

Course Title	DESIGN OF AIRCRAFT STRUCTURES (ELECTIVE –II)
Course Code	ME910
Course Credit	Lecture : 04
	Practical : 01
	Tutorial : 00
	Total : 05

Course Objective

The objective of the course is to –

- Give an overview about aircraft design process and brush up fundamental of structural design and analysis
- Give introduction of different aircraft structures, aircraft load, material used and manufacturing processes used
- Teach structural analysis for aircraft structures and various structural repair

Detailed Syllabus

Sr. No.	Name of chapter & Details	Hours Allotted
Section - I		
1	Overview of the Aircraft Design Process Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies	04
2	Fundamentals of Structural Analysis Review of Hooke's Law, Principal stresses, Equilibrium and Compatibility, Determinate Structures, St Venant's Principle, Conservation of Energy, Stress Transformation, Stress Strain Relations	04
3	Introduction to Aircraft Structures Types of Structural members of Fuselage and wing section Ribs, Spars, Frames, Stringers, Longerons, Splices, Sectional Properties of structural members and their loads, Types of structural joints, Type of Loads on structural joints	05
4	Aircraft Loads Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads	05

5	Aircraft Materials and Manufacturing processes Material selection criteria, Aluminium Alloys, Titanium Alloys, Steel Alloys, Magnesium Alloys, copper Alloys, Nimonic Alloys, Non Metallic Materials, Composite Materials, Use of Advanced materials Smart materials, Manufacturing of A/C structural members, Overview of Types of manufacturing processes for Composites, Sheet metal Fabrication ,Machining, Welding, Super plastic Forming And Diffusion Bonding	05
6	Airworthiness and Aircraft Certification Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design Covers, Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements	05
Total		28
Section - II		
7	Structural Analysis of Aircraft Structures Theory of Plates- Analysis of plates for bending, stresses due to bending, Plate deflection under different end conditions, Strain energy due to bending of circular, rectangular plates, Plate buckling, Compression buckling, shear buckling, Buckling due to in plane bending moments, Analysis of stiffened panels in buckling, Rectangular plate buckling, Analysis of Stiffened panels in Post buckling, Post buckling under shear. Sample Exercises. Theory of Shells-Analysis of Shell Panels for Buckling, Compression loading, Shear Loading / Shell Shear Factor, Circumferential Buckling Stress, sample exercises Theory of Beams-Symmetric Beams in Pure Bending, Deflection of beams, Unsymmetrical Beams in Bending, Plastic Bending of beams, Shear Stresses due to Bending in Thin Walled Beams, Bending of Open Section Beams, Bending of Closed Section Beams, Shear Stresses due to Torsion in Thin Walled Beams. Sample Exercises. Theory of Torsion- Shafts of Non-Circular Sections, Torsion in Closed Section Beams, Torsion in Open Section Beams, Multi Cell Sections, Sample Exercises.	22
8	Aircraft Structural Repair Types of Structural damage, Non-conformance, Rework, Repair, Allowable damage Limit, Repairable Damage Limit, Overview of ADL Analysis, Types of Repair, Repair Considerations and best practices	06
Total		28
Instructional Method and Pedagogy:		

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students.
- Surprise tests/Quizzes/Seminar/Tutorials will be conducted.

Students Learning Outcomes:

At the end of the course the students will be able to

- Expose themselves to Aerospace domain
- Understand the applicability of Design principles concepts in Aero Structures

Reference Books:

1. Aerodynamics Aeronautics and Flight Mechanics by Barnes W. McCormick, Wiley India Pvt Ltd.
2. Analysis of Aircraft Structures by Bruce K. Donaldson, Cambridge University Press
3. Aircraft Structures by G Lakshmi Narasaiah, BS Publications
4. Airframe & Powerplant Mechanics: Airframe Handbook by Federal Aviation Administration (FAA), Shroff/faa.
5. Aircraft Design-A Conceptual Approach by Daniel P. Raymer, AIAA education series, 6th Edition
6. Aircraft Structural Maintenance by Dale Hurst, Avotek publishers, 2nd Edition, 2006
7. Aircraft Maintenance & Repair by Frank Delp, Michael J. Kroes & William A. Watkins, Glencoe & McGraw-Hill, 1993, 6th Edition,
8. Fundamentals of Aircraft and Airship Design: Volume I--Aircraft Design by Leland Malcolm Nicolai, L Nicolai And G Carichner, Aiaa (American Institute Of Aeronautics & Ast)

Additional Resources:

- <http://www.faa.gov/>
- <http://www.civilaviation.gov.in/>