GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (CAD/CAM) (08)

NOISE AND VIBRATIONS ANALYSIS
SUBJECT CODE: 2720817
SEMESTER: II

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
				Theory Marks		Practical Marks				
L	T	P	C	ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	0	2#	4	70	30	20	10	10	10	150

Contents:

Sr. No	Topic	Lectures	Weightage %
1	**Fundamentals of Vibration:** 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, Preliminary design of automobile suspension. Design of machine foundations and isolators.	**7**	**20%**
2	**Two Degrees of Freedom System:** Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method, Case studies on formulation of equations of motion, Free vibration response, Eigen values and Eigen vectors, Normal modes and mode superposition, Coordinate coupling, decoupling of equations of motion, Natural coordinates, Response to initial conditions, coupled pendulum, free vibration response case studies, Forced vibration response, Automobile as a two degree of freedom system – bouncing and pitching modes undamped vibration absorbers, Analysis and design of damped vibration absorbers.	**9**	**25%**
3	**Multi-Degrees Freedom System:** 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.	**9**	**25%**
4	**Vibration of Continuous Systems:** Systems governed by wave equations, Vibration of strings, Vibration of rods, Euler Equation for Beams, Effect of Rotary inertia and shear deformation.	**6**	**10%**
7	**Vibration Control:**	**5**	**10%**

	Sources of vibration; vibration analysis of continuous structures; finite element analysis of structures; vibration isolation and absorption; passive and active vibration control.		
8	**Noise:** Introduction, vibration as noise sources, classification of analysis of machinery vibrations. Elementary noise radiators; noise radiation by machine; noise source identification; sound intensity measurement; identification of noise source; noise radiation and transmission; design principles for noise reduction.	**6**	**10%**

References:

1. Mechanical Vibrations, S. S. Rao, Pearson Eduction.
2. Elements of Vibration analysis, L. Meirovich, McGraw-Hill.
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.

Course Outcomes:

After learning the course the students should be able to:

1. Understand fundamentals of modelling and analysis of vibrations of mechanical systems.
2. Conduct vibration analysis of continuous systems.
3. To apply experimental methods for vibration measurement and control.
4. Understand fundamentals of noise.

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 and Analysis

Design based Problems (DP)/Open Ended Problem:

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

Major Equipment:

1. Accelerometers.

2. Data Acquisition system.
3. Computer.
4. FFT Analyser.

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.