USN | | | | | | | | | | 10AE65

Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Add the following harmonic motions, analytically and check the solution graphically, $x_1 = 2\cos(\omega t + 0.5)$, $x_2 = 5\sin(wt + 1.0)$ **(10 Marks)**

b. Define the following terms:
(i) Simple harmonic motion
(ii) Damping
(iii) Degrees of freedom.
(iv) Natural frequency
(v) Torsional vibration. **(10 Marks)**

2 a. Determine the natural frequency of a compound pendulum. **(10 Marks)**

b. Derive the differential equation of one degrees of freedom spring mass system. Also obtain its solution applying suitable boundary conditions. **(10 Marks)**

3 a. Find the equation of motion for the system shown in Fig. Q3 (a), when (i)Damping ratio=1.0 (ii) damping ratio=0.3 and (iii) Damping ratio = 2.0, if the mass 'M' is displaced by a distance of 3 cm and released. **(12 Marks)**

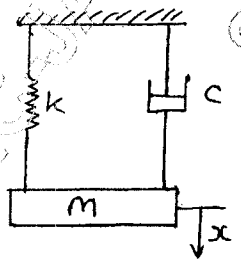

Fig. Q3 (a)

b. Define logarithmic decrement and show that $\delta = \frac{1}{n}\ln\left(\frac{x_0}{x_n}\right)$ with usual notations. **(08 Marks)**

4 a. Derive an expression for the forced vibration due to bars excitation of the support. **(10 Marks)**

b. A 75 kg machine is mounted on springs of stiffness $K = 11.76 \times 10^5$ N/m with an assumed damping factor of 0.2. A 2 kg piston within machine has a reciprocating motion with a stroke of 0.08 m and a speed of 300 CPM. Assuming the motion of the piston is harmonic. Determine the amplitude of vibration of the machine and the vibration force transmitted to the foundation. **(10 Marks)**

PART – B

5 a. Obtain an expression for the critical speed of a shaft with damping. **(10 Marks)**

b. A rotor of mass 12 kg is mounted midway on a 25 mm diameter horizontal shaft supported at the ends by 2-bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the C.G. of the rotor is 0.02 mm away from the geometric centre of the rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic forces on the bearings. Take E = 200 GPa. **(10 Marks)**

6 a. Write short notes on:
(i) Dynamic vibration absorber.
(ii) Principal modes and normal modes of vibration. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig. Q6 (b). **(12 Marks)**

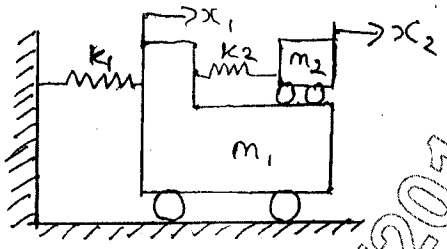

Fig. Q6 (b)

7 a. Obtain the expression for longitudinal vibration of rods or bars. **(12 Marks)**

b. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. **(08 Marks)**

8 a. Using Stodola method, find fundamental frequency and mode for the system shown in Fig. Q8 (a). **(12 Marks)**

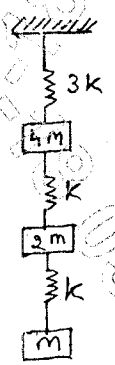

Fig. Q8 (a)

b. A shaft of 50 mm diameter and 3 long is supported at the ends and carrying 3 weights of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from left support. Taking E = 200 GPa find the frequency of transverse vibration. **(08 Marks)**

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