

ME-703- Mechanical Vibration and Noise Engineering

Unit 1 : Fundamental Aspects of Vibrations: Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; vector method of representing harmonic motion; characteristics of vibration, harmonic analysis and beats phenomenon, work done by harmonic forces on harmonic motion; periodic, non-harmonic functions- Fourier series analysis; evaluation of coefficients of Fourier series; elements of vibratory system; lumped and distributed parameter systems.

Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton's second law of motion, and Rayleigh's method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Unit 2: Damped Free Vibrations: Viscous damping: coefficient of damping; damping ratio; under damped, over damped and critically damped systems; logarithmic decrement; frequency of damped free vibration; Coulomb or dry friction damping; frequency, decay rate and comparison of viscous and Coulomb damping; solid and structural damping; slip or interfacial damping.

Unit 3: Harmonically excited Vibration: One degree of freedom- forced harmonic vibration; vector representation of forces; excitation due to rotating and reciprocating unbalance; vibration Isolation, force and motion transmissibility; absolute and relative motion of mass (Seismic Instruments).

Whirling Motion and Critical Speed : Whirling motion and Critical speed : Definitions and significance .Critical -speed of a vertical , light flexible shaft with single rotor : with and without damping .Critical speed of a shaft carrying multiple discs (without damping), Secondary critical speed.

Unit 4: Systems With Two Degrees of Freedom : Un-damped free vibration of 2 d.o.f and Principal modes of vibration; torsion vibrations; Forced, Un-damped vibrations with harmonic excitation ; Coordinate coupling; Dynamic vibration absorber; torsion Vibration Absorber; Pendulum type of dynamic vibration.

Unit 5: Noise Engineering -Subjective response of sound: Frequency and sound dependent human response; the decibel scale; relationship between, sound pressure level (SPL), sound power level and sound intensity scale; relationship between addition, subtraction and averaging, sound spectra and Octave band analysis; loudness; weighting networks; equivalent sound level, auditory effects of noise; hazardous noise, exposure due to machines and equipments; hearing conservation and damage risk criteria, daily noise dose.

Noise: Sources, Isolation and Control: Major sources of noise on road and in industries, noise due to construction equipments and domestic appliances, industrial noise control, strategies- noise control at source (with or without sound enclosures), noise control along the path (with or without partitions and acoustic barriers); noise control at the receiver, ear defenders, earplugs, semi-insert protectors.

References:

- 1- Ambekar A.G., ' Mechanical Vibrations and Noise Engineering; PHI
- 2- Meirovitch Leonard; Element of Vibration Analysis; TMH
- 3- Dukkipati RV Srinivas J Text book of Mechanical Vibrations; PHI
- 4- Kelly SG and kudari SK; Mechanical Vibrations; Schaum Series;TMH
- 5- Thomson , W.T., Theory of Vibration with Applications , C.B.S Pub & distributors .
- 6- Singiresu Rao, "Mechanical Vibrations ", Pearson Education .
- 7- G.K. Grover, " Mechanical Vibration , Nem chand and Bross , Roorkee .

List of experiments (please expand it);

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- 1- To find out effect of load on natural frequency of vibrations of a lever pin supported at one end carrying adjustable load on a vertical screwed bar and spring supported at some intermediate point (i) When the dead weight of rods is neglected and (ii) when their dead weight is taken into account .
- 2- To find out frequency of damped free vibration and rate of decay of vibration-amplitude in the system.
- 3- To find out natural frequency and damped free frequency of a torsion pendulum and , hence to find out coefficient of damping of the oil ;
- 4- To observe the phenomenon of "whirl" in a horizontal light shaft and to determine the critical speed of the shaft.
- 5- To observe the mode shapes of a spring-connected, double pendulum and hence to demonstrate the phenomenon of beats.
- 6- To demonstrate the principle of tuned Undamped Dynamic Vibration Absorber and to determine the effect of mass-ratio (of main and auxiliary mass) on the spread of the resulting natural frequencies ;
- 7- To take measurements of sound Pressure Level (SPL) and to carry out octave band analysis of a machine using Noise Level Meter.