INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**FLIGHT VEHICLE DESIGN LABORATORY**				
Course Code	AAE112				
Programme	B.Tech				
Semester	VII	AE			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Ms. K.SaiPriyanka, Assistant Professor				
Course Faculty	Mrs.M. MaryThraza, Assistant Professor Ms. K.SaiPriyanka, Assistant Professor				

I. COURSEOVERVIEW:

The aim of Flight Vehicle design(FVD) LAB is to introduce students the overview of the design process. The course covers basic principles of conceptual design process of an aircraft and the related details of all design techniques. After completion of the course the student gains adequate knowledge to design all the different phase of an aircraft design. Weight estimation of aircraft for different aircrafts.

II. COURSEPRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AAE004	IV	Low Speed Aerodynamics	4
UG	AAE011	V	Aircraft Performance	3
UG	AAE006	IV	Analysis Of Aircraft Structures	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computational Aerodynamics 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. EVALUATIONMETHODOLOGY:

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 to day 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 hoursduration.

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

VI. HOW PROGRAM OUTCOMES AREASSESSED:

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.	3	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 withappropriateconsiderationforthepublichealthand safety, and the cultural, societal, and environmental considerations.	3	Lab Practices
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Term observations
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineeringactivitieswithanunderstandingofthe limitations.	2	Presentation on real-world problems

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

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.	2	Guest Lectures
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	1	Presentation on real-world problems
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	**Understand** the basic skills involved in weight estimation for aircraft conceptual design process.
II	**Illustrate** relevant theoretical knowledge, applicable for initial sizing and configuration layout of aircraft
III	**Evaluate** basic techniques in literature retrieval and query, also creative and have systematic scientific research methods and working abilities
IV	**Observe** different designing processes and how an aircraft production company works on it
V	**Explore** the new concepts of aerodynamics propulsion and fuel system integration

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
AAE112.01	CLO 1	Understanding the different designing concepts like preliminary design conceptual design and detail deign	PO 1	3
AAE112.02	CLO 2	Interpret the weight estimation of propulsion system structural weight empty weight	PO 1, PO 3, PO 4	3
AAE112.03	CLO 3	Calculating the dimensioning of engine inlet location and capture area	PO 3, PO 4, PO 5	3
AAE112.04	CLO 4	Estimation of wing geometry and wing vertical location, wing tip shapes, tail geometry and arrangements, thrust to weight ratio-statistical estimation	PO 1, PO 2	2
AAE112.05	CLO 5	Apply a theories and to predict the maximum lift coefficient, and complete drag build up, installed performance of an engine	PO 1, PO 2	3
AAE112.06	CLO 6	Development of configuration lay out from conceptual sketch.	PO 1, PO 2	2
AAE112.07	CLO 7	Calculating the velocity, angle of Attack, angle of attack rate, pitch rate, elevator angle.	PO 2, PO 3	1
AAE112.08	CLO 8	Constructing v-n diagram, air load distribution on lifting surfaces	PO 2, PO 3	1
AAE112.09	CLO 9	Developing the concept of Propulsion selection fuel selection and	PO 1, PO 2, PO 3	2
AAE112.10	CLO 10	Plotting the mission segment with different weight fractions	PO 1, PO 2	2
AAE112.11	CLO 11	Understanding the concepts of different landing gear system	PO 2, PO 3	3
AAE112.12	CLO 12	Estimation of design-stability and control	PO 1, PO 2	3
AAE112.13	CLO 13	Analysis of performance under constrained conditions constraint	PO 2, PO 3	3

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AAE112.14	CLO 14	Acquire Basic knowledge to solve real time problems in Aircraft propulsion and structure with different loading conditions	PO 2, PO 3, PO 4	2
AAE112.15	CLO 15	Apply the fundamental concepts in competitive examinations	PO 2, PO 3	2

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

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	3															
CLO 2	3		3	2										1		
CLO 3			3	3	2								2	2	1	
CLO 4	2	3														
CLO 5	3	3														
CLO 6	3	3														
CLO 7		3	2													
CLO 8		3	2													
CLO 9	2	2	3													
CLO 10	2	2											1	2		
CLO 11		2	3													
CLO 12	2	3											2	1		
CLO 13		3	3													
CLO 14		2	3	3									1	2	1	
CLO 15		3	3													

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES –DIRECT

CIE Exams	PO 1, PO 2 PO 3, PO 4, PO 5	SEE Exams	PO 1, PO 2 PO 3, PO 4, PO 5	Assignments	-	Seminars	-
Laboratory Practices	PO 1, PO 2 PO 3, PO 4, PO 5	Student Viva	-	Mini Project	-	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	**OBJECTIVES AND REQUIREMENTS OF THE VEHICLE**
Data collection for conceptual sketch from existing aircraft includes: a. Type, Role, Mission. b. Payload c. Aerodynamic & performance requirements.	
Week-2	**CONCEPTUAL SKETCH AND WEIGHT ESTIMATION**
a. Conceptual sketch of candidate aircraft (3-view). b. First estimation of gross take-off weight with trade-off studies..	
Week-3	**AIRFOIL DESIGN AND CONSTRAINT ANALYSIS**
a. Airfoil and wing geometry selection.	
Week-4	**CONSTRAINT ANALYSIS**
a. Determination of Thrust-to-Weight ratio and Wing Loading	
Week-5	**INITIAL SIZING-I**
a. Rubber engine & fixed engine sizing.	
Week-6	**INITIAL SIZING-II**
a. Configuration layout, crew station, passengers and payload.	
Week-7	**PERFORMANCE ESTIMATIONS**
a. Performance constraint analysis	
Week-8	**LOAD ESTIMATIONS-I**
a. Landing gear loads	

Week-9	**LOAD ESTIMATIONS-II**
a. Propulsion system load.	
Week-10	**COST ESTIMATION**
a. Cost estimation and parametric analysis b. Optimization and trade studies	
WeeK-11	**DESIGN CASE STUDY-I**
a. Design study of DC-3 b. Design study B-747	
Week-12	**DESIGN CASE STUDY-II**
I. Dynamics of F-16 II. Dynamics of SR-71	
Reference Books:	
1. Daniel P. Raymer ―Aircraft design a conceptual approach‖, 5th Edition 1999.	
SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:SOFTWARE: Microsoft office excel spread sheet, MATLAB, AutoCAD Tool. **HARDWARE**: Desktop Computers with 4 GB RAM 36 nos	

XIV. COURSEPLAN:

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	Data collection for conceptual sketch from existing aircraft includes : a. Type, Role, Mission. b. Payload c. Aerodynamic & performance requirements.	CLO 2	R1: 1.2
2	Conceptual sketch of candidate aircraft (3-view). First estimation of gross take-off weight with trade-off studies.	CLO 3	R4: 3.5
3	Airfoil and wing geometry selection	CLO 3	R1: 3.4
4	Determination of Thrust-to-Weight ratio and Wing Loading	CLO 4	R1: 2.2
5	Rubber engine & fixed engine sizing.	CLO 5	R1: 2.4
6	Configuration layout, crew station, passengers and payload	CLO6, CLO 7	R1: 4.5
7	Performance constraint analysis	CLO 10, CLO 12	R2: 2.6
8	Load estimations of Landing gear.	CLO 10, CLO 12	R2: 2.6

9	Propulsion system load.	CLO 14, CLO 13, CLO 15	R1: 5.2
10	a. Cost estimation and parametric analysis b. Optimization and trade studies	CLO 13, CLO 14, CLO 14	R1: 5.2
11	a. Design study of DC-3 b. Design study B-747	CLO 14, CLO 15	R1:7.2
12	a. Dynamics of F-16 b. Dynamics of SR-71	CLO 15	R1:7.3

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

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, PO 4	PSO 1, PSO 2
2	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2, PO 3	PSO 1, PSO 2

Prepared by:

Ms. K Sai Priyanka, Assistant Professor
Ms. M. Mary Thraza, Assistant Professor **HOD, AE**