AERO ELASTICITY

PROFESSIONAL ELECTIVE - III

VII Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE46	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

This course will address issues related to the mutual interaction of elastic, inertial, and aerodynamic forces with emphasis on aeronautical applications.

1. Understand how the aeroelastic phenomena flutter, divergence and aileron reversal arise and how they affect aircraft performance,
2. Formulate aeroelastic equations of motion and use to derive fundamental relations for aero elastic analysis,
3. Perform a preliminary aeroelastic analysis of a slender wing structure in low-speed airflow and under what circumstances an aeroelastic analysis can be expected to produce useful results.

UNIT-I INTRODUCTION

Introduction to Aero elasticity COLLARS Triangle, Aerodynamics and interactions of Structural and Inertial forces Static and Dynamic Aero Elasticity Phenomena. Simple Two dimensional idealization of flow, String Theory, Fredholm Integral equations of Second Kind Exact Solutions for simple rectangular wings.

UNIT-II ANLAYTICAL METHODS

Formulations of Structural Dynamics Equation and Coupling effects for panels and plates, generalized coordinates, Lagrange‘s Equations of motion Hamilton‘s Principle Orthogonality conditions. Static Aero elastic Studies Divergences, control reversal, Aileron reversal speed, Aileron efficiency, lift distribution, Rigid and elastic wings.

UNIT-III EXPERIMENTAL ANALYSIS & EQUATIONS OF AERO ELASTIC

EXPERIMENTAL ANALYSIS: Non-dimensional Parameters, stiffness criteria, dynamic mass balancing, model experiments and dimensional similarity, flutter analysis.

EQUATIONS OF AERO ELASTIC: Formulation of Aero elastic Equations for a Typical Section, Quasi Steady Aerodynamic derivatives, modal equations Galerkins method of analysis.

UNIT-IV FLUTTER

Stability of motion of Continua Torsion flexure flutter, Solution of flutter determinant, method ofdetermining the classical flutter speed, Flutter Prevention and control.

UNIT-V AERO ELASTICITY APPLICATIONS

Application of Aero Elasticity in Engineering Problems, Galloping of transmission lines, flow induces vibrations of tall slender structures and suspension Budges.

Text Books:

1. Dewey H. Hodges, G. Alvin Pierce (2011), Introduction to Structural Dynamics and Aero

Elasticity, 2nd edition, Cambridge University Press, UK.
2. Fung Y. C. (2008), An introduction to the Theory of Aero Elasticity, Dover Publications, USA.
3. Jan R. Wright (2008), Introduction to Aircraft Aero Elasticity and Loads, John Wiley, USA

Reference Books:

1. Raymond L. Bisplinghoff, Holt Ashely (2002), Principles of Aeroelasticity, Drovers Publications, USA.
2. Adamu Yebi (2010), Vibration Analysis of Cracked Composite Aircraft Wing Modeled as Shell, VMD Verlag, New Delhi.
3. E. H. Dwell (1995), A Modern Course in Aero elasticity, Springer Publishers, Germany.

COURSE OUTCOMES:

1. Identify the aeroelastic phenomena flutter, divergence and aileron reversal arise and how they affect aircraft performance, collar triangle
2. Demonstrate a basic understanding of modern numerical methods and the state-of-the-art in structural dynamics and aeroelasticity.
3. Differentiate between static aeroelasticity and dynamic aeroelasticity
4. Develop equation of motion for linear motion and rotary motion
5. Analyze the wing flutter, under the over damping and critical damping conditions
6. Build confidence for self learning needed for aircrafts, automobiles failures due to vibration effect