SEMESTER 6

VIBRATION AND AEROELASTICITY

Course Code	**PEAOT 635**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	5/3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Engineering Mechanics, Mechanics of Aircraft Materials, Aircraft Structures I & Aircraft Structures II	**Course Type**	Theory

Course objectives:

- Understand the principles governing vibration and aeroelasticity in Aerospace structures.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Single Degree of Freedom Systems**: Vibration Terminologies – Simple Harmonic Motion, Newton's Law – D'Alembert's Principle – Spring Combination – Energy Method – Rayleigh's Method – Simple and Compound Pendulum – Longitudinal, Transverse and Torsional Vibrations, Damped Vibrations – Types – Differential Equations – Logarithmic Decrement, Forced Vibrations – With and Without Damping – Support Excitation – Vibration Isolation – Transmissibility – Vibration Measuring Instrument.	11
2	**Several Degrees of Freedom Systems**: Two Degrees of Freedom Systems – Coordinate Coupling – Principal Coordinates – Principal Modes – Vibration Absorber, Multi Degrees of Freedom Systems – Orthogonality Principle – Hamilton's Principle. **Vibrations of Plates:** Vibrations of Rectangular Plates, Vibrations of Circular Plates	9
3	**Approximate Methods**: Rayleigh's Method – Dunkley's Method – Holzer's Method – Stodola Method – Matrix Method – Matrix Iteration Method. **Continuous Systems:** Vibration of Strings – Longitudinal Vibration of Bars – Lateral Vibration of Beams – Torsional Vibration of Shafts	9
4	**Aeroelasticity:** Static Aeroelasticity, Dynamic Aeroelasticity Concepts – Coupling – Collar's Triangle – Aero Elastic Instabilities and their	7

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	Prevention – Wing Divergence – Loss and Reversal of Aileron Control – Flutter and its Prevention, Flutter of a Cantilever Wing.	

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks (8x3 =24 marks)	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. (4x9 = 36 marks)	60

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Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Solve equations of motion for undamped one-dimensional vibrations.	K3
CO2	Apply principles associated with vibrations of systems having more than one Degree of Freedom(s).	K3
CO3	Apply different methods to solve continuous systems to minimize vibration.	K3
CO4	Understand the aeroelastic instabilities and the methods of prevention	K2

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	1
CO2	3	3	3	3	-	-	-	-	-	-	-	-
CO3	3	3	2	3	-	-	-	-	-	-	-	-
CO4	3	1	2	2	-	-	-	-	-	-	-	-

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Mechanical Vibrations	V. P Singh	Dhanpat Rai & Co (P) Ltd	2014
2	Principles of Aeroelasticity	Rama B Bhat	CRC Press	2016
3	Mechanical Vibrations	G.K. Grover	Nem Chand & Bros	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Principles of Vibration	Tongue. B. H.	Oxford University Press	2000
2	An Introduction to the Theory of Aeroelasticity	Fung Y.C.	John Wiley & Sons, New York	2008

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://onlinecourses.nptel.ac.in/noc24_me85/preview
2	https://onlinecourses.nptel.ac.in/noc21_me42/preview, https://www.youtube.com/watch?v=bCWidtRmPQ8
3	https://onlinecourses.nptel.ac.in/noc21_me42/preview
4	https://nptel.ac.in/courses/101104005

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