

# GUJARAT TECHNOLOGICAL UNIVERSITY

## MECHANICAL (MACHINE DESIGN) (09)

VIBRATION AND NOISE  
**SUBJECT CODE:** 2710908  
 M.E. 1<sup>st</sup> SEMESTER

**Type of course:** Engineering Science

**Prerequisite:** Zeal to learn the subject

**Rationale:** The course intends to provide intermediate level of knowledge of Mechanical Vibrations and foundations of noise. The course includes analysis of single and multi-degrees of freedom system, analysis of continuous system along with experimental methods

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
4	0	2	5	70	30	20	10	20	0	150

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>Fundamentals of Vibration:</b> Introduction to Single degree freedom systems, Duhamel's Integral, Impulse Response function, Virtual work, Lagrange's equation, Single degree freedom forced vibration with elastically coupled viscous dampers, Transient Vibration	08	10
2	<b>Two Degrees of Freedom System:</b> Free vibration of spring-coupled system, Mass coupled system, Vibration of two degree freedom system, Forced vibration of spring-coupled system, Mass coupled system, Nonlinear stiffness, Vibration Absorber, Vibration Isolation.	05	10
3	<b>Multi-Degrees Freedom System:</b> Normal mode of vibration, Flexibility Matrix and Stiffness matrix Eigenvalues and Eigenvectors, Orthogonal properties, Forced Vibration by Matrix inversion, Modal analysis, Modal damping in forced vibration, Matrix iteration, Using Lagrange's equation to derive equation of motion.	09	20
4	<b>Vibration of Continuous Systems:</b> Systems governed by wave equations, Vibration of strings, Vibration of rods, Euler Equation for Beams, Effect of Rotary inertia and shear deformation.	06	10
5	<b>Random Vibrations:</b> Description of random process, Correlation and power spectral density	03	05
6	<b>Experimental Methods in Vibration Analysis:</b> Vibration instruments, Vibration excitors Measuring Devices, Analysers, signal processing; modal parameter identification; vibration trouble-shooting and diagnosis; time-domain and frequency-domain vibration analysis.	08	15
7	<b>Vibration Control:</b> Sources of vibration; vibration basics; vibration analysis of continuous structures; finite element analysis of structures; vibration isolation and absorption; passive and active vibration control.	05	10
8	<b>Noise:</b> Introduction Relation between vibration and noise pollution, vibration as noise sources, classification of analysis of machinery vibrations.	03	05
9	<b>Noise Generated by Vibrating Structures and Control:</b> Elementary noise radiators; noise radiation by machine; noise source	07	15

	identification; sound intensity measurement; identification of noise source; noise radiation and transmission; design principles for noise reduction.		
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### Reference Books:

1. Mechanical Vibrations, S. S.Rao, Pearson Education.
2. Mechanical Vibrations S.Graham Kelly and Shashidar K.Kudari, , McGraw-Hill Publishing
3. Engineering Vibration Inman D J Pearson Education.
4. Theory of Vibration with Applications Thomson W.T. CBS Publishers & Distributors / Prentice Hall of India
5. Introductory Course on Theory and Practice Mechanical Vibration Rao J.S., & Gupta, K. New Age International (P) Ltd.
6. Principles of Vibrations Control A.K. Mallik, Affiliated East-West Press Pvt. Ltd.
7. Modal Testing: Theory and Practice Ewins D.J John Wiley.
8. Fundamentals of Noise and Vibration Analysis for Engineers Norton M P and Karczub D G Cambridge Press.

### List of Experiments:

Experiments should be designed considering following themes.

1. Study of SDOF forced vibration
2. Study of MDOF system.
3. Solution of SDOF and MDOF problems by MATLAB / SciLab
4. Vibration measurement using FFT analyser
5. Interpretation of FFT results i.e. finding problems like unbalance, misalignment, also finding damping coefficient
6. Study of vibrations of continuous system
7. Noise measurement

### Open Ended Problems:

1. Modelling and vibration analysis of gear system with defects / faults.
2. Modelling and analysis of fault prediction system for bearing

### Course Outcome:

After learning the course the students should be able to

1. Students will understand fundamentals of modelling and analysis of vibrations of mechanical systems.
2. Students will be able to conduct vibration analysis of continuous systems.
3. Students will be able to apply experimental methods for vibration measurement and control.
4. Students would understand fundamentals of noise