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10AU73

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Add the following harmonic motions analytically and check the solution graphically:
$x_1 = 4\cos(\omega t + 10^\circ)$ and $x_2 = 6\sin(\omega t + 60^\circ)$ **(10 Marks)**

b. With a neat sketch, explain Beat phenomenon. **(06 Marks)**

c. Explain the following: (i) Linear and Non-linear vibration.
(ii) Transverse and Torsional vibrations. **(04 Marks)**

2 a. Find the natural frequency of torsional vibrations for the system shown in Fig. Q2 (a). Neglect the inertia effect of the shaft. Take $G = 0.80 \times 10^{11}$ N/m^2. **(06 Marks)**

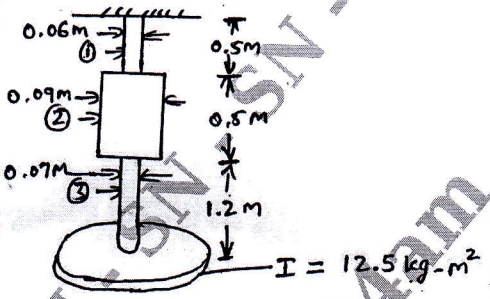

Fig. Q2 (a)

b. Find the natural frequency of vibration of the system for small amplitudes. If K_1, K_2, a and b are fixed, determine the value of 'b' for which the system will not vibrate. Find maximum acceleration of the mass. The system is shown below: **(10 Marks)**

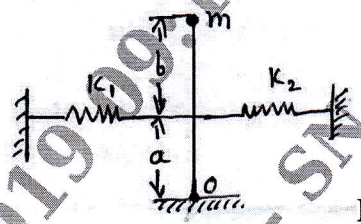

Fig. Q2 (b)

c. A mass is suspended from a spring system as shown in Fig. Q2 (c). Determine the natural frequency of the system. Given $K_1 = 5000$ N/m, $K_2 = K_3 = 8000$ N/m, m = 25 kg **(04 Marks)**

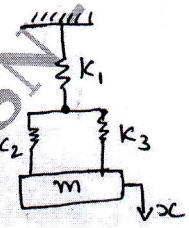

Fig. Q2 (c)

3 a. A Gun barrel of mass 600 kg has a recoil spring of stiffness 294000 N/meter. If the barrel recoils 1.3 m on firing, determine (i) the initial recoil velocity of the barrel. (ii) the critical damping co-efficient of the dashpot which is engaged at the end of recoil stroke. (iii) the time required for the barrel to return to a position 5 cm from initial position. **(10 Marks)**

b. Derive the expression for the logarithmic decrement 'δ'. **(10 Marks)**

4 a. An engine weighing 1000 N including reciprocatory parts is mounted on springs. The weights of the reciprocating parts is 22 N and the stroke is 90 mm. The engine speed is 720 rpm, (i) Neglecting damping, find the stiffness of the springs, so that the force transmitted to the foundation is 5% of the amplitude force (ii) If under the actual working condition the damping reduces the amplitude of successive vibration by 25%, determine the force transmitted at 720 rpm. **(10 Marks)**

b. A machine of mass one tonne is acted upon by an external force of 2450 N at a frequency of 1500 RPM. To reduce the effects of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine
   (i) Force transmitted to the foundation.
   (ii) Amplitude of vibration of the machine.
   (iii) Phase lag of the transmitted force with respect to the external force. **(10 Marks)**

PART – B

5 a. With sketch, explain the following: (i) Vibrometer (ii) Fullarton Tachometer. **(12 Marks)**

b. A vibration pick up has a natural frequency of 7.5 Hz and a damping factor of 0.5. Determine the lowest frequency beyond which the amplitude can be measured within 1% error. **(08 Marks)**

6 Use Lagrange's equation to find equations of motion for a system shown in Fig. Q6 (a). **(20 Marks)**

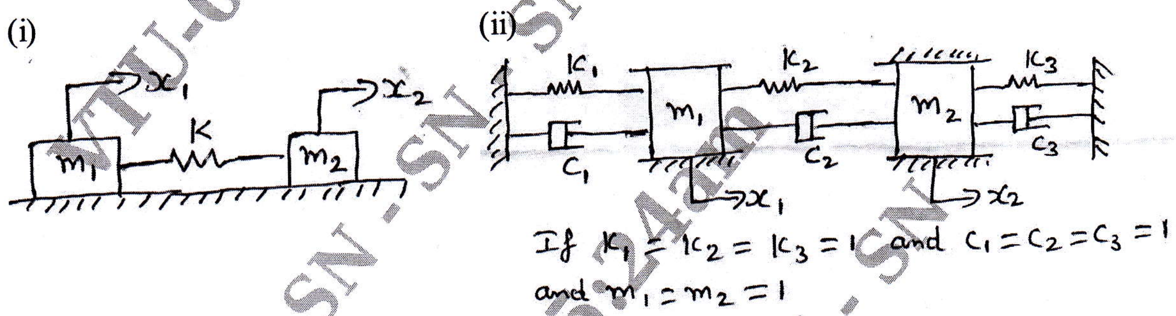

Fig. Q6

7 a. With the help of Graph explain vibration due to Road Roughness. **(10 Marks)**

b. An engine weighing 1785.4 N is to be supported on four helical springs. When the engine speed is 900 RPM there is a primary vertical distributing force of maximum value 312 N due to the unbalanced reciprocating weights. Assuming that the engine vibrates in the vertical direction with neither horizontal nor angular movement, find the stiffness of each spring in N/m of deflection to limit the maximum total periodic force on the foundations to 21.3 N. What will be the amplitude of vibration of the engine when its speed is 600 rpm? **(10 Marks)**

8 a. Determine the influence co-efficients for the system shown in Fig. Q8 (a). **(12 Marks)**

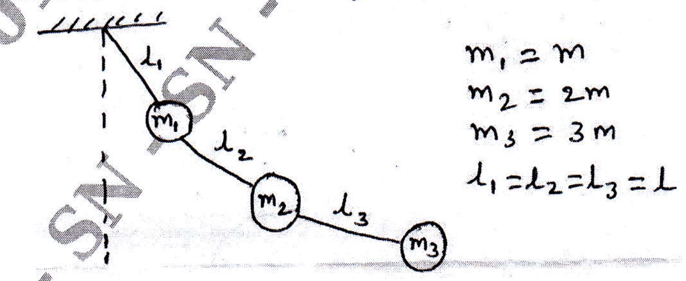

Fig. Q8 (a)

b. Derive the expression for natural frequency by Dunkerley's method. **(08 Marks)**

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