Total No. of printed pages = 7

ME 131702

Roll No. of candidate | | | | | | | | | | |

2017

B.Tech. 7th Semester End-Term Examination

Mechanical

DYNAMICS OF MACHINES

Full Marks – 100 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any SIX from the rest.

1. Answer the following questions : (10 × 1 = 10)

   (a) Resonance is a phenomenon in which the frequency of the external exciting force is _____ the natural frequency of the system.

   (i) half
   (ii) double
   (iii) equal to
   (iv) none of these

   (b) The advantage of critical damping is

   (i) Body comes to rest as in smallest possible time
   (ii) The amplitude is maximum
   (iii) The amplitude is minimum
   (iv) None of the above

[Turn over

(c) In order to double the period of a simple pendulum, the length of the string should be

(i) halved

(ii) doubled

(iii) quadrupled

(iv) none of these

(d) Choose the wrong statement

(i) Bending stresses are induced when a body is having transverse vibrations

(ii) Shear stresses are induced when a body is having torsional vibrations

(iii) Tensile stresses are induced when a body is having longitudinal vibrations

(iv) None of the above

(e) A node means a section where the amplitude of vibration is

(i) maximum

(ii) minimum

(iii) zero

(iv) none of these

(f) Bifilar suspension can be used to find the

(i) M.I. of a bar

(ii) M.I. of a disc

(iii) M.I. of a composite body

(iv) None of the above

(g) In semi definite system, one of the natural frequencies is

(i) zero

(ii) non-zero

(iii) infinite one

(iv) one

(h) There are n rotors mounted on the shaft and when subjected to torsional vibration there will be

(i) n nodes

(ii) (n – 1) nodes

(iii) (n + 1) nodes

(iv) any number of nodes

(i) According to which method, maximum kinetic energy at mean position is equal to maximum potential energy at extreme position?

(i) Energy method

(ii) Rayleigh's method

(iii) Equilibrium method

(iv) All of the above

(j) Which type of cam does not require any external force to have contact between cam and follower?

(i) Preloaded spring cam

(ii) Conjugate cam

(iii) Both (i) and (ii)

(iv) None of the above

2. (a) A harmonic motion is given by $x(t) = 10\sin\left(30t - \frac{\pi}{3}\right) mm$ where t is in seconds and phase angle in radians Find

(i) Frequency and period of motion

(ii) The maximum displacement, velocity and acceleration (5)

(b) A machine of mass 1000 kg is supported on springs which deflect 8 mm under the static load. With negligible damping the machine vibrates with amplitude of 5 mm when subjected to a vertical harmonic force at 80% of the resonant frequency. When a damper is fitted it is found that the resonant amplitude is 2 mm. Find :

(i) The amplitude of the damping force.

(ii) The damping coefficient. (10)

3. (a) Write down the difference between a Vibration Absorber and a Vibration Isolator. Mention few methods to control undesirable vibration. (3 + 2 = 5)

(b) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine :

(i) The amplitude caused by the unbalance and its phase angle

(ii) Transmissibility

(iii) The actual force transmitted. (10)

4. (a) Define the following terms: Mode, Principal mode of vibration, Normal mode of vibration and Node. (5)

(b) Show that the angular displacements of the rotors are inversely proportional to their inertias in case of Torsional Vibrations. (10)

5. (a) What is semi-definite system? Derive the expression of natural frequency for a semi-definite system. (1 + 4 = 5)

(b) Determine the natural frequencies of the system as shown in Figure 1 : (10)

Given, $k_1 = 98000$ N/m, $k_2 = 19600$ N/m, $m_1 = 196$ kg, $m_2 = 49$ kg.

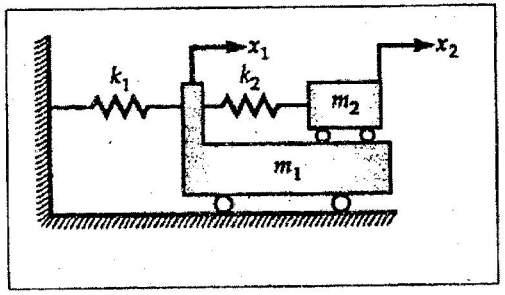

Figure 1

6. Determine the natural frequencies and mode shapes of the system as shown in Figure 2, using the matrix method. (15)

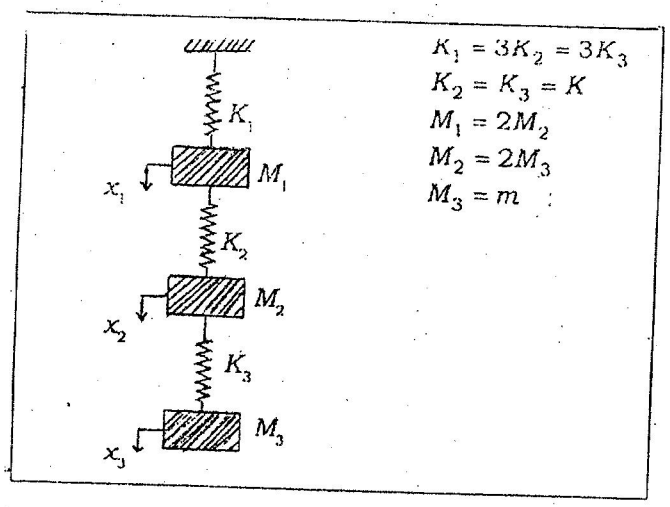

Figure 2

7. Use Holzer method to find the natural frequencies of the system as shown in Figure 3.

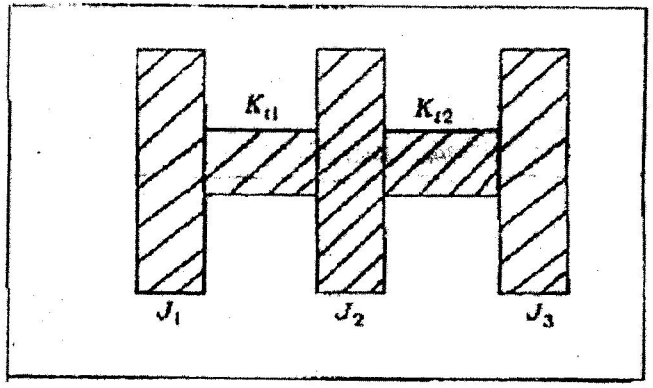

Figure 3

$J_1 = J;\ J_2 = 2J;\ J_3 = 3J$

$K_{t_1} = K;\ K_{t_2} = 2K$ $\qquad K = 2.2\times10^4\ kg\text{-}m/rad.$

8. (a) State and explain the different types of Cam. (5)

(b) The following particulars relate to a symmetrical circular cam operating a flat faced follower : Least radius = 25 mm, nose radius = 8 mm, Lift of the valve = 10 mm, angle of action of cam = 120°, cam shaft speed = 1000 rpm. Determine the flank radius and the maximum velocity, acceleration and retardation of the follower. (10)

9. Write short notes on *any three* of the following : $(3 \times 5 = 15)$

(a) Vibrometer

(b) Rayleigh Method

(c) Influence coefficient

(d) Coordinate coupling

(e) Orthogonality Principle

(f) Type of followers in cams.
