EXAMINATION
MORNING
22 SEP 2022

[Total No. of Questions: 09] [Total No. of Pages: 02]

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Program/ Course: **B.Tech. ME (Batch 2018 onward)**
Semester: **6th**
Name of Subject: **Mechanical Vibrations**
Subject Code: **PCME-115**
Paper ID: **17252**

**Time Allowed: 3 Hours** **Max. Marks: 60**

**NOTE:**

1) Parts A and B are compulsory
2) Part-C has Two Questions Q8 and Q9. Both are compulsory, but with internal choice
3) Any missing data may be assumed appropriately

**Part – A** **[Marks: 02 each]**

**Q1**

**a)** Define harmonic series.

**b)** What is transverse vibration?

**c)** Define principal mode of vibration.

**d)** Write two uses of vibration.

**e)** Write one advantage of critical damping.

**f)** Define semi definite system.

**Part – B** **[Marks: 04 each]**

**Q2** Split up the harmonic motion $x = 10 \sin\left(wt + \frac{\pi}{6}\right)$ into two harmonic motions, one is having a phase angle of zero and the other of 46°.

**Q3** A gun barrel of mass W kg has a recoil spring whose stiffness is k N/m. If W= 450 kg, k=3.6 x $10^7$ N/m and the barrel recoils 1 m on firing determine. **(a)** The initial recoil velocity of the barrel, **(b)** The critical damping coefficient of a dashpot which is engaged at the end of the recoil stroke, **(c)** The time required for the barrel to return to a position 5cm from its initial position.

**Q4** A small motor driving a compressor weighs 35 kg and causes each of the rubber isolators to deflect by 4 mm. The motor runs at a constant speed of 2000 rpm. The compressor piston has a 60 mm stroke. The piston and reciprocating parts weigh 1 kg and perform a simple harmonic motion. The amplitude of vertical motion at the operating speed is 0.5 cm. Find damping factor of rubber.

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**Q5** A reciprocating pump of 300 kg is driven through a belt by an electric motor at 4000 RPM. The pump is mounted on isolators with total stiffness of 15 MN/m and damping 6 k Ns/m. Determine the vibratory amplitude of the pump at the running speed due to the fundamental harmonic force of excitation 2 kN. Determine the amplitude at resonance also.

**Q6** Two rotors A and B, are attached to the ends of a shaft 600 mm long. The mass of rotor A is 400 kg, and its radius of gyration is 400 mm. The corresponding values of rotor B are 500 kg and 500 mm, respectively. The shaft is 80 mm diameter for the first 250 mm, 120 mm for the next 150 mm length and 100 mm for the remaining length. The modulus of rigidity of the shaft material is $0.8 \times 10^5$ MN/m$^2$. Find: (a) The position of the node. (b) The frequency of torsional vibrations.

**Q7** A small reciprocating machine of 30 kg mass runs at a constant speed of 5000 rpm. After installation, the forcing frequency was found to be too close to the natural frequency of the system. Design a dynamic absorber if the closed frequency of the system is to be at least 20% from the disturbing frequency.

**Part – C** **[Marks: 12 each]**

**Q8** Find the natural frequency of the system shown in Figure 1 by the Matrix method.
M = 1 kg, k = 100 N/m

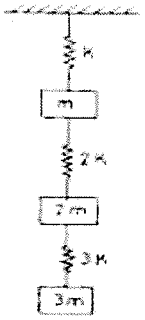


Figure 1

**OR**

A uniform bar of length L is fixed at one end, and the free end is stretched uniformly to $L_0$ and released at t = 0. Find the resulting longitudinal vibration.

**Q9** Find the sum of two harmonic motions of equal amplitude but of slightly different frequencies. Discuss the beat phenomenon that results from this sum.

**OR**

Describe centrifugal pendulum vibration absorber

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