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

COURSE CONTENT

FLIGHT VEHICLE DESIGN

VII Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC34	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Basic knowledge of Flight Dynamics and Design

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 student will try to learn:

I. The fundamental concepts of various aerofoil characteristics and blend the best suitable requirements for various applications designing in various applications.
II. Initial sizing of fuselage and tail plane design; static stability; structural loading; cost analysis; takeoff and landing; and specification of (T/W) ratio and wing loading (W/S).
III. The characteristics of stability and performance of an aircraft and the role of primary and secondary controls in longitudinal and lateral stability.
IV. The Conceptual designs of aerospace vehicles, components, missions, or systems that incorporate realistic constraints/applicable engineering standards.

III. COURSE SYLLABUS:

MODULE-I:OVERVIEW OF THE DESIGN PROCESS (9)

Phases of aircraft design, aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, integrated product development and aircraft design. initial conceptual sketches, takeoff gross weight estimation, airfoil selection, airfoil design, airfoil design considerations, wing geometry and wing vertical location, wing tip shapes, tail geometry and arrangements, thrust to weight ratio, thrust matching, wing loading performance, constraint analysis.

MODULE –II: INITIAL SIZING & CONFIGURATION LAYOUT (9)

Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces, and development of configuration lay out from conceptual sketch. the inboard profile drawing, lofting definition, significance and methods, flat wrap lofting, special consideration in configuration lay out, Isobar tailoring, structural load paths, radar, IR, fuselage design, crew station, passengers and payload.

MODULE –III: PROPULSION, FUEL SYSTEM INTEGRATION, LANDING GEAR AND BASELINE DESIGN ANALYSIS – I (9)

Propulsion selection, jet engine integration, propeller engine integration, engine design considerations, engine size estimation, fuel system design and integration, landing gear and sub systems arrangements, guidelines and significance of design layout, report of initial specifications.

Estimation of lift curve slope, maximum lift coefficient, complete drag build up, installed performance of an engine,

aircraft structures and loads categories, air load distribution on lifting surfaces, review of methods of structural analysis, material selection, weights and moments statistical group estimation method.

MODULE –IV: BASELINE DESIGN ANALYSIS – II (9)

Estimation of static pitch stability, velocity stability and trim, estimation of stability and control derivatives, static lateral, directional stability and trim. estimation of aircraft dynamical characteristics, handling qualities, relation to aircraft dynamic characteristics, steady level flight, minimum thrust required for level flight, range and loiter endurance, steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb, level turning flight, gliding flight, energy maneuverability methods of optimal climb trajectories and turns, the aircraft operating envelope, take off analysis, landing analysis, effects of wind on aircraft performance.

MODULE –V: COST ESTIMATION, PARAMETRIC ANALYSIS, OPTIMISATION, REFINED SIZING AND TRADE STUDIES (9)

Elements of life cycle cost, cost estimating method, operation and maintenance costs, aircraft and airline economics, airline revenue, investment cost analysis, improved conceptual sizing methods, trade studies, requirement trades, growth sensitivities, multivariable design optimization methods, determination of final baseline design configuration, preparation of type specification report. Case studies on design of DC-3 and Boeing B-707&747; General dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber.

IV. TEXT BOOKS:

1. Raymer, D.P, “Aircraft Design: A Conceptual Approach”, AIAA Education Series, AIAA, 3rd Edition, 1999, ISBN: 1-56347-281-0.
2. Howe, D, “Aircraft Conceptual Design Synthesis”, Professional Engineering Publishing, London, 2000, ISBN: 1-86058-301-6.
3. Fielding, J.P, “Introduction to Aircraft Design”, Cambridge University Press, 2005, ISBN: 0-521- 657222-9

V. REFERENCE BOOKS:

1. Krishnamurthy, C.S., "Finite Element Analysis", Tata McGraw Hill, 2000.
2. K. J. Bathe, E. L. Wilson, "Numerical Methods in Finite Elements Analysis", Prentice Hall of India, 1985.
3. Robert D Cook, David S Malkus, Michael E Plesha, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, 4th Edition, 2003.
4. Larry J Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, 2nd Edition, 1984.