Con. 6536-11. sem VI / mech / machanical vibration. MP–3487

(3 Hours) 10-12-11 [Total Marks : 100

N.B. : (1) Question No.**1** is **compulsory**.
(2) Attempt any **four** questions from remaining **six** questions.
(3) Assume **suitable** data wherever required with **justification**.
(4) **Figures** to the **right** indicate **full** marks.

1 Solve any four of the following: 20

(a) Explain why mechanical vibration is an important area of study for engineers. Mechanical vibrations are known to have harmful effects as well as useful ones. Briefly describe five practical examples of "good vibrations" and five practical examples of "bad vibrations".

(b) Discuss why natural oscillations in a mechanical system are governed by energy conversion

(c) Explain different methods of formulation of differential equation of a vibrating system.

(d) What do you mean by Static Balancing and Dynamic Balancing? What are the necessary conditions to achieve them?

(e) Write short note on Coulomb Damping

(f) Write short note on—Jump Phenomenon in Cam-Follower system.

2 (a) Derive the equation of motion for the system shown in Fig.1 using Lagranges's Equation using Θ_1 and Θ_2 as generalized coordinates 10

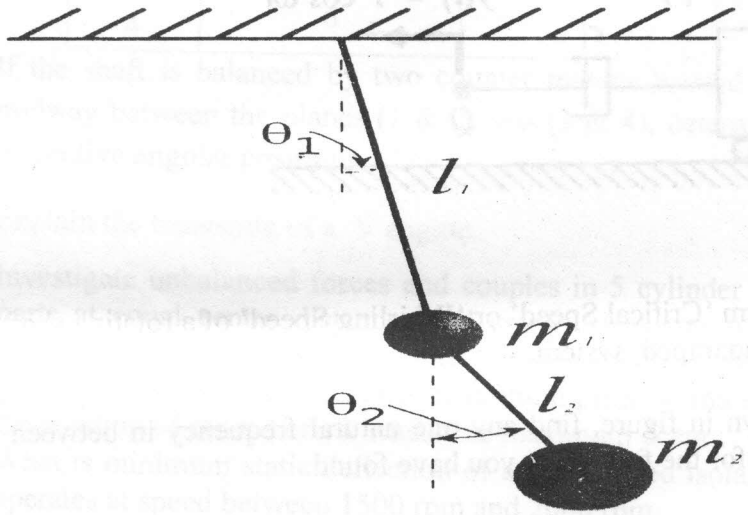

Figure 1

(b) Derive the equation of motion and find the natural frequency of vibration for the system shown in Fig.2 10

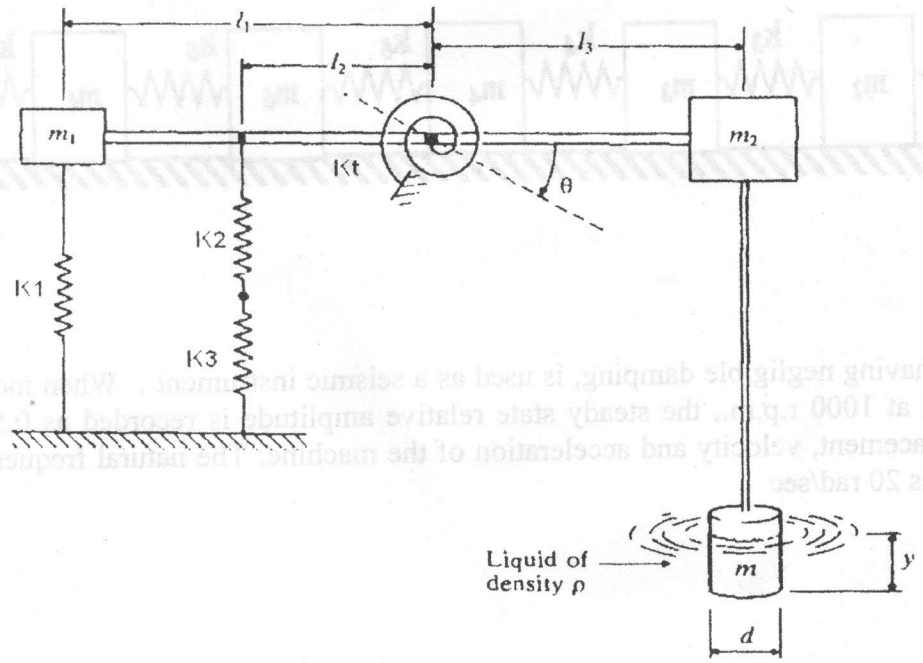

Figure 2

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3 (a) Find the Eigen values and Eigen vectors of the system shown in fig3

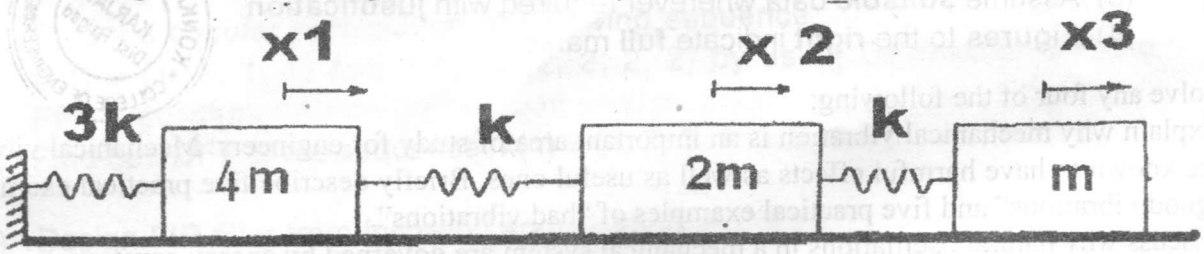

Figure 3

(b) Draw the mode shape for the for lowest value of Eigen value obtained in question 3 (a) 5

4 (a) Determine the steady state response of mass m for the system shown in fig 4. 10

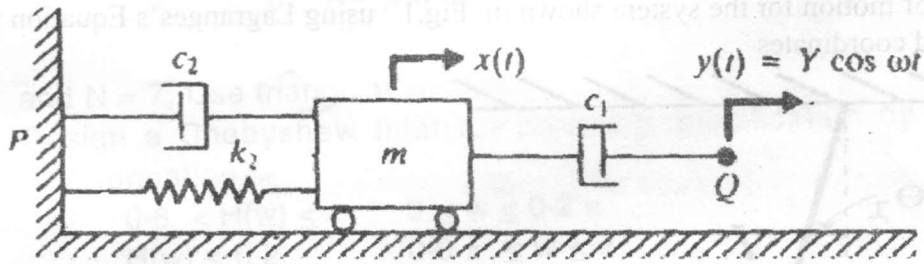

Figure 4

(b) Explain what do you mean by the term 'Critical Speed' or 'Whirling Speed' of a rotating shaft? Derive the necessary formulae for undamped system. 10

5 (a) For the spring-mass system as shown in figure, find any one natural frequency in between 8 rad/s and 12 rad/s. Draw the mode shape for the frequency you have found. 14

Take $k_1 = k_7 = 0$

$k_2 = k_3 = k_4 = k_5 = k_6 = 1$ N/cm

$m_1 = m_2 = m_3 = m_4 = m_5 = m_6 = 1$ kg.

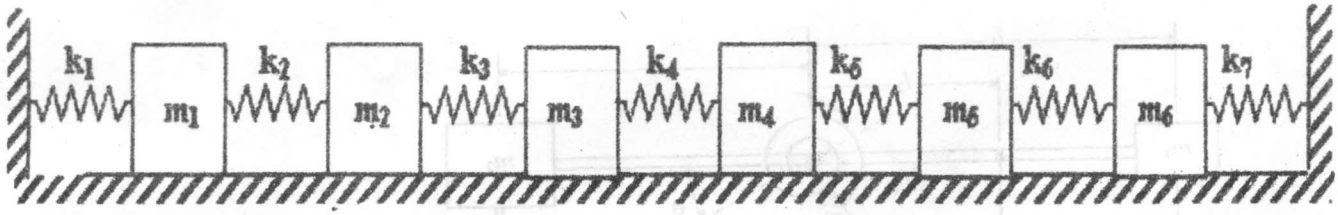

Figure 5

(b) A spring-mass system, having negligible damping, is used as a seismic instrument . When mounted on a machine operating at 1000 r.p.m., the steady state relative amplitude is recorded as 0.5 mm. Find the values of displacement, velocity and acceleration of the machine. The natural frequency of the seismic instrument is 20 rad/sec 6

6 (a) A rotor has the following properties — 14

Mass	Magnitude (kg)	Radius (cm)	Angle (degrees) With respect to mass 1	Axial Distance from 1st Mass (cm)
1	9	10	0	0
2	7	12	60	16
3	8	14	135	32
4	6	12	270	56

If the shaft is balanced by two counter masses located at 100 mm radii and revolving in planes midway between the planes (1 & 2) and (3 & 4), determine the magnitude of the masses and their respective angular positions.

(b) Explain the balancing of a V engine. 06

7 (a) Investigate unbalanced forces and couples in 5 cylinder inline engine having similar reciprocating parts at equal centre distances and cranks successively at 72° apart. If reciprocating mass per cylinder is 2 kg and crank radius 50 mm, connecting rod length 150 mm and cylinder centre distances are 100 mm, determine maximum primary and secondary unbalance at 150 r.p.m. and state the position of central crank when this maximum occur.. 12

(b) What is minimum static deflection of an undamped isolator to provide 75 % isolation to pump that operates at speed between 1500 rpm and 2000 rpm. 8