

## FLIGHT VEHICLE DESIGN LABORATORY

<b>VII Semester: AE</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AAE112	Core	L	T	P	C	CIA	SEE	Total
		-	-	3	2	30	70	100
<b>Contact Classes: Nil</b>		<b>Tutorial Classes: Nil</b>		<b>Practical Classes: 36</b>		<b>Total Classes: 36</b>		
<p><b>COURSE OBJECTIVES:</b></p> <p><b>The course should enable the students to:</b></p> <ol style="list-style-type: none"> <li>I. Understand the basic skills involved in weight estimation for aircraft conceptual design process.</li> <li>II. Illustrate relevant theoretical knowledge, applicable for initial sizing and configuration layout of aircraft.</li> <li>III. Evaluate basic techniques in literature retrieval and query, also creative and have systematic scientific research methods and working abilities</li> <li>IV. Observe different designing processes and how an aircraft production company works on it</li> <li>V. Explore the new concepts of aerodynamics propulsion and fuel system integration</li> </ol> <p><b>COURSE LEARNING OUTCOMES (CLOs):</b></p> <ol style="list-style-type: none"> <li>1. Understanding the different designing concepts like preliminary design conceptual design and detail design.</li> <li>2. Interpret the weight estimation of propulsion system structural weight empty weight.</li> <li>3. Calculating the dimensioning of engine inlet location and capture area.</li> <li>4. Estimation of wing geometry and wing vertical location, wing tip shapes, tail geometry and arrangements, thrust to weight ratio-statistical estimation.</li> <li>5. Apply a theories and to predict the maximum lift coefficient, and complete drag build up, installed performance of an engine.</li> <li>6. Development of configuration lay out from conceptual sketch.</li> <li>7. Calculating the velocity, angle of Attack, angle of attack rate, pitch rate, elevator angle.</li> <li>8. Constructing v-n diagram, air load distribution on lifting surfaces.</li> <li>9. Developing the concept of Propulsion selection fuel selection.</li> <li>10. Plotting the mission segment with different weight fractions.</li> <li>11. Understanding the concepts of different landing gear system.</li> <li>12. Estimation of design-stability and control.</li> <li>13. Analysis of performance under constrained conditions constraint.</li> <li>14. Acquire Basic knowledge to solve real time problems in Aircraft propulsion and structure with different loading conditions.</li> <li>15. Apply the fundamental concepts in competitive examinations.</li> </ol>								
<b>LIST OF EXPERIMENTS</b>								
<b>Week-1</b>	<b>OBJECTIVES AND REQUIREMENTS OF THE VEHICLE</b>							
Data collection for conceptual sketch from existing aircraft includes: a. Type, Role, Mission. b. Payload c. Aerodynamic & performance requirements.								
<b>Week-2</b>	<b>CONCEPTUAL SKETCH AND WEIGHT ESTIMATION</b>							

a. Conceptual sketch of candidate aircraft (3-view). b. First estimation of gross take-off weight with trade-off studies..	
<b>Week-3</b>	<b>AIRFOIL DESIGN AND CONSTRAINT ANALYSIS</b>
a. Airfoil and wing geometry selection.	
<b>Week-4</b>	<b>CONSTRAINT ANALYSIS</b>
a. Determination of Thrust-to-Weight ratio and Wing Loading	
<b>Week-5</b>	<b>INITIAL SIZING-I</b>
a. Rubber engine & fixed engine sizing.	
<b>Week-6</b>	<b>INITIAL SIZING-II</b>
a. Configuration layout, crew station, passengers and payload.	
<b>Week-7</b>	<b>PERFORMANCE ESTIMATIONS</b>
a. Performance constraint analysis	
<b>Week-8</b>	<b>LOAD ESTIMATIONS-I</b>
a. Landing gear loads	
<b>Week-9</b>	<b>LOAD ESTIMATIONS-II</b>
a. Propulsion system load.	
<b>Week-10</b>	<b>COST ESTIMATION</b>
a. Cost estimation and parametric analysis b. Optimization and trade studies	
<b>Week-11</b>	<b>DESIGN CASE STUDY-I</b>
a. Design study of DC-3 b. Design study B-747	
<b>Week-12</b>	<b>DESIGN CASE STUDY-II</b>
a. Dynamics of F-16 b. Dynamics of SR-71	
<b>Reference Books:</b>	
Daniel P. Raymer —Aircraft design a conceptual approach, 5 <sup>th</sup> Edition 1999	
<b>SOFTWARE AND HARDWARE REQUIREMENTS FOR A BATCH OF 36 STUDENTS:SOFTWARE:</b> Microsoft office excel spread sheet, MATLAB, AutoCAD Tool. <b>HARDWARE:</b> Desktop Computers with 4 GB RAM	