AE 220/238: Aerospace Structural Mechanics

Course instructor: P. J. Guruprasad
Contact information: pjguru@aero.iitb.ac.in; # 7142

Course Description:
Introduction: semi-monocoque aerospace structures - Loads and Design considerations; construction concepts, layout, nomenclature and structural function of parts, strength v/s stiffness based design. Torsion of non-circular prismatic beams: importance of warping; St. Venant or Prandtl's formulation; Membrane analogy and its application to narrow rectangular cross-section. General formulation of Thin-Walled Beam (TWB) Theory: Cartesian and midline systems, CSRD & thin-wall assumptions, general expressions for dominant displacement, strain and stress fields, equilibrium equations in midline system, stress resultants and general boundary conditions. Torsion and Bending of TWBs: Torsion of single and multi cell closed sections - Bredt-Batho theory, shear flow, torsion constant, free warping calculation, and concept of center of twist, torsional equilibrium equation and boundary conditions. Torsion of open TWBs without warp restraint, primary & secondary warping, St. Venant torsion constant. Uncoupled bending of open, closed, single cell, multi-cell TWBs - axial stress, shear flow, shear centre, displacement analysis. Torsion of open section TWBs with primary warp restraint - concept and theory of torsion bending, torsion bending constant, secondary warping restraint. Unsymmetric bending and coupled bending torsion analysis. Buckling of TWBs: Concept of structural instability, flexural buckling analysis, bending of beams under combined axial and lateral loads, short column and inelastic buckling. Pure torsional buckling and coupled flexural-torsional buckling of open TWBs. Introduction to the concept of buckling of plates, local buckling of TWBs. Introduction to buckling and post-buckling of stiffened skin panels, ultimate load carrying capacity of a typical semimonocoque TW box-section. Introduction to tension-field beams.

References:
1. Megson, T. H. G., Aircraft Structures for Engineering Students, Butterworth-Heinemann, 4th Ed., 2007.
2. Peery, D. J., Aircraft Structures, McGraw-Hill Education, 1st Ed., 1950.
3. Donaldson, B. K., Analysis of Aircraft Structures (Cambridge Aerospace Series), 2nd Ed., Cambridge University Press, 2008.
4. Sun, C. T., Mechanics of Aircraft Structures, Wiley-Interscience, 1998.

Grading policy: Grades are strictly based on the following break-up:
Quiz 1: 10%
Quiz 2: 10%
Assignments: 10%
Mid-sem: 30%
End-sem: 40%
Grades will be assigned by normalizing the score of every student with the highest score. Subsequently, the letter grades are assigned based on the score range given below:
AA: 100 – 90
AB: 90 – 80
BB: 80 – 70
BC: 70 – 60
CC: 60 – 50
CD: 50 – 40
DD: 40 – 35
FR: Below 35

Note: The above system is based on the assumption that the overall score of atleast one student is greater than or equal to 85. If none of the students in the class score marks greater than or equal to 85 then no one will be given an AA grade. In such a circumstance the scores of all the students will be normalized according to the formula: **score = (your_actual_score) x 90/85.** Letter grades then will be assigned based on the split give above.

Attendance policy: Attendance is cumpolsory. IITB attendance policy for the students will be strictly followed for this class. Students whose attendance is below 80% of the total no. of classes will be given a **DX** letter grade.