



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170110

Semester –VII

Subject Name: Introduction to Aero Elasticity

Type of course: Professional Elective course

Prerequisite: Theory of Vibration, Mechanics of solids, Aerospace structures & Basic Aerodynamics.

Rationale: Aeroelasticity is the study of the interactions between the elasto dynamics of a flexible lifting surface with the dynamics of the fluid flow over it. The issues that are of concern in this study include stability of the aeroelastic system, its static and dynamic response, and controlling these aeroelastic instabilities and response.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Introduction Aero elastic Problems, Classification and Solution of Aero elastic Problems, Deformation of Structures and Influence Coefficients. Energy Method	8
2	Static Aeroelasticity One Dimensional Aeroelastic Model of Airfoils, Divergence of 2-D airfoil and Straight Wing, Aileron Reversal, Control Effectiveness, Wing loading and deformations, Swept Wing	12
3	Dynamic Aero elasticity Dynamic/Flutter model of 2-D Airfoil.	04
4	Unsteady Aerodynamics. 2-D and 3-D Supersonic flow, Subsonic flow (Kernal Function Approach), Theodorsen Theory, Finite State Model	14
5	Flutter Calculation: U-g Method, P-k Method., Exact Treatment of Bending - Torsion Flutter of Uniform Wing, Flutter Analysis by Assumed Mode Method.	07

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30%	30%	20%	10%	10%	0



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Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. TIMOSHENKO S., "Vibration Problems in Engineering" – John Wiley and Sons, New York, 1993.
2. FUNG Y.C., "An Introduction to the Theory of Aeroelasticity" – John Wiley & Sons, New York, 1995.
3. BISPLINGHOFF R.L., ASHELY H and HOGMAN R.L., "Aeroelasticity" – Addison Wesley Publication, New York, 1983.
4. TSE. F.S., MORSE, I.F., HUNKLE, R.T., "Mechanical Vibrations", – Prentice Hall, New York, 1984.
5. SCANLAN R.H. & ROSENBAUM R., "Introduction to the study of Aircraft Vibration & Flutter", John Wiley and Sons. New York, 1982.
6. BENSON H.TONGUE, "Principles of Vibration", Oxford University Press, 2000.

Course Outcomes:

Upon completion of this course students should be able:

Sr. No.	CO statement	Marks % weightage
CO1	To understand the underlying theoretical basics of Aero elasticity.	15%
CO2	To study about static aeroelasticity.	20%
CO3	To understand about Flutter model of 2-D Airfoil	20%
CO4	To describe unsteady aerodynamics concepts.	30%
CO5	Apply U-g Method and P-k Method to solve aeroelastic flutter problems.	15%

List of Experiments:

1. Introduction to aeroelasticity.
2. To study about static aeroelasticity
3. To simulate structure of airfoil.
4. To study about airfoil flutter.
5. To study about unsteady aerodynamics
6. To study about dynamic aeroelasticity.

List of Open Source Software/learning website:

<https://nptel.ac.in/>