INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICALENGINEERING

COURSE DESCRIPTOR

Course Title	**FLLIGHT CONTROL LABORATORY**				
Course Code	AAE107				
Programme	B.Tech				
Semester	V	AE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	2	2
Chief Coordinator	Dr. Yagya Dutta Dwivedi, Professor				
Course Faculty	Dr. Yagya Dutta Dwivedi, Professor Mr. P Anudeep, Assistant Professor				

I. COURSE OVERVIEW:

This laboratory complements the Aircraft Performance course and Aircraft Stability and Control course. The main aim of this lab is to train and enhance practical knowledge of the students on aircraft performance and stability criteria and related equipments like Wind tunnel, Aircraft simulator and MATLAB programming. This lab helps to gain adequate knowledge on working of Wind tunnel, Six Component Balance, Pitot Static Tube, Aircraft Simulator. Students will compare the performance of various aircraft wings at different operating conditions and do the analysis.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AAE004	IV	Low Speed Aerodynamics	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Flight Control Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✘	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Each laboratory will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day today performance and 10 marks for the final internal lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being Internal Examiner and the other being External Examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

The emphasis on the experiments is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculations and graphs related to the concern experiment.
20 %	To test the results and the error analysis of the experiment.
20 %	To test the subject knowledge through viva – voce.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for continuous lab assessment during day to day performance, 10 marks for final internal lab assessment.

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and Error Analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Calculations of the observations
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.	2	Calculations of the observations
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.	1	Mini Projects

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products	2	Lab Practices
PSO2	**Problem-solving Skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles.	--	--
PSO 3	**Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies	--	--
PSO 4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aeronautical/aerospace allied systems to become technocrats.	--	--

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Learn the basic MATLAB simulation of un-accelerated flight for takeoff, cruise and landing conditions by solving equations of motions.
II	Understand the concept behind the conventional and unconventional airfoil performance and stability conditions.
III	Identify the functions of the basic controls like ailerons, elevators and rudders used in typical airplanes.
IV	Understand the dynamics of the aircraft flight simulator and it's functioning in different flight conditions like takeoff, landing and cruise condition.

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AAE107.01	CLO 1	Learn the basics of MATLAB codes related to flight simulations.	PO 1	2
AAE107.02	CLO 2	Understand and simulate the effects altitude and temperature in International Standard Atmosphere (ISA).	PO 1	2
AAE107.03	CLO 3	Explain and simulate the Equations of Motions in one degree of Freedom (1-DOF).	PO 2	1
AAE107.04	CLO 4	Understand the application of Equations of Motions in 2-DOF.	PO 1, PO 2	1
AAE107.05	CLO 5	Simulate the equations of motions by using MATLAB software in 2-DOF.	PO 1, PO 2	2
AAE107.06	CLO 6	Observe the Aerodynamic performance of a symmetrical airfoil by experiment.	PO 1, PO 2	2
AAE107.07	CLO 7	Understand the impact of corrugated Airfoil in the study of aerodynamic performance.	PO 2, PO 3	1
AAE107.08	CLO 8	Analyze the Aerodynamic performance and stability of a corrugated airfoil.	PO 2, PO 3	1
AAE107.09	CLO 9	Evaluate the flight performance of a symmetrical airfoil.	PO 2, PO 3	2
AAE107.10	CLO 10	Evaluate the flight stability and control of a symmetrical airfoil.	PO 2, PO 3	2
AAE107.11	CLO 11	Analyze the flight performance of a corrugated airfoil.	PO 2, PO 3	1
AAE107.12	CLO 12	Compare the performance of symmetrical and corrugated airfoil.	PO 2, PO 3	1
AAE107.13	CLO 13	Analyze the Aerodynamic efficiency of a Delta wing aircraft.	PO 2, PO 3	1
AAE107.14	CLO 14	Analyze the Aerodynamic stability of a Delta wing aircraft.	PO 1, PO 2	2
AAE107.15	CLO 15	Analyze the takeoff and landing performance of airplane by using simulator and assessing difficulties.	PO 1, PO 2	2
AAE107.16	CLO 16	Understand the concept of flight control application on the flight simulator operation to perform takeoff and landing.	PO 1, PO 2	2

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X. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	2															
CLO 2	2															
CLO 3		1											2			
CLO 4	1	2														
CLO 5	2	2														
CLO 6	2	1														
CLO 7		1	1													
CLO 8		1	2													
CLO 9		2	2													
CLO 10		2	2										2			
CLO 11		2	1													
CLO 12		1	1										2			
CLO 13		2	1													
CLO 14	2	2											2			
CLO 15	2	2														
CLO 16	1	2														

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO 1, PO 2 PO 3	SEE Exams	PO 1, PO 2 PO 3	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2 PO 3	Student Viva	-	Mini Project	PO 3	Certification	-

XII. ASSESSMENT METHODOLOGIES-INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XIII. SYLLABUS

LIST OF EXPERIMENTS	
Week-1	**MATLAB**
Introduction to flight with MAT LAB.	
Week-2	**ISA PROFILE FOR FLIGHT**
Determination of the International Standard Atmosphere (ISA).	
Week-3	**EQUATION OF MOTION IN 1-D**
Study of equation of motion with one degree of freedom by using simulating software.	
Week-4	**EQUATION OF MOTION IN 2-D**
Study of equation of motion with two degree of freedom by using simulating software.	
Week-5	**AERODYNAMIC PERFORMANCE STUDY OF A SYMMETRICAL AIRFOIL**
Study the aerodynamic performance of a symmetrical airfoil wing with varying angles of attack and velocity.	
Week-6	**AERODYNAMIC PERFORMANCE STUDY OF A CORRUGATED WING**
Performance test on a corrugated wing by using wind tunnel by varying angles of attack and Reynolds number.	
Week-7	**AERODYNAMIC PERFORMANCE STUDY OF A DELTA WING**
Performance test on a delta wing by using wind tunnel by varying angles of attack and Reynolds number.	
Week-8	**AERODYNAMIC STABILITY STUDY OF A SYMMETRICAL AIRFOIL**
Static stability analysis on a symmetrical airfoil by using wind tunnel by varying angles of attack and Reynolds number.	
Week-9	**AERODYNAMIC STABILITY STUDY OF A CORRUGATED WING**
Static stability analysis on a corrugated wing by using wind tunnel by varying angles of attack and Reynolds number.	
Week-10	**AERODYNAMIC STABILITY STUDY OF A DELTA WING**
Static stability analysis on a Delta wing by using wind tunnel by varying angles of attack and Reynolds number.	
WeeK-11	**FLIGHT SIMULATION OF TAKEOFF AND LANDING**
Study of the takeoff and landing performance on a flight simulator with constant wind condition.	
Week-12	**FLIGHT SIMULATION OF TAKEOFF AND LANDING AT DIFFERENT WIND CONDITIONS**
Study of the takeoff and landing performance on a flight simulator with varying wind condition.	

Reference Books:

1. Anderson, J.D. Jr., "Aircraft Performance and Design", International Edition McGraw Hill, 1st Edition, 1999.
2. Yechout, T.R. et al., "Introduction to Aircraft Flight Mechanics", AIAA Education Series, AIAA, 1st Edition, 2003.

XIV. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Week No.	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Introduction to flight with MAT LAB.	CLO 1	R1: 1.2
2	Determination of the International Standard Atmosphere (ISA).	CLO 2, CLO 3	R1: 3.5
3	Study of equation of motion with one degree of freedom by using simulating software.	CLO 4	R1: 3.4
4	Study of equation of motion with two degree of freedom by using simulating software.	CLO 5, CLO 6	R1: 2.2
5	Study the aerodynamic performance of a symmetrical airfoil wing with varying angles of attack and velocity.	CLO 7	R1: 2.4
6	Performance test on a corrugated wing by using wind tunnel by varying angles of attack and Reynolds number.	CLO 8, CLO 10	R1: 4.5
7	Performance test on a delta wing by using wind tunnel by varying angles of attack and Reynolds number.	CLO 9, CLO 10	R2: 2.6
8	Static stability analysis on a symmetrical airfoil by using wind tunnel by varying angles of attack and Reynolds number.	CLO 11, CLO 13	R2: 2.6
9	Static stability analysis on a corrugated wing by using wind tunnel by varying angles of attack and Reynolds number.	CLO 12, CLO 13	R2: 5.2
10	Static stability analysis on a Delta wing by using wind tunnel by varying angles of attack and Reynolds number.	CLO 14	R2: 5.2
11	Study of the takeoff and landing performance on a flight simulator with constant wind condition.	CLO 15	R2:6.2
12	Study of the takeoff and landing performance on a flight simulator with varying wind condition.	CLO 16	R2:6.3

XV. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	To improve standards and analyze the concepts.	Guest Lectures	PO 1, PO 2	PSO 1
2	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2, PO 3	PSO 1

Prepared by:
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