

Course: AE 331 - Structure (3: 3, 2) – Required Core Course

Course Description: Introduction: review of CE 271- Strength of material- Aircraft Structural Detail; structural idealization, Aircraft materials, Loads on Aircraft Structures, Shear forces and Moments and Bending and Twisting in Aircraft structural components . Theory of Elasticity. Bending and twisting of thin walled x-sections. Shearing in thin walled beams. Force Analysis in Landing Gears.

Prerequisites: AE-301, CE-270

Textbooks & required Materials:

1. Curtis, H.D., *Fundamentals of Aircraft Structural Analysis*, McGraw-Hill, 1996.
2. Bruhn, E.F., *Analysis and Design of flight vehicle structure*, Jacobs Publishing, 3rd edition, 1975.
3. Donaldson, B.C., *Analysis of Aircraft Structures*, Cambridge University Press, 2nd edition, 2008.

Course Learning Objectives:

By the completion of the course, the students should be able to:

1. Identify the nature and the composition of aircraft structures in order to know the type of loads acting on the aircraft.
2. Define the equilibrium of the force systems in different structures (truss, beam, and frame). Analyse the forces in the landing gear
3. Identify and distinguish between unstable and stable and between determinate and indeterminate structures
4. Find the internal forces in trusses and reactions by applying equilibrium force systems.
5. Sketch the free body diagrams to find the bending moments and shear forces in beams, frames, wing and aircraft.
6. Calculate the centroid and second moment of area, find the principle axis and use the parallel axes theorem.
7. Define the type of loads on aircraft and calculate the inertia loads and load factors
8. Calculate the shear stresses due to torsion for circular, open and thin walled closed sections
9. Calculate the bending stresses due to bending, find normal stress and neutral axis.
10. Calculate the bending shear stresses for closed, open sections and find the shear center.
11. Calculate the shear flow for thin-walled closed sections
12. Formulate the equilibrium equations and find the strain-displacement, stress-strain relationships.
13. Outline the aircraft material and its behavior under different loading.

Course Topics and their Duration:

Course Topics	Duration in weeks
1. Aircraft materials	0.5
2. Review of CE270	0.5
3. Equilibrium forces system , landing gear	1
4. Properties of section: centroid, second moment of area...etc	1
5. General load on aircraft	1
6. Moments and shear in beams, frames, wing and Fuselage	1
7. Bending stresses: normal stress and neutral axis	1
8. Torsion: stress and deflections	
a. Circular sections	1.5
b. Open thin walled sections	1
c. Closed thin walled sections	1
9. Bending shear stress	
a. Solid sections	1
b. Open sections	1.5
c. Shear center	1.5
10. Shear flow in closed thin walled sections	1.5
11. Principle of Theory of Elasticity	1

Class Schedule:

- **Lectures:** two 80 minutes sessions per week
- **Tutorials:** one 100 minutes session per week

Course Contribution to Professional Component:

- Engineering science: 75%
- Engineering design: 25%

Course Relationship to Program Outcomes:

Program Outcomes	ABET Outcomes										
	a	b	c	d	e	f	g	h	i	j	k
Highest Attainable Level of Learning*	2	-	-	-	2	-	-	2	-	-	-

*1: Low level (knowledge & Comprehension), 2: Medium (Application & Analysis), 3: High (Synthesis & Evaluation)

Prepared by: Mohammed Alharbi

Last Updated: May 2008