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10AE65

Sixth Semester B.E. Degree Examination, July/August 2022
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full 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. Determine the natural frequency of a simple spring mass system by energy method. Also obtain its solution. **(10 Marks)**

b. Determine the differential equation of motion of the system shown in Fig.Q.2(b). Moment of inertia of the mass m and the bar about the pivot point is I_0.

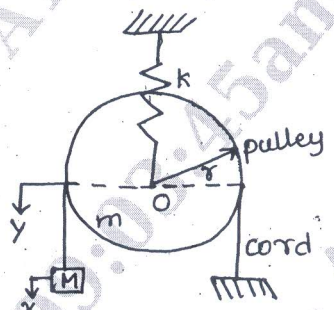

Fig.Q.2(b)

(10 Marks)

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

b. A machine of mass 75 kg is mounted on springs of stiffness 12 kN/cm with an assumed damping factor 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 7.5 cm and a speed 50 Hz. Assuming the motion of the piston to be harmonic determine: i) amplitude of the machine ii) Transmissibility iii) Force transmitted to the foundation iv) The phase angle of the transmitted force with respect to the exciting force. **(10 Marks)**

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 $E = 1.96\times10^{11}$ N/m^2. **(10 Marks)**

6 a. Explain the following :
i) Modes of vibration
ii) Co-ordinate coupling
iii) Vibration absorber **(06 Marks)**

b. Find the natural frequency and amplitude ratio for the system shown in Fig.Q.6(b). Take $m_1 = 10$kg, $m_2 = 15$kg and $k = 320$ N/m. **(14 Marks)**

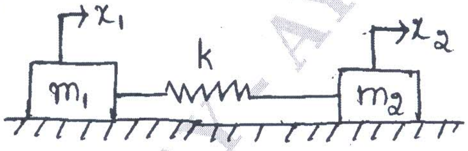

Fig.Q.6(b)

7 a. Derive the general solution of a torsional vibration of rods. **(10 Marks)**

b. Derive suitable mathematical expression for longitudinal vibration of rod of uniform cross section. **(10 Marks)**

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

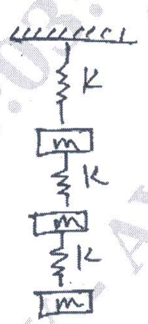

Fig.Q.8(a)

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.Q.8(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 $G = 9\times10^8$ N/m^2 **(10 Marks)**

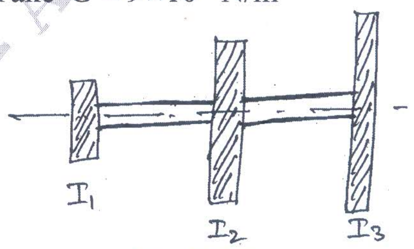

Fig.Q.8(b)

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