(3 Hours) [Total Marks: 80]

N.B. 1) Question No. 1 is **compulsory**

2) Answer any **Three** questions from remaining **Five**

3) Assume suitable data wherever required, justify the same

4) Answer to questions showed be grouped and written together.

1		Solve **any Four**	20
	a	A spring mass system has natural frequency of 12 Hz. When the spring constant is reduced by 800 N/m, the frequency is changed by 50%. Determine the mass and spring constant of original system	
	b	A 5 kg mass attached to the lower end of a spring, whose upper end is fixed, vibrates with a natural period of 0.45 sec. determine the natural period when a 2.5 kg mass is attached to the mid-point of the same spring with the upper and lower end fixed.	
	c	Prove that the loss of amplitude per cycle = 4F/k, in case of coulomb damping. Where F – friction force, k – spring stiffness.	
	d	Discuss how a single revolving mass is balanced by two masses revolving in different planes.	
	e	A single DOF system consists of a mass of 20 kg and a spring stiffness 4000 N/m. the amplitude of successive cycles are found to be 50, 45, 40, 35 ……mm. determine the nature and magnitude of the damping force and frequency of damped vibrations.	
2	a	A 2.5kg slender bar of length 40 cm is pinned at one end. A 3 kg particle is to be attached to the bar. How far from the pin support should the particle be placed such that period of bar's oscillation is 1 sec.?	10
	b	A door 200 cm high, 75 cm wide and 4 cm thick and weighing 35 kg is fitted with an automatic door closer. The door opens against a spring with a modulus of 1 kg-cm/radian. If the door is opened 90^0 and released, how long will it take the door to be within 1^0 of closing? Assume the return spring of the door to be critically damped.	10
3	a	A thin disk of mass 0.8 kg and radius 60 mm is attached to the end of a 1.2 m steel (G= 80×10^9 N/m^2, ρ = 7500 kg/m^3) shaft diameter 20 mm. the disk is subjected to harmonic torque of amplitude 12.5 N-m at a frequency of 700 rad/s. what is the steady state amplitude of angular oscillations of the disk?	12
	b	A seismic instrument is mounted on a machine running at 1000 rpm. The natural frequency of the seismic instrument is 20 rad/sec. the instrument records relative amplitude of 0.5 mm. Compute the displacement, velocity and acceleration of machine. Damping in seismic instrument is neglected.	08
4	a	A radio set of 20 kg mass must be isolated from a machine vibrating with amplitude of 0.05 mm at 500 rpm. The set is mounted on four isolators, each having a spring scale of 31,400 N/m and damping coefficient 392 N sec/m. i) What is the amplitude of vibration of the radio? ii) What is the dynamic load on each isolator due to vibration?	10
	b	A steel shaft of diameter 10 cm is carrying three masses 2.5 kg, 3.75 kg and 7 kg respectively as shown in Fig. 1. The distance between the rotors is 0.7 m. determine the natural frequencies of torsional vibrations. The radii of gyration of three rotors are 0.20, 0.30 and 0.40m respectively. Take G = 9×10^8 N/m^2.	10

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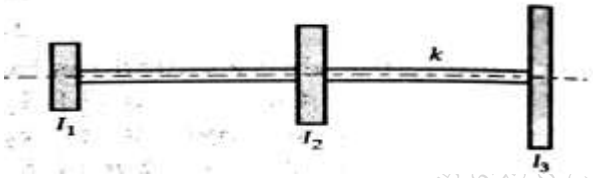

Fig. 1

5 a Determine the natural frequency of vibration for a system in Fig. 2. Take mass of the beam as 5 kg. 08

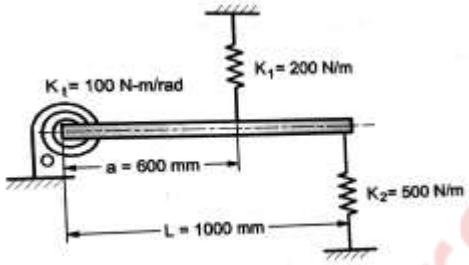

Fig. 2

b Fig.3 Shows the arrangement of the cranks in a four crank symmetrical engine in which the masses of the reciprocating parts at cranks 1 and 4 are each equal to m_1 and at cranks 2 and 3 are each equal to m_2. 12

Show that the arrangement is balanced for primary forces and couples and for secondary forces provided for that

$\frac{m_1}{m_2} = \frac{cos\theta_2}{cos\theta_1}$; $\frac{a_1}{a_2} = \frac{tan\theta_2}{tan\theta_1}$, and $\cos\theta_1 \times \cos\theta_2 = \frac{1}{2}$

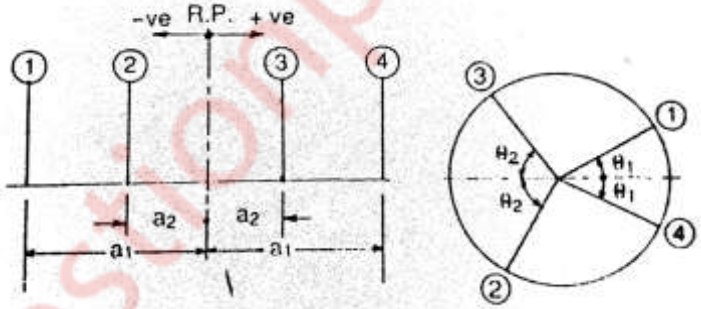

Fig. 3

6 a A centrifugal blower rotating at 400 rpm is driven by an electric motor running at 1200 rpm through a single stage reduction gear. Moments of inertia of the blower rotor and the motor are 1500 kg-m^2 and 450 kg-m^2 respectively. Lengths of the rotor shaft and motor shaft are 500 mm and 200 mm respectively and their diameters are 100 mm and 50 mm respectively. Neglecting inertia of the gears, find the frequency of torsional vibrations of the system. Take G = 85 x 10^9 N/m^2. 12

b A spring mass system with mass m kg and stiffness k N/m has a natural frequency of f Hz. Determine the value of the stiffness k' of another spring which when arranged in conjunction with spring of stiffness k in series will lower the natural frequency by 20% and in parallel will raise the natural frequency by 20%. 08

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