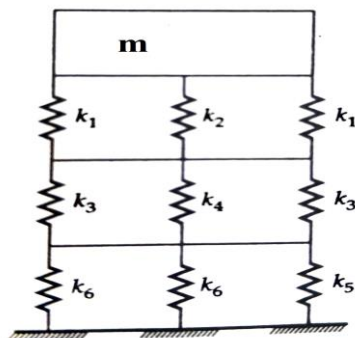


GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI (NEW) EXAMINATION – SUMMER 2024****Subject Code:2161901****Date:28-05-2024****Subject Name:Dynamics of Machinery****Time:10:30 AM TO 01:00 PM****Total Marks:70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1**
- (a) Explain the three basic types of free vibrations. 3
- (b) Differentiate between static balancing and dynamic balancing. 4
- (c) Determine the magnitude and angular position of balance masses rotating at a radius of 100 mm in the planes X & Y which are 400 mm away from each other. A shaft carries four masses L, M, N and O of magnitude 200 Kg, 300 Kg, 400 Kg and 200 Kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from L at 300 mm, 400 mm, and 700 mm. The angles between the cranks M, N and O measured anticlockwise from L are 45° , 115° and 235° respectively. The distance of plane of balancing mass X is 100 mm away from plane of mass L. 7
- Q.2**
- (a) Derive an expression for variation in tractive force. 3
- (b) Define the terms, (i) Natural frequency, (ii) amplitude of vibration, (iii) Damping, (iv) resonance 4
- (c) Find the natural frequency of the system shown in figure. Take $m = 1000$ Kg, the value of stiffness of all the springs is same and taken as 1000 N/m. 7

**OR**

- (c) Explain the method of balancing of radial engines. 7
- Q.3**
- (a) “The balancing is necessary for rotors of high-speed engines” Justify the statement. 3
- (b) Explain in detail Coulomb damping. How to calculate the loss of amplitude in it? 4
- (c) A machine of mass 75 Kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine, (i) the resistance of the dashpot at unit velocity, (ii) the ratio of the 7

frequency of damped vibrations to the frequency of the un-damped vibrations, and (iii) the periodic time of the damped vibrations.

OR

- Q.3**
- (a) Explain the reason for connecting the front and rear wheels of a locomotive engines with connecting rod. 3
 - (b) Derive an expression for equivalent length of a torsionally equivalent shaft. 4
 - (c) The mass of an electric motor is 120 Kg and it runs at 1500 rpm. The armature mass 35 Kg and its centre of gravity lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine, (i) stiffness of each spring, (ii) dynamic force transmitted to the base at the operating speed and (iii) natural frequency of the system. 7

- Q.4**
- (a) Explain in brief jump phenomenon in cam 3
 - (b) Derive an expression for natural frequency of torsional vibrations of single rotor system. 4
 - (c) A vertical shaft of 5 mm diameter and 200 mm long is supported in long bearings at its ends. A disc of mass 50 Kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75 % of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. Take $E = 200 \text{ GN/m}^2$. 7

OR

- Q.4**
- (a) Explain the vector diagram showing the effect of stiffness, damping and mass of the system in case of forced vibrations. 3
 - (b) Write a short note on seismic instruments. 4
 - (c) Examine the five cylinder in-line engine for balance of primary and secondary forces and couples running at 750 rpm and has successive cranks 144° apart. The distance between the cylinder centre lines being 375 mm. the piston stroke is 225 mm and length of connecting rod is 900 mm. the reciprocating mass for each cylinder is 15 Kg. 7

- Q.5**
- (a) Write a short note on polydyne cam. 3
 - (b) A seismic instrument with natural frequency of 6 Hz is used to measure the vibration of a machine operating at 120 rpm. The relative displacement of the seismic mass as read from the instrument is 0.05 mm. Determine the amplitude of vibration of the machine. Neglect damping. 4
 - (c) Derive the normal functions for free longitudinal vibrations of a bar length L and uniform cross section. One end of the bar is fixed and the other is free. 7

OR

- Q.5**
- (a) Write a short note on vibration isolation and materials used for it. 3
 - (b) A vertical spring mass system has a mass of 0.5 Kg and an initial deflection of 0.2 m. find the spring stiffness and the natural frequency of the system. 4

- (c) An inside cylinder locomotive has its cylinder centre lines 700 mm apart and has a stroke of 600 mm. The rotating masses per cylinder are equivalent to 150 Kg at the crank pin and the reciprocating masses per cylinder to 180 Kg. The wheel centre lines are 1.5 m apart. The cranks are at right angles. The whole of the rotating and $\frac{2}{3}$ of the reciprocating masses are to be balanced by masses placed at a radius of 600 mm. Find the magnitude and direction of the balancing masses. Find the variation in rail pressure under one wheel at a crank speed of 300 rpm.
