GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3720916
ADVANCED VIBRATIONS AND ACOUSTICS
SEMESTER: II

Type of course: Core course

Prerequisite: Zeal to learn the Subject

Rationale: The course intends to provide intermediate level of knowledge of Mechanical Vibrations and foundations of acoustics. 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	C	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	Hours
1.	**Fundamentals of mechanical vibrations:** Sources of vibration, Free Vibration, Forced vibration, Natural frequency, Equivalent system, Energy method, Response to an initial disturbance, Duhamel's integral, Stiffness modeling, Non linear stiffness, Damped models, single degree of freedom system with viscous damping, Logarithmic decrement, General excitation- Duhamel's integral, Harmonic excitation, Mechanical Impedance, System identification from frequency response	13
2.	**Two Degree of Freedom Systems:** Free vibration of spring coupled system, Two degrees of freedom mass coupled systems, Forced vibrations of undamped system, Undamped vibration absorbers, Forced damped vibrations, Vibration Isolation	04
3.	**Multi degree of freedom systems:** Closed couple systems, Far coupled systems, Orthogonality of mode shapes, Modal analysis, Forced vibration, Using Lagrange's equation to derive equation of motion	06
4.	**Numerical methods:** Approximate methods for fundamental frequency, Dunkerley's lower bound approximation, Rayleigh's upper bound approximation, Matrix method	04
5.	**Continuous systems:** System governed by wave equation, solution of wave equation for free and forced vibrations, Free and forced vibration of beams	05
6.	**Fundamentals of Acoustics:** Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due	12

	to a simple source, Psychoacoustics, Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise.	

Reference Books:

1. Theory and Practice of Mechanical Vibrations, J. S. Rao, K. Gupta, New Age International Publishers
2. Mechanical Vibrations S. S. Rao, Pearson Education
3. Mechanical Vibrations S. G. Kelly, McGraw-Hill International editions
4. Engineering Vibration D. J. Inman, Prentice Hall
5. Fundamentals of Acoustics Lawrence E Kinsler, Austin R Frey, John Willey & Sons, Fourth Edition, 2000

Course Outcome:

After learning the course the:

Sr. No.	CO statement	Percentage Weightage
CO-1	Students will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations.	30%
CO-2	Students will be able to prepare mathematical models of mechanical system for its dynamic analysis.	35%
CO-3	Students will be able to estimate natural frequencies of mechanical system using computational methods.	15%
CO-4	Students will be able to understand the basics of acoustics, psychoacoustics, equal loudness contours, dBA scale, loudness, pitch and timbre.	20%

List of Experiments:

1. Experiments based on single degree of freedom systems;
2. Experiments based on two degree of freedom systems.
3. Experiments on lateral vibration of beams.
4. Draw the Campbell diagram using computer software (like MATLAB, Labview, Scilab).
5. Modal analysis using computer software (like MATLAB, Labview, Scilab).
6. Experiments based on analysis of vibration spectra, vibration signal captured by accelerometer and FFT analyzer.
7. Experiments based on Noise analyses.

Major Equipment:

1. Universal Vibration experimental set up.
2. Accelerometer , Microphone, FFT analyzer.

List of Open Source Software/learning website:

1. **NPTEL courses**
2. **Scilab Software**