1	3	3	-	1	3	-
4	1	-	-	-	3	3	2	1	3	3	-	1	3	-
Avg	1	-	-	-	3	3	2	1	3	3	-	1	3	-

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEEL323 - Aircraft Design Project**
Prerequisite	2AEPC211 - Low Speed Aerodynamics, 2AEPC212 - Aircraft Structures, 2AEPC213 - Airbreathing Propulsion, 2AEPC301 - Aircraft Performance, 2AEPC302 - Aircraft Stability and Control, 2AEPC303 - High Speed Aerodynamics
Teaching Scheme: Lecture/Tutorial/Practical	00/01/02
Credits	02
Evaluation Scheme : ISE/MSE+ESE	50/50

Course Objectives:

1. To provide students with the opportunity to apply their knowledge of aerodynamics, structures, propulsion, and flight mechanics to the design of a complete aircraft.
2. To introduce students to the aircraft design process, including mission analysis, sizing, weight and balance, performance analysis, stability and control analysis, and systems integration.
3. To provide students with experience in working in teams on a complex engineering project.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEEL323_1	Apply knowledge of aerodynamics, structures, propulsion, and flight mechanics to the conceptual design of an aircraft.
2AEEL323_2	Develop a preliminary aircraft design based on mission requirements and sizing considerations.
2AEEL323_3	Estimate the take-off weight, and the dimensional parameters of wing, fuselage, tail, and control surfaces based on requirements
2AEEL323_4	Analyze aircraft performance, including takeoff, climb, cruise, descent, landing.
2AEEL323_5	Perform the constraints analysis and performance analysis for a given aircraft requirements and select the suitable design variables
2AEEL323_6	Demonstrate an understanding of ethical considerations and safety principles in aircraft design.
2AEEL323_7	Demonstrate teamwork and collaboration skills in a project-based engineering environment.
2AEEL323_8	Effectively communicate aircraft design concepts and decisions through technical reports and presentations.

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Course Contents:

1. Introduction to Aircraft Design Process
2. Requirements Capture and Design Considerations
3. Preliminary Estimation of Takeoff Weight
4. Estimating the Takeoff Wing Loading, Selecting the planform and Airfoil Selection
5. Preliminary Fuselage Sizing and Design
6. Takeoff and Landing Analysis
7. Preliminary Sizing of the Vertical and Horizontal Tails
8. Estimating Wing-Body Aerodynamics
9. Propulsion System Thrust Sizing
10. Constraints Diagram
11. V-n Diagram and Gust Envelope
12. Refined Weight Estimation

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Fundamentals of Aircraft and Airship Design (Volume I - Aircraft Design)	Nicolai and Carichner	AIAA	-	2010

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Aircraft Design - A Conceptual Approach	Daniel P. Raymer	AIAA	6th	
2	Introduction to Aircraft Design	John. P. Fielding	Cambridge University Press	-	2005
3	General Aviation Aircraft Design	Snorri Gudmunsddon	Elsevier Science	1st	2021
4	Aircraft Performance and Design	John D. Anderson	Tata McGraw	3rd	2016

E-Resources/Reference Papers:

1. https://www.nacdec.in/
2. https://mdolab.engin.umich.edu/wiki/aircraft-design-software
3. https://openvsp.org/
4. https://aerotoolbox.com/category/aircraft-design/
5. https://in.mathworks.com/help/aeroblks/lightweight-airplane-design.html
6. https://www.gokcincinar.com/software/fast/

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Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes								Marks		Weightage
		1	2	3	4	5	6	7	8	Max	Min	
1	ISE : PA	☑	☑	☑	☑	☑	☑	☑	☑	50	20	50 %
2	ESE : PP	☑	☑	☑	☑	☑	☑	☑	☑	50	20	50 %

- ISE - In-Semester Examination, ESE - End-Semester Examination
- PA - Practical Assessment, PP - Project Presentation

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	2	-	1	-	-	-	-	-	3	3
2	3	3	3	3	2	-	1	-	-	-	-	-	3	3
3	3	3	3	3	2	-	1	-	-	-	-	-	3	3
4	3	3	3	3	2	-	1	-	-	-	-	-	3	3
5	3	3	3	3	2	-	1	-	-	-	-	-	3	3
6	1	1	1	1	1	3	1	1	1	1	1	1	1	1
7	-	-	-	-	-	-	3	3	3	3	3	3	3	3
8	-	-	-	-	-	-	1	3	3	3	3	3	3	3
Avg	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**2**	**2**	**3**	**3**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEVS324 - Predictive Maintenance and Condition Monitoring**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	01
Evaluation Scheme : ISE/MSE+ESE	25/25

Course Objectives:

1. To make students understand the concepts of data analytics, signal processing, and machine learning in the context of predictive maintenance and condition monitoring.
2. To utilize MATLAB for tasks such as data import, feature extraction, and equipment health estimation.
3. To develop predictive models for predicting equipment failures and remaining useful life and apply these techniques to real-world industrial scenarios.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEVS324_1	Explain the fundamental principles of predictive maintenance and condition monitoring techniques.
2AEVS324_2	Utilize MATLAB effectively for data import, preprocessing, and feature extraction from various sources.
2AEVS324_3	Apply signal processing techniques to analyze and extract relevant information from time-series data.
2AEVS324_4	Develop and implement various machine learning models (e.g., classification, regression) for predicting equipment failures and remaining useful life.
2AEVS324_5	Analyze and interpret the results of predictive maintenance models to make informed decisions regarding equipment maintenance and repair.
2AEVS324_6	Apply the acquired knowledge and skills to solve real-world industrial problems related to predictive maintenance.

Course Contents:

1. Introduction to Predictive Maintenance and Condition Monitoring
2. Basics of MATLAB for Data Analysis and Signal Processing
3. Importing Data and Processing Data using MATLAB
4. Finding Natural Patterns in Data
5. Building Classification Models
6. Exploring and Analyzing Signals

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7. Preprocessing Signals to Improve Data Set Quality and Generate Features
8. Estimating Time to Failure
9. Case Studies on Predictive Maintenance

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	MATLAB with Control System, Signal Processing & Image Processing Tool Boxes	S.N.Sivanandam, S.N.Deepa	Wiley	First Edition	2016
2	MATLAB An Introduction with Applications	Rao.V.Dukkipati	New Age International Publishers	-	2011
3	MATLAB and its Applications in Engineering	Rajkumar Bansal, Ashok Kumar Goel, Manoj Kumar	Pearson	Fifteenth Impression	2014
4	Vibration Monitoring and Diagnosis: Techniques for Cost-effective Plant Maintenance	Ralph Albert Collacott,	University of Michigan	-	2007

E-Resources/Reference Papers:

1. https://in.mathworks.com/learn/training/predictive-maintenance-with-matlab.html

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes						Marks		Weightage
		1	2	3	4	5	6	Max	Min	
1	ISE : CAS	☑	☑	☑	☑	☑	☑	25	10	50 %
3	ESE : OE	☑	☑	☑	☑	☑	☑	10	10	50 %
4	ESE : PE	☑	☑	☑	☑	☑	☑	15		

- ISE - In-Semester Examination, ESE - End-Semester Examination
- CAS - Continuous Assessment, OE - Oral Examination, PE - Practical Examination

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CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	2
2	-	2	-	-	2	-	-	-	-	-	-	-	2	2
3	-	2	-	2	-	-	-	-	-	-	-	-	2	2
4	-	-	3	-	3	-	-	-	-	-	-	-	2	2
5	-	-	-	-	-	-	-	-	3	3	-	3	2	2
6	-	-	-	-	-	-	2	-	-	-	2		2	2
Avg														

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AECC325 - Aptitude and Reasoning Part - IV**
Prerequisite	2AECC210 - Aptitude and Reasoning Part I, 2AECC223 - Aptitude and Reasoning Part II, 2AECC312 - Aptitude and Reasoning Part III
Teaching Scheme: Lecture/Tutorial/Practical	00/00/02
Credits	01
Evaluation Scheme : ISE/MSE+ESE	50/00

Course Objectives:

1. To equip students with a strong foundation in probability, permutation, and combination, enabling them to solve complex problems in various domains.
2. To enhance students' analytical and interpretative skills by exposing them to diverse data presentation formats, including syllogisms, graphs, and tables.
3. To foster critical thinking, problem-solving, and strategic decision-making abilities through engaging gaming rounds.
4. To develop essential professional skills, including effective communication, resume writing, and professional interview etiquette, preparing students for the job market.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AECC325_1	Apply the principles of probability, permutation, and combination to solve complex problems.
2AECC325_2	Analyze and interpret data presented in various formats, including syllogisms, graphs (like mixed bar and pie charts), and tables.
2AECC325_3	Demonstrate critical thinking and problem-solving skills by successfully navigating and solving challenges presented in gaming rounds.
2AECC325_4	Develop effective communication and interpersonal skills, including resume writing and professional interview etiquette.

Course Contents:

1. Advance Probability
2. Advance Permutation and Combination
3. Statement Assumption
4. Syllogism
5. Mixed Bar and Pie Chart
6. Data Interpretation
7. Gaming Round
8. Verbal Ability

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9. Interview Etiquettes and Grooming

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
01	Quantitative Aptitude for Competitive Examinations	R.S. Agarwal	S Chand	Revised	2022
02	A Modern Approach to Verbal & Non-Verbal Reasoning	R.S. Agarwal	S Chand	Revised	2024
03	English Grammar And Composition	P C Wren, H Martin	S Chand	2nd	2019

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes				Marks		Weightage
		1	2	3	4	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	50	20	100 %

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
2	3	3	3	3	-	-	-	-	-	-	-	-	-	-
3	-	3	-	3	2	-	1	-	-	-	-	-	-	-
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-
Avg	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEHS326 - Universal Human Values**
Prerequisite	NIL
Teaching Scheme: Lecture/Tutorial/Practical	02/00/00
Credits	02
Evaluation Scheme : ISE/ESE	50/00

Course Objectives:

1. To enable students to understand the importance of Universal Human Values and develop the ability to apply them in personal, family, societal, and professional contexts.
2. To equip students with the knowledge of self-exploration as a means to achieve continuous happiness and prosperity.
3. To provide insights into ethical and harmonious practices that integrate individual well-being with societal and environmental sustainability.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEHS326_1	Explain the significance of value education in shaping ethical behavior and holistic development in individuals.
2AEHS326_2	Analyze the human aspirations, self-exploration process, and the role of right understanding in achieving personal harmony.
2AEHS326_3	Demonstrate an understanding of mutual fulfillment in human relationships, family values, and societal harmony through ethical and moral conduct.
2AEHS326_4	Evaluate the principles of co-existence and sustainable living by aligning human actions with the balance in nature and existence.
2AEHS326_5	Integrate universal human values and professional ethics into decision-making processes to promote responsible and ethical professional behavior.

Course Contents:

Unit -1	**Introduction to Value Education**	**04**
Need for Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations , Right Understanding, Relationship and Physical Facility, Correct Understanding of Human Needs, Self Exploration, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations		

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Unit -2	**Harmony in the Individual**	**05**
Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body , Programme to ensure self-regulation and Health		
Unit -3	**Harmony in the Family**	**04**
Understanding values in human-human relationship, Harmony in the Family – the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation		
Unit -4	**Harmony in the Society**	**04**
Understanding the harmony in society: Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals Human order systems and dimensions, Social Harmony , Sustainable Development , Peer Pressure		
Unit -5	**Harmony in the Nature and Existence**	**04**
Understanding Harmony in the Nature , Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature , Realizing Existence as Coexistence at All Levels, The Holistic Perception of Harmony in Existence		
Unit -6	**Professional Ethics**	**05**
Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models - Typical Case Studies, Strategies for Transition towards Value-based Life and Profession		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	A Foundation Course in Human Values and Professional Ethics	R R Gaur, R Asthana, G P Bagaria,	Excel Books	2nd	2019
2	Understanding Human Being, Nature and Existence Comprehensively	UHV Team	UHV	1st	2022
3	Ethics in Engineering	Mike W. Martin, Roland Schinzinger	McGraw-Hill Education	4th	2013

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Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Professional Ethics and Human Values	M. Govindarajan, S. Natarajan, V.S. Senthil Kumar	PHI Learning Pvt. Ltd.	1st	2004
2	An Introduction to Ethics	William Lilly	Allied	1 st	1967
3	Education and Human Values: Reconciling Talent with an Ethics of Care	Michael A. Peters, Tina Besley	Sense Publishers	1st	2015

E-Resources/Reference Papers:

1. AICTE Universal Human Values Course Resources
2. National Programme on Technology Enhanced Learning (NPTEL)
3. UNESCO E-Library on Ethics and Human Values
4. GIAN (Global Initiative of Academic Networks)
5. MIT OpenCourseWare: Ethics in Engineering Practice

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	50	20	40 %

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	-	-	-	-	-	-	-	-	3	3	-	3	-	-
2	-	-	-	-	-	-	-	-	3	3	-	3	-	-
3	-	-	-	-	-	-	-	-	3	3	-	3	-	-
4	-	-	-	-	-	-	1	-	3	3	-	3	-	-
5	-	-	-	-	-	-	-	3	-	3	-	3	-	-
Avg	-	-	-	-	-	-	1	3	3	3	-	3	-	-

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Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEUV302 - Flight Control Systems**
Prerequisite	2AEUV201 - Introduction to Unmanned Aerial Vehicles (UAVs) 2AEUV301 - UAV Electronics and Sensors
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	03
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To provide a comprehensive understanding of the theoretical principles behind UAV flight control systems and their various components.
2. To equip students with knowledge of advanced control mechanisms, including adaptive control and robust control techniques, for UAVs.
3. To analyze UAV flight control systems' performance, stability, and optimization in various operational conditions.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEUV302_1	Apply open-source flight control systems (ArduPilot, PX4) to configure UAVs and integrate essential sensors for enhanced navigation and performance.
2AEUV302_2	Discover autonomous missions and real-time control algorithms to leverage advanced hardware and software platforms by specific operation requirements
2AEUV302_3	Analyze flight data logs to diagnose issues and optimize UAV systems for stability, efficiency, and mission-specific needs by using open source ground control softwares
2AEUV302_4	Evaluate UAV flight control systems, incorporating robust techniques to address environmental and operational challenges by the help of existing developer community

Course Contents:

Unit 1	**Introduction to Open Source UAV Flight Control Systems**	**6**
Overview of ArduPilot and PX4 autopilot systems: architecture and components. Practical setup and configuration of popular flight controllers (e.g., Pixhawk series). Introduction to ground control software, i.e., Mission Planner and QGroundControl. **Additional topics [Not for ESE]:** Configuring a quadcopter flight controller using PX4. Initial setup, firmware installation, and basic calibration.		
Unit 2	**Practical UAV Control Dynamics**	**6**
Flight dynamics: roll, pitch, yaw control, and motor mixing principles for multi-rotors. Real-world challenges in UAV		

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control, i.e., vibrations, load variations, and environmental factors.Controller tuning for different UAV airframes and flight conditions. Introduction to advanced flight modes, i.e., stabilize, loiter, and auto. Tuning PID values and testing stability using ground control software.		
Unit 3	**Sensor Integration and Calibration**	**7**
Overview of essential sensors (IMU, GPS, compass, barometer) and their role in flight control. Hardware integration of sensors with flight controllers (e.g., Herelink, T12 radios). Calibration techniques for sensors to ensure accuracy and reliability. **Additional topics [Not for ESE]:** Integrating additional sensors like LiDAR, radar, and airspeed sensors. Sensor calibration using QGroundControl and real-time data validation.		
Unit 4	**Autonomous Navigation and Mission Planning**	**6**
Autonomous mission planning: waypoint creation and uploading using MAVLink. Configuring autonomous flight parameters: altitude, speed, and fail-safes. Practical considerations for long-range and beyond-line-of-sight (BVLOS) missions. Introduction to real-time trajectory updates and obstacle avoidance. **Additional topics [Not for ESE]:** Hands-on Planning and executing autonomous missions on a simulated UAV.		
Unit 5	**Real-Time Data Processing and Control Algorithms**	**6**
Introduction to real-time flight control algorithms and custom coding. Writing and deploying control algorithms on hardware platforms like Raspberry Pi and Jetson. Data logging and post-flight analysis, i.e., interpreting flight logs for troubleshooting. Implementing fail-safe mechanisms for GPS loss, signal failure, and low battery. **Additional topics [Not for ESE]:** Hands-on Customizing flight behavior through algorithm adjustments and testing.		
Unit 6	**UAV System Optimization and Advanced Applications**	**8**
Flight control optimization for specific missions, i.e., reducing power consumption and improving agility. Advanced PX4 features, i.e., swarm intelligence and cooperative UAV operations. Practical implementation of robust control for dynamic payloads and environmental conditions. Safety considerations in autonomous UAV systems. **Additional topics [Not for ESE]:** Hands-on Optimizing flight performance and conducting real-world mission tests.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Unmanned aircraft systems: UAVS design, development and deployment	Austin, R.	John Wiley & Sons.	1st	2011
2	Designing Purpose-Built Drones for Ardupilot Pixhawk 2.1: Build drones with Ardupilot	Ty Audronis	Packt Publisher	1st	2017
3	Introduction to UAV systems	Fahlstrom P, Gleason T	Wiley, UK	4th	2012
4	Handbook of unmanned aerial vehicles	Valavanis K. P.; Vachtsevanos, G. J., eds	Springer reference	1st	2015
5	A first course in aerial robots and drones	Sebbane, Y. B.	CRC Press	1st	2022

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E-Resources/Reference Papers:

1. https://oscarliang.com/flight-controller/
2. https://docs.px4.io/main/en/hardware/reference_design.html
3. https://ardupilot.org/dev/docs/building-the-code.html
4. https://ardupilot.org/mavproxy/index.html#home
5. https://ardupilot.org/planner/docs/mission-planner-building.html
6. https://docs.cubepilot.org/user-guides/herelink/herelink-user-guides

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes				Marks		Weightage
		1	2	3	4	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	20	16	40 %
2	MSE	☑	☐	☐	☐	30	24	60 %
3	ESE	☐	☑	☐	☐	30		

- ISE - In-Semester Examination, MSE - Mid-Semester Examination, ESE - End-Semester Examination
- ABA - Activity Based Assessment, TA - Tutorial Assessment, PA - Practical Assessment

CO's - PO's & PSO's Mapping: (Low - 1, Medium - 2, High -3, No Correlation - "-")

CO's	PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	2	-	3	-	2	1	2	-	3	2	1
2	3	3	1	1	2	-	-	3	3	2	1	1	1	2
3	3	3	2	3	3	-	3	2	3	2	-	2	3	1
4	3	3	3	3	3	-	1	2	3	1	-	2	3	3
Avg	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**2**

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

Changing Lives.., Enriching Future...

Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEAT302 - Air Transportation Management and Route Planning**
Prerequisite	2AEAT301 – Airport Operation and Air Traffic Control 2AEAT201 – Introduction to Air Transportation
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	03
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. To equip students with the ability to analyze and forecast air travel market demand using various quantitative methods, considering different passenger segments and market dynamics.
2. To enable students to critically evaluate and design efficient airline route structures and develop effective pricing strategies for maximizing profitability in diverse operational contexts.
3. To provide students with the skills to apply optimization techniques and mathematical modeling to solve complex airline network planning, scheduling, and resource allocation problems.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEAT302_1	Evaluate air travel market demand by applying macro and micro-forecasting methods to predict variations under diverse passenger segmentation and demand curve scenarios.
2AEAT302_2	Design effective route structures and pricing strategies by analyzing point-to-point, linear, and hub-and-spoke systems to maximize airline profitability in given operational case studies.
2AEAT302_3	Solve airline network planning problems by applying network flow models, under specified operational complexities.
2AEAT302_4	Develop optimized flight schedules by implementing hub-and-spoke scheduling, route development, and load factor analysis using optimization techniques under given operational scenarios.
2AEAT302_5	Optimize fleet assignment, aircraft routing, and crew scheduling by applying mathematical modeling techniques to address maintenance cycles and transportation problems in predefined case studies.

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Course Contents:

Unit 1	**Forecasting Air Travel Demand**	**06**
Air travel Market: demand – Purpose of Forecasting – Forecasting methods: Macro & Micro-Forecasting, Passenger segmentation, Variation in Demand – Demand Curve		
Unit 2	**Route Structures & Pricing Strategies**	**07**
Point-to-point – Linear – Hub and Spoke and its variations – case study of route systems – Airline profitability – Pricing strategies of FSNC and LCC – Point-to-point revenue management – Hub and spoke revenue management		
Unit 3	**Network flows**	**07**
Complexity of airline planning – Network flow models and definitions – Shortest path problems – Minimum cost flow problem – Maximum flow problems.		
Unit 4	**Principle of Flight Scheduling**	**07**
Mission of Scheduling – Hub & Spoke Scheduling – Route development and Flight Scheduling process – Load Factor and Frequency – Travelling Salesman Problem		
Unit 5	**Fleet assignment and Aircraft Routing**	**06**
Fleet Assignment – Factors in fleet planning – Fleet planning process - Aircraft Routing – Maintenance routing – Routing cycles – Route generators – Mathematical formulation - Transportation problems – Minimization and Maximization problems.		
Unit 6	**Crew and Manpower Scheduling**	**06**
Crew pairing – Pairing generators – Crew Rostering - Crew scheduling solution – Manpower planning mathematical modelling case study – Gate Assignment mathematical model for a case study.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Air Transport Management – An International Perspective	Lucy Budd and Stephen Ison	Routledge	1st	2017
2	Airline Operation and Scheduling	Massoud Bazargan	Ashgate	2nd	2010

Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Airline Operations and Management – A management textbook	Gerald N. Cook Bruce G. Billig	Routledge (Taylor and Francis Group)	1st	2017

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Sl.No	Title	Author	Publisher	Edition	Year
2	Air Transportation – A Management Perspective	John G. Wensveen	Ashgate		2007

Assessment Modes:

Sl. No	Method/ Technique	Course Outcomes					Marks		Weightage
		1	2	3	4	5	Max	Min	
1	ISE : ABA	☑	☑	☑	☑	☑	40	16	40 %
4	MSE	☑	☑	☑	☐	☐	30	24	60 %
5	ESE	☐	☐	☐	☑	☑	30		

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1	1	-	-	-	-	2	-	-	-	1	-	1	-	-
2	1	-	-	-	-	1	-	-	-	1	-	1	-	-
3	2	1	1	2	1	-	-	-	-	2	-	2	-	-
4	2	3	1	2	1	-	-	-	-	2	-	2	-	-
5	2	2	1	1	1	-	-	-	-	2	-	2	-	-
Avg	**2**	**2**	**1**	**2**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**

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Department of Aeronautical Engineering

Changing Lives.., Enriching Future...

Course Details:

Class	T.Y B.Tech., Sem - VI
Course Code and Course Name	**2AEAV302 - Aircraft Instrumentation and Control**
Prerequisite	2AEAV201 - Introduction to Flight and Avionics 2AEAV301 - Aircraft Systems and Instruments
Teaching Scheme: Lecture/Tutorial/Practical	03/00/00
Credits	03
Evaluation Scheme : ISE/MSE/ESE	40/30/30

Course Objectives:

1. Build on the foundational knowledge of aircraft systems and instrumentation to explore advanced concepts and applications.
2. Develop practical problem-solving skills related to control systems and fault diagnostics in aircraft.
3. Understand the integration of modern avionics and automated control technologies in advanced aircraft systems.
4. Analyze and simulate control system responses for improving flight performance and safety.

Course Outcomes (CO's): After successful completion of this course, the student will be able to,

2AEAV302_1	Interpret the operation, functions, and limitations of various aircraft instrumentation systems.
2AEAV302_2	Examine the instrument systems to address practical problems in the design and operation of instruments subjected to layout procedures.
2AEAV302_3	Choose the appropriate displays and methods to group the instruments in the aircraft.
2AEAV302_4	Interpret sensor data and classify different aircraft control systems based on their functionality, design, and application in modern aviation.
2AEAV302_5	Prepare improvements and solutions to evaluate the performance, errors, and operational challenges of gyroscopic instruments, flight displays, and control systems using AI & ML.

Course Contents:

Unit 1	**Advanced Principles of Aircraft Instrumentation**	**6**
Review of fundamental concepts, advanced instrumentation principles for data acquisition and processing, challenges in modern aircraft instrumentation: accuracy, redundancy, and integration		
Unit 2	**Flight Control System Dynamics**	**7**
Dynamics of primary and secondary flight control systems, fly-by-wire systems: working principles, advantages, and challenges, autopilot systems: modes, response tuning, and operational challenges.		

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Unit 3	**Fault Diagnostics and Redundancy in Instrumentation Systems**	**7**
Common faults in aircraft instrumentation and control systems, troubleshooting strategies and redundancy for critical systems, maintenance and calibration techniques for digital instruments.		
Unit 4	**Advanced Navigation and Communication Systems**	**7**
Satellite-based navigation systems: GPS, GLONASS, and Galileo, inertial navigation systems (INS): principles and applications, integration of navigation and communication systems in aircraft, air traffic communication systems: ADS-B and CPDLC, challenges in modern navigation and communication systems.		
Unit 5	**Practical Aircraft Control System Concepts**	**6**
Basics of control system tuning: proportional, integral, and derivative (PID) controllers, simple simulations of control system responses, introduction to actuator dynamics and their effect on control, the role of feedback in maintaining stability,		
Unit 6	**Emerging Trends in Aircraft Instrumentation and Control**	**6**
Role of artificial intelligence and machine learning in fault detection, predictive maintenance using IoT-enabled sensors, case studies of next-generation systems in commercial and military aircraft.		

Text Books:

Sl.No	Title	Authors	Publisher	Edition	Year
1	Aircraft Hydraulic Systems: An Introduction to the Analysis of Systems and Components	E. H. J. Pallett	Longman Group United Kingdom	2nd	1992
2	Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration	Moir, I. and Sea bridge, A	AIAA (American Institute of Aeronautics and Astronautics)	3rd	2011
3	Avionics Training Systems, Installation and Troubleshooting	Len Buckwalter	Avionics Communicati ons Inc	-	-

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Reference Books:

Sl.No	Title	Author	Publisher	Edition	Year
1	Aerodynamics, Aeronautics and Flight Mechanics	McCormick, B.W.	John Wiley	2nd	1995
2	Aircraft Fuel Systems	Roy Langton	Wiley-Blackwell	2nd	2009
3	Aircraft Structures for Engineering Students	Megson, T.H.G	Elsevier	4th	2007

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2	2	3	2	2	1	-	-	-	-	1	-	-	1	-
3	2	-	2	-	2	-	-	-	-	-	-	-	-	-
4	2	2	3	3	2	-	-	-	-	1	-	-	1	-
5	2	3	3	2	3	-	-	-	-	1	-	-	-	1
Avg	**2**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**

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