GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS
SUBJECT NAME: DYNAMICS OF MACHINES (Programme Elective – II)
SUBJECT CODE:3714705
M.E. 1st SEMESTER

Type of course: Engineering

Prerequisite: NA

Rationale: This subject deals with fundamentals of mechanical vibrations which are useful to analyze mechatronics systems.

Teaching and Examination Scheme:

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

Content:

Sr. No.	Content	Hours	% Weightage
1.	**Fundamentals of mechanical vibrations** Sources of vibration, Free Vibration, Forced vibration, Simple harmonic motion, Campbell diagram, Fourier analysis	03	6%
2.	**Single degree of freedom system-Free Vibrations** Natural frequency, Equivalent system, Energy method, Response to an initial disturbance, Phase plane method, Duhamel's integral, Stiffness modeling, Non linear stiffness	05	11%
3.	**Single degree of freedom system-Damped vibrations** Damped models, single degree of freedom system with viscous damping, Logarithmic decrement, General excitation- Duhamel's integral	05	12%
4.	**Single degree of freedom system-Forced Vibrations** Harmonic excitation, Mechanical Impedance, System identification from frequency response	05	12%
5.	**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	05	12%
6.	**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	08	19%
7.	**Numerical methods** Approximate methods for fundamental frequency, Dunkerley's lower bound approximation, Rayleigh's upper bound approximation, Matrix method	06	14%
8.	**Continuous systems** System governed by wave equation, solution of wave equation for free and forced vibrations, Free and forced vibration of beams	06	14%

Total	**43**	

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

Course Outcome:

After learning the course the students should be able to:

- Understand importance of mechanical vibrations in design of mechatronics systems.
- Understand free vibrations, damped vibrations and forced vibrations of single degree of freedom systems and multi degree of freedom systems.
- Determine exact and approximate natural frequency of mechanical systems.

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).

Major Equipments:

Vibration measuring instruments and equipments; Basic mechanisms

List of Open Source Software/learning website:

Scilab software