INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

FLIGHT VEHICLE DESIGN LABORATORY								
VII Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED55	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		0	0	3	1.5	40	60	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		
Prerequisite: Basic knowledge of Excel and MAT Lab								

I. COURSE OVERVIEW:

This course is designed to provide students an understanding of procedure followed in conceptual design of an aircraft, meeting the user-specified design requirements and safety considerations specified by the aircraft certification agencies. The course introduces theoretical basics of methods and models that are used in the conceptual airplane design and discusses the theoretical problem-solving skills related to analysis and design of flight vehicle structures. This course explains re-sizing and of a baseline civil transport aircraft to meet a specified market requirement.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The conceptual sketch of aircrafts based on client requirements such as type, role, payload, mission, aerodynamic & performance requirements.
II. The Estimation total takeoff gross weight, thrust-weight ratio, wing loading parameters using data sheets.
III. The Development of initial layouts for major components such as fuselage, empennage, landing gears and wings.

III. COURSE OUTCOMES:

After successful completion of the course, students will be able to:

CO1 Choose data collection for conceptual sketch from existing air craft for understanding aerodynamic & performance requirements.
CO2 Classify rubber engine sizing of a given fighter aircraft for calculating the take -off weights in order so that the aircraft meets all set requirements.
CO3 Make use of airfoil geometry and co-ordinates for obtaining the required 3D model by using designer tools like CATIAV5.
CO4 Simplify the performance estimations involving design layout for calculating the variation of C_L and C_D at angle of attack.
CO5 Estimate take-off gross weight of simple cruise mission profile for calculating the empty weight fraction.
CO6 Identify the total drags on an aircraft and calculate the total weight, thrust and drag for exit pressure and Mach number for the given nozzle configurations

IV. COURSE CONTENT

Week-1: OBJECTIVES AND REQUIREMENTS OF THE VEHICLE
Data collection for conceptual sketch from existing aircraft, Mission profile of commercial and fighter aircraft.

Week-2: CONCEPTUAL SKETCH AND WEIGHT ESTIMATION
Conceptual sketch of candidate aircraft (3-view). First estimation of gross take-off weight with trade-off studies

Week-3: AIRFOIL DESIGN AND CONSTRAINT ANALYSIS
Air foil selection, Airfoil design configuration

Week-4: WING DESIGN
Selection of wing design, Determination of Wing Loading.

Week-5: INITIAL SIZING-I
Rubber engine, Fixed engine sizing

Week-6: INITIAL SIZING-II
Configuration layouts., Design of Crew and passenger cabin for the hypothetical aircraft

Week-7: CONSTRAINT ANALYSIS
Determination of Thrust-to-Weight ratio, Design Considerations in Airliners, Cargo, and SST

Week-8: DESIGN ESTIMATIONS-I
Design of Horizontal and vertical tail., Design of control surfaces to meet system requirements

Week-09: CONSTRAINT ANALYSIS -II
Constraint Analysis of Military Aircraft, Constraint Analysis of Transport Aircraft

Week-10: COST ESTIMATION
Cost estimation in aircraft design, Aircraft Loads and V-N Diagram

Week-11: DEMONSTRATION OF SYSTEMS
Hydraulic System, Pneumatic System

WEEK-12: DEMONSTRATION ON
a) Landing gears, Shock absorbers and Electro-mechanical operations of Elevators, Rudder, Flap on an actual aircraft and Artificial Horizon, Airspeed Indicator.

Week-13: DESIGN CASE STUDY-II
Dynamics of F-16, Dynamics of SR-71

Week-14: DESIGN CASE STUDY-II
Dynamics of F-16, Dynamics of SR-71

V. TEXT BOOKS:

1. Daniel P.Raymer, “Aircraft Design: A Conceptual Approach”, AIAA Educational Series, USA, 4th Edition,2006.
2. Sadraey, M. H., “Aircraft Design: A Systems Engineering Approach”, Wiley (2012).
3. J.F.Marchman, L.R.Jenkinson, “Aircraft Design Projects for Engineering Students”, AIAA Publishers, USA, 2003.
4. Ajoy Kumar Kunda, “Aircraft Design”, Cambridge University Press, UK, 2010.

VI. REFERENCE BOOKS:

1. E.Torenbeek, “Synthesis of Subsonic Airplane Design”, Delft University Press, NewYork,1986.
2. E.H Bruhn, “Analysis and Design of Flight Vehicles Structures”, Jacobs Publishing House, USA,

New Edition, 1973.
3. E.E Scheler, L.G Dunn, “Airplane Structural Analysis and Design”, John Wiley & Sons, USA, 1963.
4. D.Howe “Aircraft conceptual Design Synthesis”, John Wiley and Sons Publishers, USA, 2005.

VII. ELECTRONICS RESOURCES:

1. http://www.arabiceng.com/?page=articles_file_download&id=80
1. http://a.moirier.free.fr/Conception/Bouquins/Torenbeek%20~%20Synthesis%20Of%20Subsonic%20 Airplane%20Design.pdf.

VIII. MATERIALS ONLINE

1. Course template
2. Lab manual