No. of Pages: 2

B

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2017

Mechanical Engineering

(Machine Design)

01ME6101 Advanced Theory of Vibration

Max. Marks : 60 Duration: 3 Hours

Answer any two full questions from each part
Limit answers to the required points.

PART-A

1.a) Show that for finding the natural frequency of vibration of a spring mass system, the mass of the spring can be taken into account by adding one third of its mass to the main mass. (4 Marks)

b) A homogeneous cylinder of mass 'm' and radius 'r' is linked by a spring of stiffness 'k' N/cm and is resting on an inclined plane as shown in fig. Assume the cylinder rolls without slipping evaluate the frequency of oscillation for small angle of oscillation. (5 Marks)

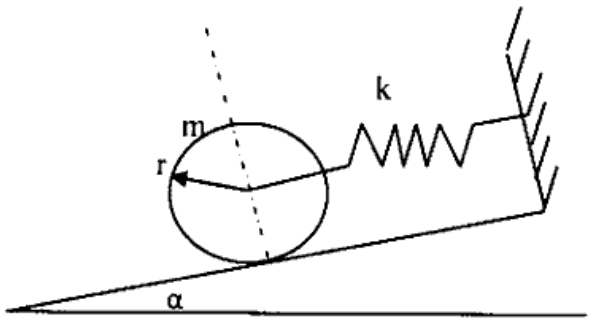

Fig. 1

2. a) Show that accelerometer is an instrument with high natural frequency and seismograph is an instrument with low natural frequency. (4 Marks)

b) Determine the normal modes of vibration of an automobile simulated by the simplified two DOF system with the following assumed numerical values ?

Total mass : 1500 Kg, C.G Located at 1.8 m from front axle and 1.5 m from rear axle. Equivalent stiffness at front and rear tyre is 380 N/cm and 360 N/cm respectively. Radius of gyration : 1.2 m (5 Marks)

3.a) Two equal mass m are attached to light string with tension T. Find the normal mode frequencies of the system shown in Fig-1 .

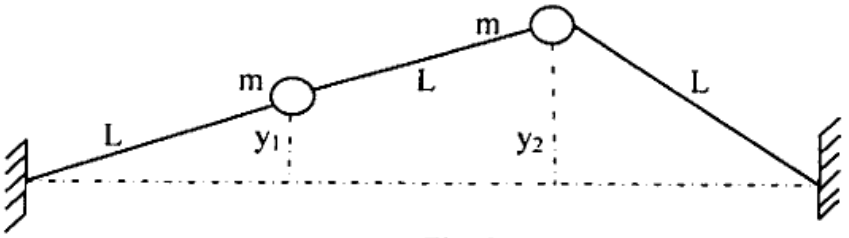

Fig. 2

(4 Marks)

b) An air compressor of 500 kg operates at a constant speed of 1750 rev/min. Rotating parts are well balanced. The reciprocating part is 10 kg and crank radius is 100 mm. The mounting introduces an effective damping of damping factor 0.15. Specify the spring for the mounting such that only 18% of the unbalanced force is transmitted to the foundation. Also determine the amplitude of transmitted force

(5 marks)

Part B

4. Determine the matrix equation of motion of the system shown in Fig 3 using stiffness formulation and hence find its Eigen values and Eigen vectors

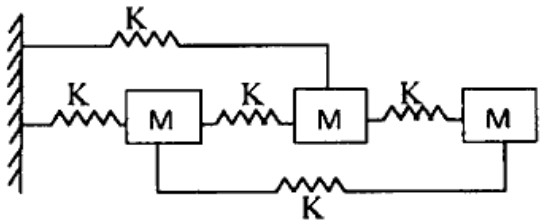

Fig - 3

(9 Marks)

5. Determine the equation of motion and natural frequencies and normal modes of a fixed free uniform rod shown in Fig 4 using assumed modes $\varphi(x) = \frac{2x}{L}$ and $\varphi(x) = \left(\frac{2x}{L}\right)^2$

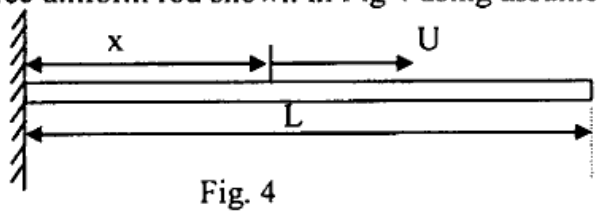

Fig. 4

(9 Marks)

6. The stiffness matrix of system is given below. Determine the Choleski decomposition matrix U and U^{-1}

$$K = k\begin{bmatrix} 3 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{bmatrix}$$

(9 marks)

PART C

7 a) Obtain the differential equation for the lateral vibration of beams assuming flexural rigidity is constant. (8 marks)

b) Write the computational procedure for Holzer's method for determining the natural frequency of a torsional system (4 marks)

8. Discuss the Rayleigh method for finding fundamental natural frequency of a Multi D.O F system and evaluate the fundamental natural frequency of a simply supported beam of span 'l' and mass 'm'. (12 marks)

9.a) Derive the equation for the natural frequencies of a uniform cord of length L fixed at the two ends and subjected to a uniform tension 'T'. Assume mass per unit length as 'ρ'

(6 marks)

b) Obtain the transfer function for a torsional system with three identical rotors connected by shafts of stiffness 'k' (6 marks)