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10AE65

Sixth Semester B.E. Degree Examination, June/July 2017
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain difference between:
(i) Deterministic and Random vibration.
(ii) Linear and non linear vibration.
(iii) Damped and undamped vibration. **(06 Marks)**

b. Add the following harmonic motion analytically and check the solution graphically :
$x_1 = 4\cos(wt + 10^\circ)$ and $x_2 = 6\sin(wt + 60^\circ)$ **(08 Marks)**

c. Derive an expression for equation of motion of a vibratory system by,
(i) Energy method (ii) Rayleigh's method. **(06 Marks)**

2 a. Define and find an expression for undamped natural frequency of a compound pendulum. **(08 Marks)**

b. Find the natural frequency of a effect of mass of spring system as shown in Fig. Q2 (b). **(07 Marks)**

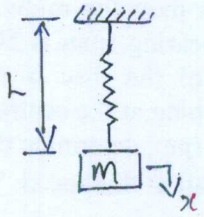

Fig. Q2 (b)

c. Find the natural frequency of the system shown in Fig. Q2 (c). Take $K = 2\times10^5$ N/m and m = 20 kg. **(05 Marks)**

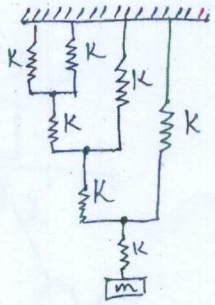

Fig. Q2 (c)

3 a. A door 200 cm high, 75 cm wide and 4 cm thick and weighing 35 kg is fitted with an automobile door closer. The door opens against a spring with a modulus of 1 kg-cm/radian. If the door is opened 90° and released, how long will it take the door to be within 1° of closing? Assume the return spring of the door to be critically damped. **(10 Marks)**

b. Derive an expression for logarithmic decrement of an under damped system. **(06 Marks)**

c. What is damping? Mention different types of damping. **(04 Marks)**

4 a. Obtain the complete response equation for the motion of a spring-mass-doshpot system subjected to a harmonic force $F_0 \sin \omega t$ starting from differential equation of motion. **(10 Marks)**

b. Consider the spring mass system shown in Fig. Q4 (b). The mass is given a velocity of 0.1 m/sec. What will be the subsequent displacement and velocity of the mass if C = 100 N-sec/m, K = 3000 N/m, m = 20 kg, $F \sin \omega t = 0$. Assume initial velocity of the mass as zero. Calculate the steady state response of the mass if $F \sin \omega t = 5 \sin 10t$. **(10 Marks)**

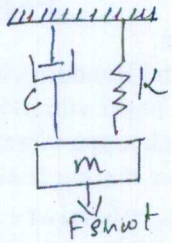

Fig. Q4 (b)

PART – B

5 a. Explain the working of a seismic instrument with a neat sketch. State the conditions for which the instrument functions as
(i) Vibrometer (ii) Accelerometer **(10 Marks)**

b. A disc of mass 4 kg is mounted midway between bearings which may be assumed to be simple supports. The bearing span is 50 cm. The steel shaft is of 10 mm diameter and is horizontal. The C.G. of the disc is displaced 2 mm from the geometric centre. The equivalent viscous damping at the centre of the disc-shaft may be assumed as 50 N-sec/m. If the shaft rotates at 250 rpm, determine the maximum stress in the shaft. Also find the power required to drive the shaft at this speed. Take $E = 1.96 \times 10^{11}$ N/m^2. **(10 Marks)**

6 a. Find the frequencies of the system shown in Fig. Q6 (a). Take K = 90 N/m, $l = 0.25$ m, $m_1 = 2$kg , $m_2 = 0.5$ kg **(10 Marks)**

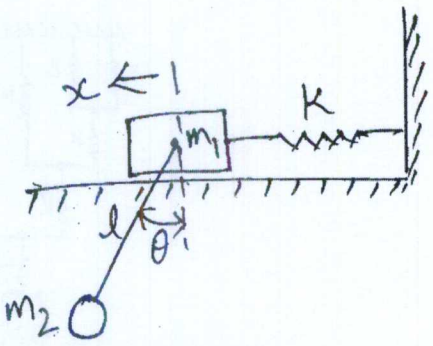

Fig. Q6 (a)

b. Determine the natural frequencies of a co-ordinate coupled system. **(10 Marks)**

7 a. A bar of uniform cross-section having length l is fixed at both ends. The bar is subjected to longitudinal vibrations having a constant velocity V_0 at all points. Derive suitable mathematical expression of longitudinal vibration in the bar. **(10 Marks)**

b. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. **(10 Marks)**

8 a. Use stodola method to find the fundamental mode of vibration of the system shown in Fig. Q8 (a) **(10 Marks)**

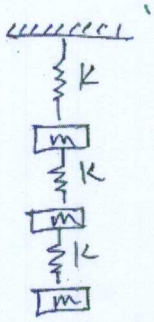

Fig. Q8 (a)

b. A steel shaft of diameter 10 cm is carrying three masses 2.5 kg, 3.75 kg and 7 kg respectively as shown in Fig. Q8 (b). The distances between the rotors are 0.70 m. Determine the natural frequencies of torsional vibrations. The radii of gyration of three rotors are 0.20, 0.30 and 0.40 m respectively. Take $G = 9 \times 10^8$ N/m^2 **(10 Marks)**

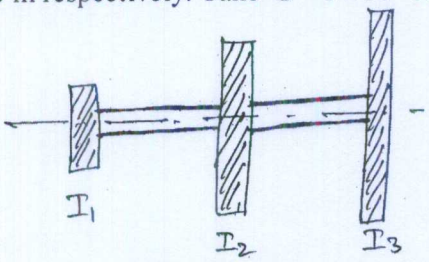

Fig. Q8 (b)

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