CBCS SCHEME

USN

17AU82

Eighth Semester B.E. Degree Examination, July/August 2021
Mechanical Vibration

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Differentiate between:
(i) Linear and non-linear vibration
(ii) Deterministic and random vibration
(iii) Longitudinal, transverse and torsional vibration **(10 Marks)**

b. Split the harmonic motion $x = 10\sin\left(\omega t + \frac{\pi}{6}\right)$ into two harmonic motions one having phase angle of zero and the other of 45°. Use both analytical and graphical method. **(10 Marks)**

2 a. Determine the natural frequency of the spring mass system as shown in Fig.Q2(a). Take mass of the spring into account, use energy method.

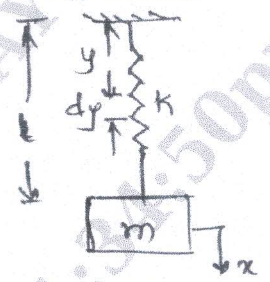

Fig.Q2(a) **(10 Marks)**

b. A block of mass 0.05 kg is suspended from a spring having a stiffness of 25 N/m. The block is displaced downward from its equilibrium position through a distance of 2 cm and released with an upward velocity of 3 m/sec. Determine:
(i) Natural frequency (ii) Period of oscillation
(iii) Maximum amplitude of vibration (iv) Maximum velocity
(v) Maximum acceleration (vi) Phase angle **(10 Marks)**

3 a. Setup the differential equation for spring mass-damper system and obtain complete solution for the critical damped condition. **(08 Marks)**

b. A spring-mass-dashpot system is given an initial displacement zero and velocity of XW_n where W_n is the undamped natural frequency of the system. Find the equation of motion for the system, when (i) $\xi = 0.5$ (ii) $\xi = 1$ (iii) $\xi = 2.5$ **(12 Marks)**

4 a. Obtain an expression for whirling of shaft with air damping. **(08 Marks)**

b. A shaft 1.5 cm dia and 1m long is held in long bearings. The weight of the disc at the centre of the shaft is 15 kg. The eccentricity of the centre of gravity of the disc from centre of rotor is 0.03 cm. The modulus of elasticity of the material of the shaft is 2×10^6 kg/cm^2. The permissible stress in the shaft material is 700 kg/cm^2. Find :
(i) The critical speed of the shaft
(ii) The range of speed over which it is unsafe to run the shaft. Neglect the weight of the shaft. **(12 Marks)**

5 a. Show that providing damping in vibration isolation is not useful, when the frequency ratio is more than 1.414 or $\sqrt{2}$. **(10 Marks)**

b. A machine of total mass 17 kg is mouted on springs having stiffness is 11000 N/cm. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and speed 6000 rpm. Assuming the motion to the SHM. Take $\xi = 0.2$. Determine:
(i) Amplitude of motion (ii) Transmissibility (iii) Force transmitted to the foundation **(10 Marks)**

6 a. Find the solution for the differential equation of a spring-mass system under forced vibration without damping. **(08 Marks)**

b. An engine weighing 1000 N including reciprocating parts is mounted on springs. The weights of the reciprocating parts is 22 N. and the stroke is 90 mm. the engine speed is 720 rpm:
(i) Neglecting damping, find the stiffness of the springs, so that the force transmitted to the foundation is 5% of the amplitude force.
(ii) If under the actual working condition the damping reduces the amplitude of successive vibration by 25%, determine the force transmitted at 720 rpm. **(12 Marks)**

7 a. Explain the principle of dynamic vibration absorber. **(10 Marks)**

b. Use Lagranges equation to find the natural frequency and amplitude ratio of the system as shown in Fig.Q7(b).

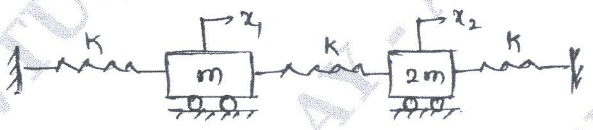

Fig.Q7(b) **(10 Marks)**

8 a. Explain two types of frequency measuring instruments, with neat sketches. **(10 Marks)**

b. The motion of vibrating system is to be recorded by a seismic instrument having natural frequency 1500 Hz. What is the reading of the instrument, if the motion is given by equation $Z = 1.5 \sin 188.5t + 0.5 \sin 377t$ damping factor is 0.65. **(10 Marks)**

9 Find all the natural frequencies of the four degree of freedom system shown in Fig.Q9 by Holzer's method.

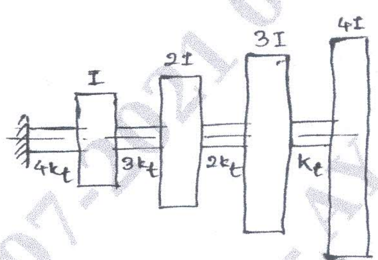

Fig.Q9 **(20 Marks)**

10 Explain Stodola's method and determine fundamental mode of vibration and its natural frequency of spring-mass system shown in Fig.Q10 by Stodola's method.

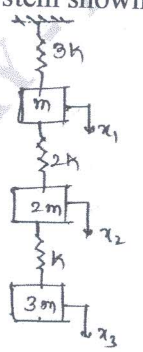

Fig.Q10 **(20 Marks)**