Printed Pages : 7

EME024

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140658

Roll No.

B. Tech.

(SEM. VI) THEORY EXAMINATION, 2014-15

MECHANICAL VIBRATIONS

Time : **3** Hours] [Total Marks : **100**

Note: Attempt all questions of the following :

1 Attempt any two questions.

(a) Add the following harmonic motions analytically and check the solution graphically. $X_1 = 2 \cos (wt+0.5)$; $X_2 = 5 \text{ Sin } (wt+ 1.0)$. **10**

(b) Derive an expression for the longitudinal vibration of a uniform bar of length L, one end of which is fixed and other end is free. **10**

(c) A cylinder of mass m and mass moment of inertia J_0 is free to roll without slipping but is restrained by two springs of stiffnesses k_1 and k_2 as shown in Fig. 1. Find its natural frequency **10**

of vibration. Also find the value of 'a' that maximizes the natural frequency of vibration.

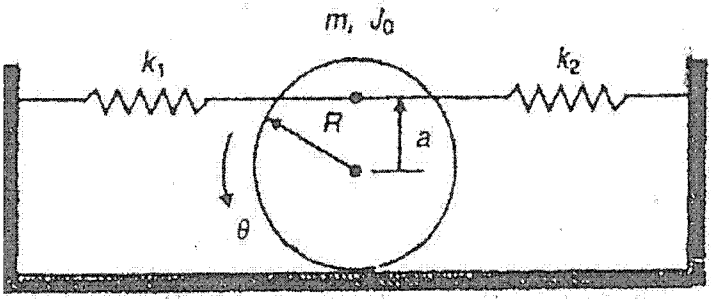

Fig. 1

2 Explain any four of the following: 5×4=20

(a) Coordinate coupling,

(b) Damping,

(c) Orthoganality principle,

(d) Influence coefficient,

(e) Dunkerley's method.

3 Attempt any two questions :

(a) The damped vibration record of a spring-rnass-dashpot system shows the following data : **10**

Amplitude on second cycle = 1.20 cm

Amplitude on third cycle = 1.05 cm

Spring constant, k = 7840N/m

Mass on the spring, M = 2kg

Determine the damping constant, assuming it to be viscous.

(b) An aircraft instrument of mass 10 kg is to be isolated from the engine vibrations. The engine runs at speeds ranging from 1800 rpm to 2500 rpm. Natural rubber isolators with negligible damping are used. Determine the rubber stiffness for 90% isolation. **10**

(c) A cylinder of weight w and radius r rolls without slipping on a cylindrical surface of radius R, as shown in Fig. 2. Determine its differential equation of motion for small oscillations about the lowest point. **10**

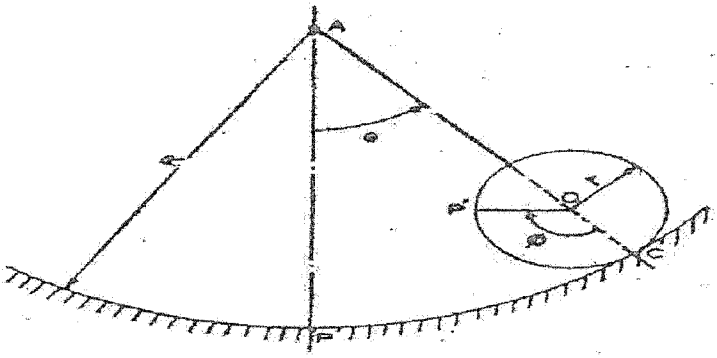

Fig. 2

4 Attempt any two questions :

(a) The static deflection of an automobile on its springs is 100 mm. Find the critical speed when the automobile is travelling on a road, which can be approximated by a sine wave of amplitude 80 mm and wavelength of 16 m. Assume the damping to be given by $\xi = 0.05$. Also determine the amplitude of vibration at 75 km/hr. (Ref. fig. no. 3) **10**

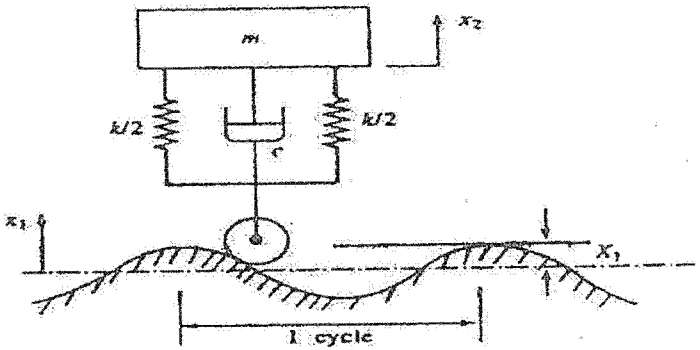

Fig. 3

(b) Figure no. 4 shows a double pendulum. Determine the natural frequencies of the oscillation when $m_1 - m_2 = m$ and $L_1 = L_2 = L$. **10**

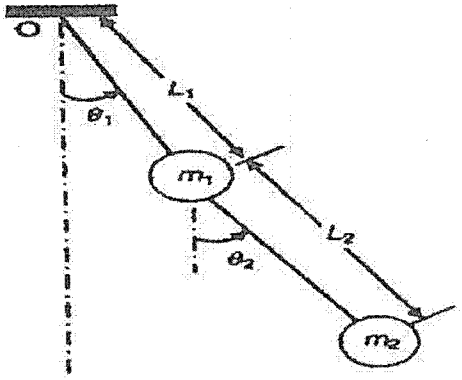

Fig. 4

(c) For the system shows in Fig.no.5, determine the natural frequencies and corresponding modes by using Holzer's method.

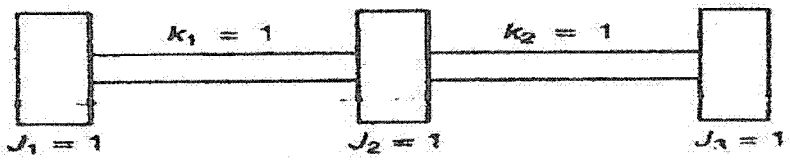

Fig. 5

5 Attempt any two questions :

(a) (i) Explain the Maxwell's reciprocal theorem and D. Alembert's principle. **5×2=10**

(ii) A commercial type of vibration pickup has a natural frequency of 6 Hz and a damping factor of 0.65. What is the lowest frequency beyond which the amplitude can be measured within one percent error?

(b) A rotor having a mass 5 kg is mounted midway on a 10 mm diameter shaft supported at the ends by two bearings. The bearing span is 400 mm. Because of certain manufacturing inaccuracies, the c.g. of the disc is 0.02 mm away from the geometric centers of the rotor. If the system rotates at 3000 rpm, find the amplitude of steady state vibrations and dynamic force transmitted to the bearing. Neglect damping and take $E = 1.96 \times 10^{11}$ N/m^2. Assume the shaft to be simply supported. **10**

(c) A mild steel shaft of 10 mm dia is built into walls at both ends. It carries two flywheels, each at 0.25 m from a wall and also 0.25 m from each other, of steel 0.3 mm in diameter and thick. Find the two natural frequencies in torsion. **10**