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10AE65

Sixth Semester B.E. Degree Examination, June/July 2015
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

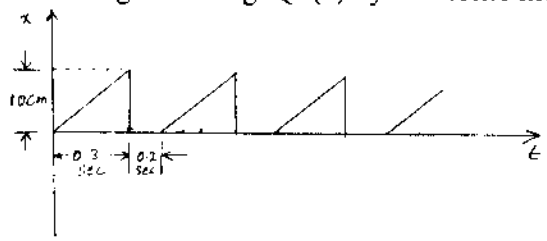
PART – A

1 a. Explain the following terms with a neat sketch : i) phase difference ii) SHM. **(06 Marks)**

b. Split the harmonic motion $x = 10 \sin (wt + \pi/6)$ into two harmonic motions, one having a phase angle of zero and the other of 45^0, by graphical method. **(04 Marks)**

c. Represent the periodic motions given in fig. Q1(c) by harmonic motion. **(10 Marks)**

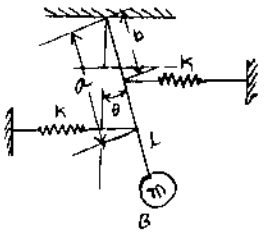
Fig.Q1(c)



2 a. What is undamped free vibration? Obtain the solution of differential equation $m\ddot{x} + kx = 0$, applying the initial boundry conditions. **(04 Marks)**

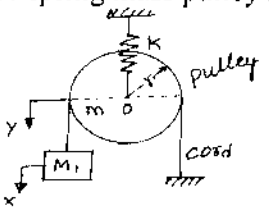
b. Calculate the natural frequency of the system shown in the fig. Q2(b), if the mass of the rod is negligible compared to the mass 'm'. **(06 Marks)**

Fig.Q2(b)



c. Using energy method, find the natural frequency of system shown in fig. Q2(c). The cord may be assumed inextensible in the spring mass pulley system and no slip. **(10 Marks)**

Fig.Q2(c)

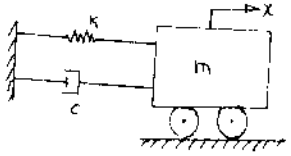


3 a. What is Damping? What are the uses of critical damping? Explain. **(04 Marks)**

b. What is damped natural frequency? Sketch the time – displacement plot for the three cases of damped free vibration. **(04 Marks)**

c. Find the equation of motion for the system shown in fig. Q3(c) 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 3cm and released. **(12 Marks)**

Fig.Q3(c)



4 a. Explain vibration isolation with its basic requirements. **(04 Marks)**

b. What are the materials used for vibration isolation? Enumerate the properties of these materials. **(06 Marks)**

c. The weight of an electric motor is 125kg and it runs at 1500 rpm. The armature weighs 35kg and its centre of gravity lies 0.05cm from its axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one – eleventh of the impressed force. Assume that the weight of the motor is equally distributed among the five springs. Determine i) Stiffness of each spring ii) Dynamic force transmitted to the base at operating speed iii) Natural frequency of the system. **(10 Marks)**

PART - B

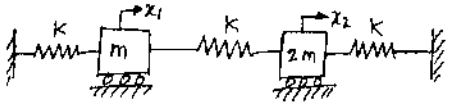
5 a. Obtain an expression for the critical speed of a shaft with damping. **(10 Marks)**

b. The rotor of a turbo super charger weighing 9 kg is keyed to the centre of a 25mm diameter steel shaft of length 40cm, between bearings. Determine
i) the critical speed of shaft ii) the amplitude of vibration of the rotor at a speed of 3200 rpm, if the eccentricity is 0.015mm iii) the vibratory force transmitted to the bearing at this speed. Assume the shaft to be simply supported and that the shaft material has a density of $8gm/cm^3$. Take $E = 2.1 \times 10^6 kg/cm^2$. **(10 Marks)**

6 a. Write short notes on : **(06 Marks)**
i) Dynamic vibration absorber ii) Principal modes and normal modes of vibration.

b. Find the natural frequency and amplitude ratio of the system shown in fig. Q6(b). **(14 Marks)**

Fig.Q6(b)

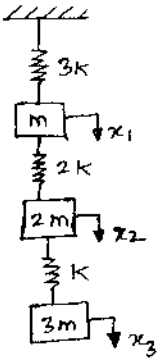


7 a. What are continuous systems? Derive the one dimensional wave equation for lateral vibration of a string. **(10 Marks)**

b. Find the frequency equation of a uniform beam fixed at one end and free at the other for transverse vibration. **(10 Marks)**

8 a. Determine the influence co-efficients of the spring mass system shown in fig. Q8(a). **(04 Marks)**

Fig.Q8(a)



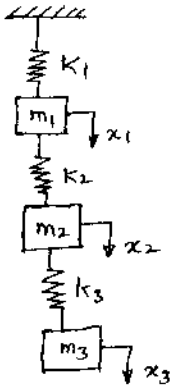


Fig.Q8(b)

b. Determine the natural frequency of the spring mass system shown in fig. Q8(b). Take $m_1 = m_2 = m_3 = m$ and $k_1 = k_2 = k_3 = k$. Use Stodola's method. **(16 Marks)**

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