AE-6161 Theory of Plates

1. Course Summary

This course focuses on the developments of isotropic and anisotropic plate theories. Classical and energy solutions will be presented for a variety of geometries and loadings. Aerospace applications such as elastically coupled composite and sandwich plates are studied in details.

2. Topics to be covered in this course

1. Basic theory for isotropic plates: Kirchhoff plate theory.
2. Decoupling into bending and stretching equations. Boundary conditions.
3. Classical solution of plate equations: the Navier solution, The Levy solution.
4. Bending of circular plates. Basic solutions for circular plates under symmetric and unsymmetric loading.
5. Energy principles for plates. Approximate solutions of plate equations based on energy principles.
6. Shearing deformations in plates. Mindlin plate theory. Navier and Levy solutions for shear deformable plates. Reissner plate theory. Energy principles for shear deformable plates.
7. Anisotropic plate constitutive laws. Classical lamination theory. Governing equations for anisotropic plates.
8. Governing equations for plates undergoing large displacements and rotations. Von Karman equations.
9. Buckling of anisotropic plates under compressive and shearing loads. Effects of shearing deformations.
10. Sandwich plate theory. Instabilities and wrinkling; effects of imperfections.
11. Vibrations of plates. Effects of shearing deformations and in plane loads.

3. Reference Books

The following reference text books are on reserve in the library for the course:

1. S.P. Timoshenko and Woinowsky-Krieger: **Theory of Plates and Shells**. McGraw-Hill Book Company, 1959.
2. J.N. Reddy: **Energy and Variational Methods in Applied Mechanics**. John Wiley & Sons, 1984. (TA350.R39)
3. I.H. Shames and C.L. Dym: **Energy and Finite Element Methods in Structural Mechanics**. Hemisphere Publishing Corp., 1985. (TA645.S4794)
4. G. Wempner: **Mechanics of Solids with Applications to Thin Bodies**. Sijthoff & Noordhoff, The Netherlands, 1981.
5. C.Y. Chia: **Nonlinear Analysis of Plates**. McGraw-Hill Book Company, New-York, 1980. (TA660.P6)
6. S.P. Timoshenko and J.M. Gere: **Theory of Elastic Stability**. McGraw-Hill Book Company, 1961.
7. K. Washizu: **Variational Methods in Elasticity and Plasticity**. Pergamon Press, Oxford, U.K., 1975. (QA931.W33)