Sem VI / Mech-Auto / CBSGS / ND-16 / Mech Vibration

QP Code : 601201

(REVISED COURSE)
(3 Hours) **[Total Marks : 80**

N.B.: (1) Ques ion No.1 is compulsory.
(2) Answer **any three** questions from remaining questions.
(3) Assume suitable data if required.
(4) Figures to the right indicate full marks.

1. Solve **any Four**

a) A single DOF system consists of a mass of 20 kg and a spring of stiffness 4000 N/m. The amplitude of successive cycles are found to be 50, 45, 40, 35 ..... mm. Determine the nature and magnitude of damping force and frequency of damped vibrations. **5**

b) For the system shown in Fig. 1, the characteristic of the dashpot is such that when constant force of 49 N is applied to the piston its velocity is found to be constant at 0.12 m/sec. (a) Determine the value of C (b) Would you expect the complete system to be periodic or aperiodic? **5**

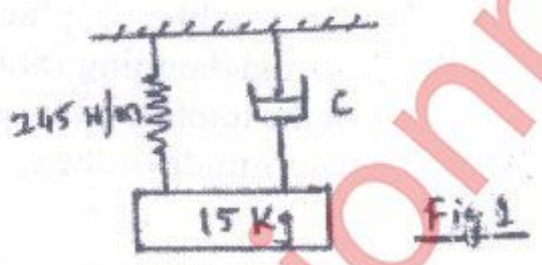

Fig 1

c) A vertical spring mass system has a mass of 0.5 kg and an Initial deflection of 0.2 cm. Find the spring stiffness and natural frequency of the system. **5**

d) Prove that an undamped measuring Instrument will show a true response for frequency ratio $(\omega/\omega_n) = 1/\sqrt{2}$. **5**

e) Explain what do you mean by the term 'Critical Speed' of rotating shaft? Derive necessary formulae for undamped system. **5**

2. a) Three rail bogies are connected by two springs of stiffness 40×10^5 N/m each as shown In Fig. 2. The mass of each bogey is 20×10^3 kg Determine the frequencies of vibration. Neglect friction between the wheels and the rails. **10**

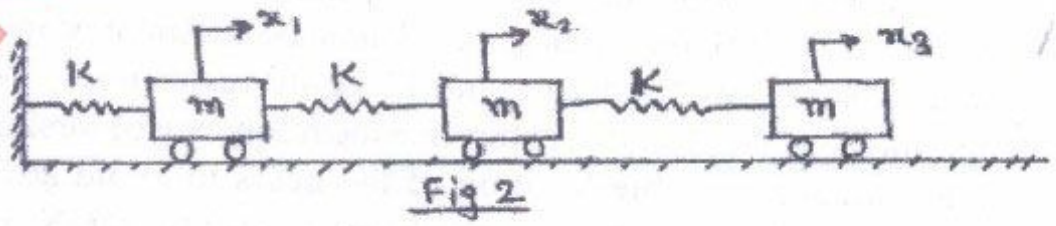

Fig 2

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b) The sph re of diameter D floats half submersed in water. If sphere is depress l slightly and released. Determine the period of vibration. What is time period if D = 1m. **10**

3. a) Derive the equivalent system parameters of the following Fig. 3, taking x as the generalized coordinate **10**

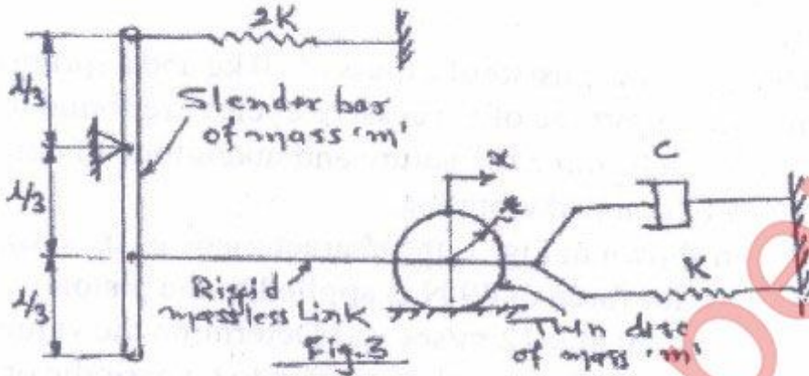

Fig.3

b) A 400 kg tumbler with a 0.45 kg-m rotating unbalance operates at speeds between 400 and 600 rpm. If the tumbler is placed on an elastic foundation of stiffness 1 x 10^6 N/m and damping ratio 0.1, What is the maximum steady state amplitude of the tumbler over its operating range? For what speeds will steady state amplitude of the tumbler be less than 1.9 mm? **10**

4. a) A vehicle has a mass of 1200 kg. The suspension system has a spring constant of 400 kN/m and damping ratio 0.5. If the vehicle speed is 100 km/hr, determine the displacement amplitude of vehicle. The road surface varies sinusoidally with an amplitude of 0.05 m and wavelength of 6m. **10**

b) An aircraft radio weighing 118N is to be isolated from engine vibrations ranging in frequency from 1600 to 2200 rpm. What static deflection must the isolator have for 85% isolation? **10**

5. a) A 12 cylinder aero engine drives an air screw through gearing. The air screw runs at 0.6 times the speed of the engine. The shaft from the engine to the pinion is 1000 mm and of 70 mm diameter. The screw shaft is 650 mm long and 90 mm in diameter. The mass moment of inertia of engine and air screw are 0.5 kg-m^2 and 15 kg-m^2 respectively. Neglecting the inertia of gear and shafts, determine the frequency of torsional vibrations. Also suggest suitable location of the gears to avoid adverse effect of torsional vibrations. Assume modulus of rigidity 80 GN/m^2. **14**

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b) Explain the balancing of v- engine. 6

6. a) The reciprocating masses of first three cylinders of 11 four cylinder engine are 4.1, 6.2 and 7.4 tonnes respectively. The Centre lines of three cylinders are 5.2 m, 3.2 m and 1.2m from the fourth cylinder. If the cranks for all cylinder are equal, determine the reciprocating mass of 4th cylinder and angular position of crank such that the system is completely balanced for the primary force and couple. If the crank radius 80 cm, connecting rod 3.8 m, and speed of engine 75 rpm, find the maximum unbalanced secondary force and crank angle at which it occurs. 12

b) Find out natural frequency of system shown in Fig.4, $m_1 = 10$ kg, $m_2 = 15$ kg and $k = 320$ N/m by Lagrange's equation. 8

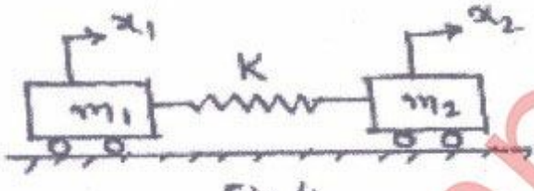

Fig.4