# AIRCRAFT STRUCTURES

(Elective-II)

**Course Code: 15ME2211**

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**Course Outcomes:**

At the end of the course, the student will be able to

**CO1:** explain the aircraft design process and structure of the aircraft.

**CO2:** discuss aircraft materials, manufacturing processes and structural analysis of aircraft structures.

**CO3:** apply the theory of beams for the design of aircraft structure.

**CO4:** apply the theory of torsion for the design of aircraft structure.

**CO5:** explain air worthiness, aircraft certification and aircraft structural repair.

**UNIT-I** (10-Lectures)

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** (10-Lectures)

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** (10-Lectures)

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** (10-Lectures)

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** (10-Lectures)

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