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10ME/MR72

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Mechanical Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. What is the natural frequency of the Beats phenomena? **(08 Marks)**

b. Split the Harmonic motion $x = 10 \sin (wt + \pi/6)$, into two Harmonic motions one having a phase angle of zero and other of 45°. **(12 Marks)**

2 a. Determine the Natural frequency of Simple Spring Mass System :
i) Energy method ii) Rayleigh's method. **(07 Marks)**

b. Find the natural frequency of the system as shown in Fig. Q2(b). **(08 Marks)**

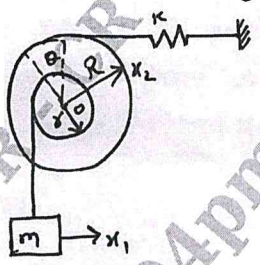

Fig. Q2(b)

c. A spring mass system has natural frequency of 12Hz when the spring constant is reduced by 800 N/m, the frequency is changed by 50%. Determine the mass of spring constant of original system. **(05 Marks)**

3 a. Set up the differential equation for a spring – mass – damper system and obtain the complete solution for the critically daped system. **(10 Marks)**

b. A mass of 1kg is attached to a spring having stiffness of 3920 N/m. The mass slides on a horizontal surface, the co-efficient of friction between the mass of surface being 0.1. Determine the frequency of vibration of the system of the amplitude after one cycle if the initial amplitude is 0.25cm. Determine the final rest position. **(10 Marks)**

4 a. Derive the expression for the Transmissibility Ratio. **(10 Marks)**

b. A vibrating body is supported by six isolators each having stiffness 32000N/m and 6 dashpots having damping factor as 400N-sec/m. The vibrating body is to be isolated by a rotating device having an amplitude of 0.06 mm at 600 rpm. Take m = 30kg. Determine
i) Amplitude of vibration of the body.
ii) Dynamic load on each isolator due to vibration. **(10 Marks)**

PART – B

5 a. Derive the critical speed of shaft with Air damping. **(10 Marks)**

b. A rotor of mass 12kg is mounted midway on a 25mm diameter horizontal shaft supported at the ends of two bearings. The span between the bearings is 900mm. Because of some manufacturing defect the C.g of the rotor is 0.02mm away from geometric centre of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take E = 200 GPa. **(10 Marks)**

6 a. Derive the Torsional vibrations. **(08 Marks)**

b. An Engine drives a centrifugal pump through a 2:1 speed reducer gear box. The mass moments of Inertia of engine fly – wheel and pump Impeller are 500kg.m^2 and 60 kg m^2 respectively. The length and diameter of fly wheel shaft are 250mm and 50mm respectively. The length and diameter of impeller shaft are 150mm and 40mm respectively. The modules of rigidity of shaft is 80 GPa. Determine frequency of Torsion. **(12 Marks)**

7 a. Using Stodola's method determine the fundamental mode of vibration and its natural frequency of the system spring mass as shown in Fig. Q7(a). **(10 Marks)**

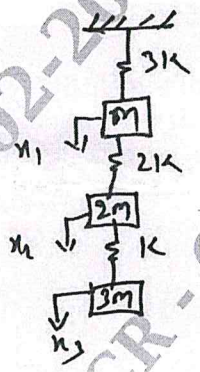

Fig. Q7(a)

b. Find the lowest natural frequency of Transverse vibration for the system shown in Fig. Q7(b) by Rayleigh's method. **(10 Marks)**

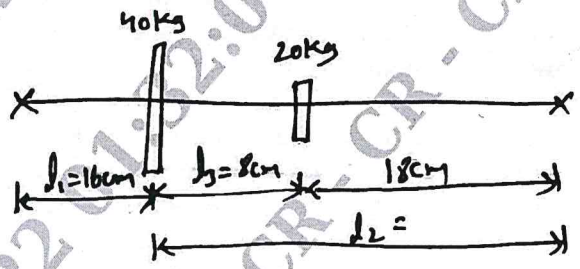

Fig. Q7(b)

8 Explain the Machine condition Monitoring and Diagnosis :

a. Machine condition Monitoring Techniques. **(10 Marks)**

b. Machine Maintenance Techniques. **(10 Marks)**

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