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10AE65

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
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. Define the following terms:
i) Natural frequency ii) Degree of freedom iii) SHM **(03 Marks)**

b. Add the following harmonic motions analytically,

$x_1 = 4\cos(\omega t + 20^\circ)$

$x_2 = 7\sin(\omega t + 45^\circ)$ **(07 Marks)**

c. A periodic motion observed on an oscilloscope is shown in Fig. Q1 (c). Represent this motion by a harmonic series. **(10 Marks)**

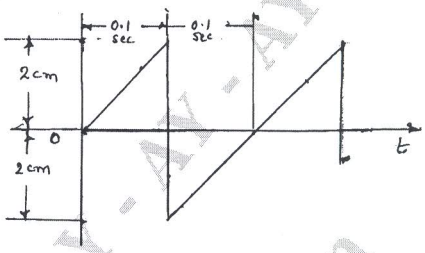

Fig. Q1 (c)

2 a. Find the natural frequency of the system. Shown in Fig. Q2 (a) **(10 Marks)**

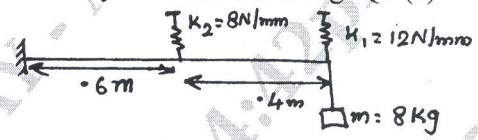

Fig. Q2(a)

b. Find the natural frequency for system shown in Fig. Q2(b). **(10 Marks)**

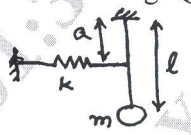

Fig. Q2(b)

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-dashpot system subjected to a harmonic force $F_0 \sin \omega t$ starting from differential equation of motion. **(10 Marks)**

b. A TV set of 30 kg mass must be isolated from a machine vibrating with an amplitude of 0.001 m at 1500 rpm. The set is mounted on 5 isolators (mounted in parallel) each having certain stiffness and damping constant values. If the amplitude of vibration of the TV set is measured as 0.0004 m, determine the damping constant values and the stiffness of each isolator assuming that they are connected in parallel and the damping ratio of the system is 0.048. Also determine the dynamic load on each isolator. **(10 Marks)**

PART – B

5 a. Derive an expression for critical speed of shaft. Explain the situation through which shaft deformation goes, when shaft speed is increased gradually to speed much above critical speed from rest. **(12 Marks)**

b. Simply supported shafts at its 2 ends carry a mass at its centre with an eccentricity of 0.4mm. Determine the critical speed of shaft and permissible range of speed, if maximum stress permitted for shaft material is 70Mega Pascals. **(08 Marks)**

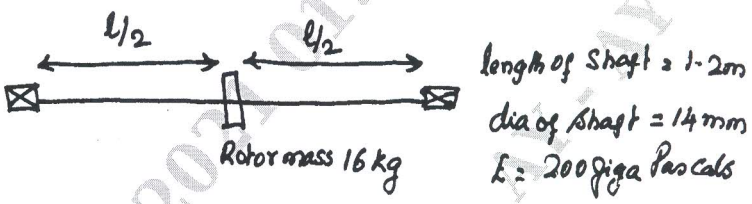

Fig. Q5(b)

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)**

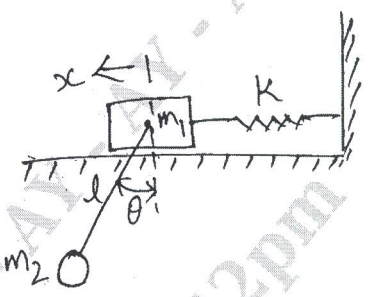

Fig. Q6 (a)

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

7 a. Derive frequency equation for a beam with
i) both ends free and having transverse vibrations.
ii) one end free and other end fixed and having transverse vibrations. **(12 Marks)**

b. 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 mathematical expressions of longitudinal vibrations in bar. **(08 Marks)**

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

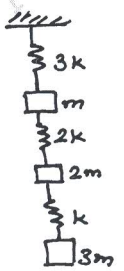

Fig. Q8 (a)

b. A shaft 180mm dia is supported at 2.5m apart. It carries three discs of weight 2500N, 500N and 2000N at 0.6m, 1.5m and 2m from left end. Assume shaft weight to be 1900N/m and E = 200GPa. Determine the natural frequency of transverse vibration. **(08 Marks)**

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