

AIRCRAFT STRUCTURES**(Elective-II)****Subject Code: 13ME2212****L P C**
4 0 3**Pre requisites:** Mechanics of solids and Design of machine members**Course Educational Objectives:**

1. To provide the basic methodologies to design and analysis of aircraft structures
2. To learn the different types of materials used for aircraft components
3. To apply the theory of beams and torsion to the design of aircraft structure

Course Outcomes:

The student will be able to

1. know the fundamentals of flight and the structure of aircraft
2. appreciate the difficulties in the actual design and manufacture of an aircraft with emphasis on the frame
3. apply the theory of beams, plate buckling and torsion to the design of aircraft structure
4. interpret properly test results and performance

UNIT-I

Aircraft design process: introduction, phases of aircraft design, aircraft conceptual design process, conceptual stage, preliminary design, detailed design, design methodologies .

Introduction to aircraft structures: types of structural members of fuselage and wing section ribs, spars, frames, stringers, longeron, splices, sectional properties of structural members and their loads, types of structural joints, type of loads on structural joints aircraft loads, duration: aerodynamic loads, inertial loads, loads due to engine, actuator loads, manoeuvre loads, gust loads, ground loads, ground conditions, miscellaneous loads

UNIT-II

Aircraft materials and manufacturing processes: material selection criteria, aluminum 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.

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.

UNIT-III

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

UNIT-IV

Theory of torsion- shafts of non-circular sections, torsion in closed section beams, torsion in open section beams, multi cell sections, theory of shells-analysis of shell panels for buckling, compression loading, shear loading / shell shear factor, circumferential buckling stress.

UNIT-V

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.

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.

TEXT BOOKS

1. Daniel P. Raymer, "*Aircraft Design-A Conceptual Approach*", AIAA education series, 6e, 2001.
2. Michael Niu, "*Airframe Structural Design*", Conmilit Press, 2e, 1988.
3. Michael Niu, "*Airframe Stress Analysis and Sizing*", Conmilit Press, 3e, 1999.
4. Frank Delp, Michael J. Kroes & William A. Watkins, "*Aircraft Maintenance & Repair*", Glencoe & McGraw-Hill, 6e, 1993.
5. Filippo De Florio, "*An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA*", Butterworth-Heinemann

WEB RESOURCES

1. <http://www.aero.org/>
2. http://www.rl.af.mil/rrs/resources/griffiss_aeroclub/aircraft.html