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10AE65

Sixth Semester B.E. Degree Examination, Aug./Sept. 2020
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any 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).

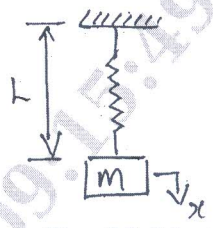

Fig. Q2 (b) **(07 Marks)**

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

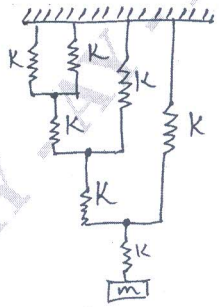

Fig. Q2 (c) **(05 Marks)**

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. With usual notation derive an expression for maximum displacement for a forced vibration of undamped single degree freedom system. **(10 Marks)**

b. A machine of a total mass 68kg mounted on springs of stiffness K = 11,000 N/cm, with an assumed damping factor $\xi = 0.2$. A piston within the machine has a mass of 2kg has a reciprocating motion with stroke 7.5cm and a speed of 3000rpm. Assuming the motion of piston to be SHM. Determine:

i) Amplitude.
ii) Phase angle with respect to exciting force.
iii) Transmissibility and force transmitted to foundation.
iv) Phase angle of transmitted force with respect to exciting force. **(10 Marks)**

PART – B

5 a. With neat sketch, explain the working of seismic instrument. **(08 Marks)**

b. A Frahm's Reed tachometer is used for measuring the frequency of vibration of a system. The reed is at the resonance frequency of 30Hz when a mass of 0.025kg is placed at its end. The length and the thickness of the reed are 60mm and 0.6mm respectively. Determine its width if the Young's modulus of the reed material is 2.1×10^{11} N/m **(06 Marks)**

c. A seismic instrument with a natural frequency of 5Hz is used to measure the vibration of a machine operating at 150rpm. The relative displacement of the seismic mass as read from the instrument is 0.05mm, neglecting air damping, determine the amplitude of vibration of the machine. **(06 Marks)**

6 a. Figure Fig.Q6(a) shows a torsional geared system. Determine:
i) Stiffness of equivalent shaft
ii) Torsional frequency.

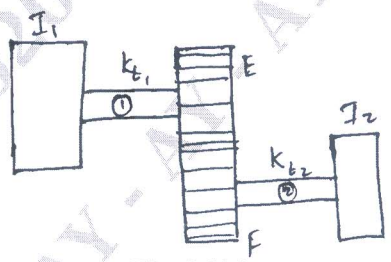

Fig.Q6(a) **(10 Marks)**

b. Derive an expression for the amplitudes of vibration of the two masses shown below in Figure Fig.Q6(b).

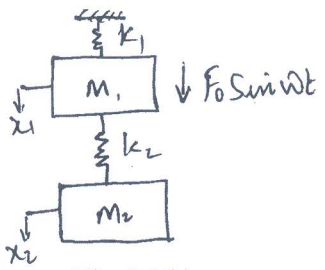

Fig.Q6(b) **(10 Marks)**

7 a. Derive expressions for amplitudes of vibrations of the two masses shown in Fig.Q.7(a). **(10 Marks)**

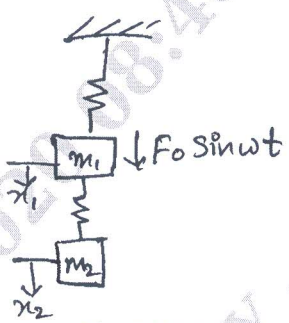

Fig.Q.7(a)

b. A torsional three rotor system is shown in Fig.Q.7(b). Determine i) Differential equation of motion; ii) Frequency equation. **(10 Marks)**

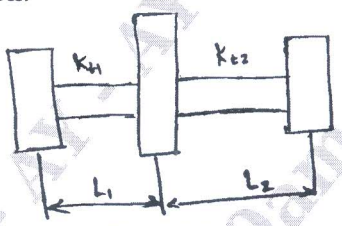

Fig.Q.7(b)

8 a. Explain Dunkerley's method. **(08 Marks)**

b. A shaft of 50 mm diameter and 3 m long is supported at the ends and carries three weights of 1000N, 1500N and 750N at 1m, 2m and 2.5m form the left support. Taking E = 200 GPa, find the frequency of transverse vibrations. (Ref. Figure Fig.Q8(b)).

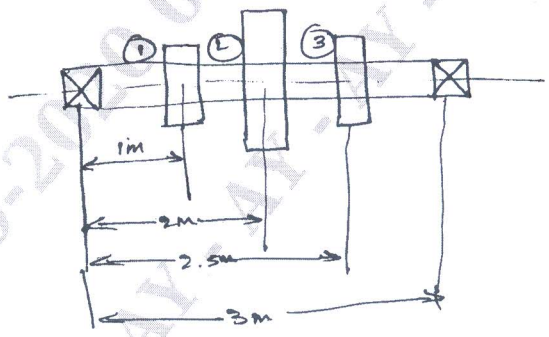

Fig.Q.8(b) **(12 Marks)**

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