Code No: 07A72101 | R07 | Set No. 2

IV B.Tech I Semester Examinations,MAY 2011
VIBRATIONS AND STRUCTURAL DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the concept of torsional vibration absorber with neat sketch. [16]

2. Explain the procedure of finding natural frequency of vibrations by Dunkerleys method with the help of simple supported beam acted by three point loads at equidistane along the span. [16]

3. Explain the torsional vibrations and obtain the equation of natural torsional frequency for the system shown in figure 1. [16]

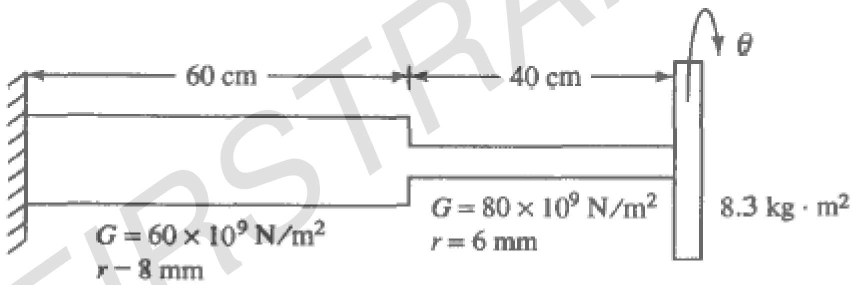

Figure 1:

4. Derive an expression for the longitudinal vibrations of a uniform bar of length L, one end of which is fixed and the other end is free and determine the fundamental frequency and draw the modes of vibrations. [16]

5. Determine the fundamental frequency of vibrations using FEM approach with lumped mass matrix for the system shown in figure 2. [16]

6. Show that the Laplace transform of f(t) = t sin ωt is given by
$F(s) = \frac{2\omega s}{(s^2+\omega^2)^2}$. [16]

7. In the figure 3 shown below, the disk is subjecte to a time independent moment of the form

$$M(t) = M_0 \text{Sin}(\omega t).$$

   (a) Find the equation of motion for the angular displacement of the disk.

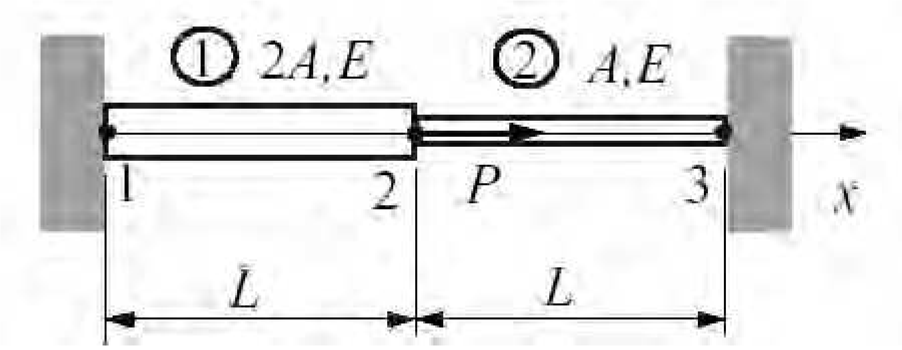

Figure 2:

(b) With

k = 280 N/m, b = 12 N/(m/s),

m = 4 kg,

I = 0.40 kg. m^2, r = 0.10 m

M_0 = 3 N. m, ω=5 rad/s,

Determine the steady-state response of disk as a funciton of time. [8+8]

8. A 200 kg machne is attached to a spring stiffness of 400,000 N/m. During operation the machine is subjected to a harmonic excitation of magnitude 500 N and frequency 50 rad/s. Design an undamped vibration absorber such that the steady state amplitude of the primary mass is zero and the steady state amplitude of the absorber mass is less than 2 mm. [16]

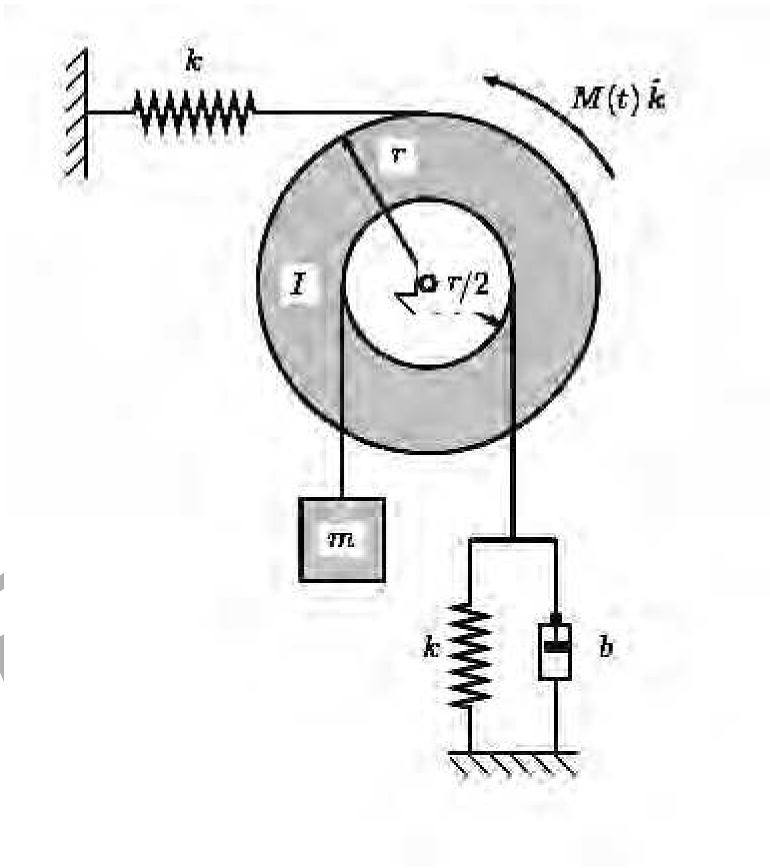

Figure 3:

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Code No: 07A72101 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,MAY 2011
VIBRATIONS AND STRUCTURAL DYNAMICS
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Find the Laplace transform of the derivative of a function. [16]

2. Explain the rayleigh's method of determining first natural frequency of multi degree freedom system and derive the frequency equation. [16]

3. (a) Describe the whirling speed of light vertical shaft with single disc of without damping with a supported diagram.
   (b) Describe the whirling speed of light vertical shaft with single disc of with damping with a supported diagram. [8+8]

4. A prismatical bar rests on two equal discs rotating with equal speeds in opposite directions as shown in figure 4. If the bar is displaced from the position of equilibrium and released, it begins to perform harmonic oscillations by moving back and forth along its axis. Prove that the coefficient of Coulomb friction between the materials of the bar and of the discs is given by formula

   $\mu = \frac{4\pi^2\alpha}{g\tau^2}$
   in which is half the distance between the centers of the discs and is the period of oscillations of the bar. [16]

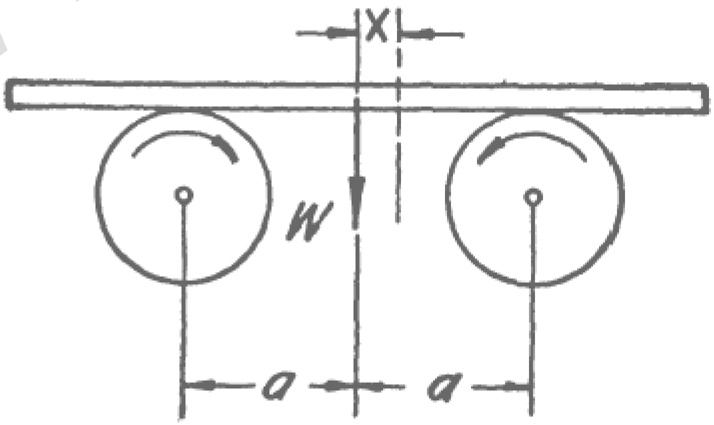
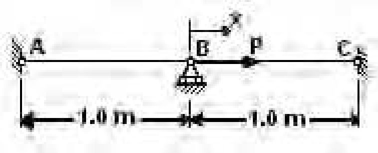


Figure 4:

5. A uniform string of length l and a large initial tension S, stretched between two supports, is displaced through a distance 'd' at the centre and is released at t = 0. Find the equation of motion for the string. [16]

6. Find the natural frequencies of longitudinal vibrations for the two element structure shown below using FEM approach assuming uniform area A and density ρ with lumed mass matrix. [16]



7. Two pendulums of different lengths are free to rotate y-y axis and coupled together by a rubber hose of torsional stiffness 7.35 X 10^3 Nm / rad as shown in figure 5. Determine the natural frequencies of the system if masses
   m1 = 3kg, m2 = 4kg, L1 = 0.30 m L2 = 0.35 m. [16]

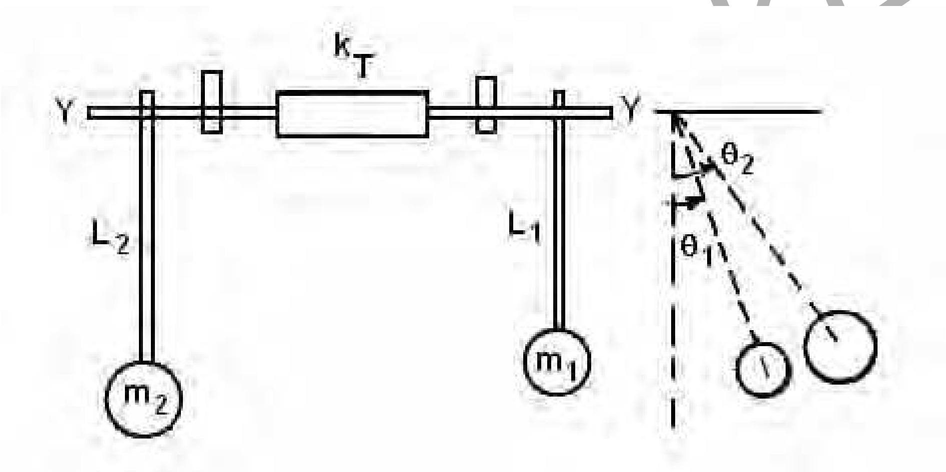


Figure 5:

8. Explain coordinate coupling and derive the condition for dynamic coupling. [16]

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Code No: 07A72101 **R07** **Set No. 1**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Determine the frequency of oscillations for the system shown in figure 6. Also determine the time period if m = 4 kg and r = 80 mm. [16]

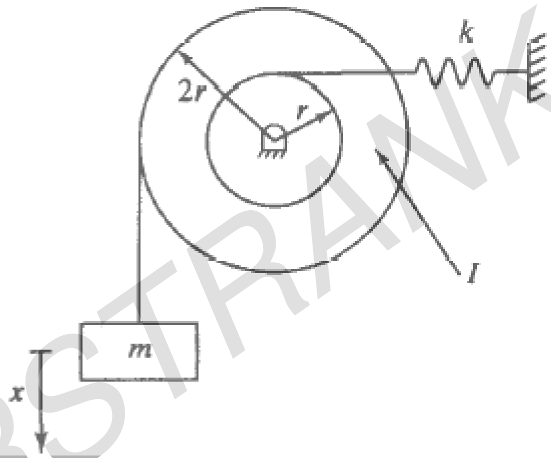

Figure 6:

2. Determine the response of spring mass damper system to an step input and the plot the system response for different amounts of damping. [16]

3. Describe the concept of vibration absorber with the help of neat sketches. [16]

4. For the spring-mass-damper system shown below figure 7, x is measured from the static equilibrium position. If the surface is assumed to be frictionless:

   (a) Determine the governing equations of motion;

   (b) What is the period of each oscillation;

   (c) What value of the damping coefficient b corresponds to critical damping?

   (d) If k = 1 N/m and m = 4 kg, find the displacement of the mass x(t) if the system is critically damped and started with the initial conditions x(0) = 0, $\dot{x}(0) = \dot{x}_0$. [16]

5. Write the wave equation for longitudinal vibration of tapered bar and when subjected to external forces and give the displacement boundary conditions for all end conditions. [16]

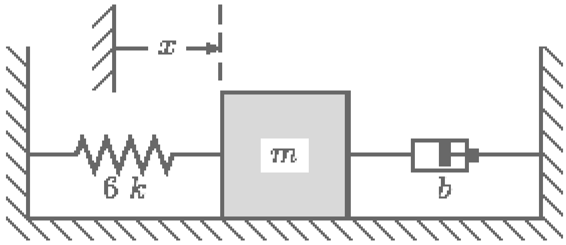

Figure 7:

6. A shaft 12.5 mm diameter rotates in long bearings and disc weighing 20 N is attached to the mid span of the shaft. The span of the shaft between the bearings is 600 mm. the mass center of the disc is 0.5 mm from the axis of the shaft. Neglecting the mass of the shaft and taking the deflection as for a beam fixed at the both ends, find the whipping speed of the shaft. Determine the range of the speed over which the stress in the shaft due to bending will exceed 1200 N/m^2. E = 200 GN/ m^2. [16]

7. A solid steel shaft of uniform diameter, which carries tow discs of weights 600 N and 1000 N is represented by a SSB 10 cm and 20 cm from the left support of 30 cm length shaft made of steel with density 7800 kg/m^3. Determine the frequency of oscillation using Dunkerleys method by considering the weight of the shaft. E = 19.6 x10^6 N/cm^2 and I = 40 cm^4. [16]

8. Find the natural frequencies of longitudinal vibrations of the cantilevered stepped shaft of areas A and 2A and of equal lengths (L), as shown below figure 8 using consistant mass matrix approach. [16]

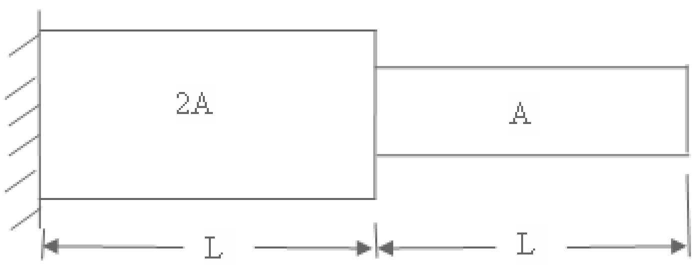

Figure 8:

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Code No: 07A72101 **R07** **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. For the three nodded cantilever beam as shown in figure 9, determine global stiffness matrix and lumped mass matrix. [16]

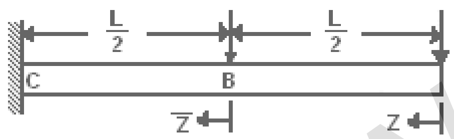

Figure 9:

2. A power shaft has a diameter of 30 mm and 900 mm long , and a simply supported. The shaft carries a rotor of 4 kg at its mid span. The rotor has an eccentricity of 0.5 mm. Calculate the critical speed of shaft and deflection of the shaft at mid span at 1000 r/min. Neglect mass of shaft take E = $2X10^5$ MPa. [16]

3. Explain maxwell's reciprocal theorem with the help of simple supported beam with two concentrated loads. [16]

4. A machine runs at 5000 rpm. Its forcing frequency is very near to its natural frequency. If the nearest frequency of the machine is to be at least 20% from the forced frequency, design a suitable vibration absorber for the system. Assume the mass of the machine as 30kg. [16]

5. What are the methods of determining natural frequency of vibrating system? Determine the frequency of oscillation for the system shown in below figure 10. [16]

6. A rectangular pulse of constant area Δ but variable duration acts on an undamped spring-mass system. Plot the amplitude of vibration of the system after the expiry of the pulse against the duration of the pulse. [16]

7. Derive the solution for wave equation due to continues vibrations. [16]

8. For the mechanical system shown below figure 11, the uniform bar has mass m and pinned at point O. For the system:

   (a) Find the equations of motion;

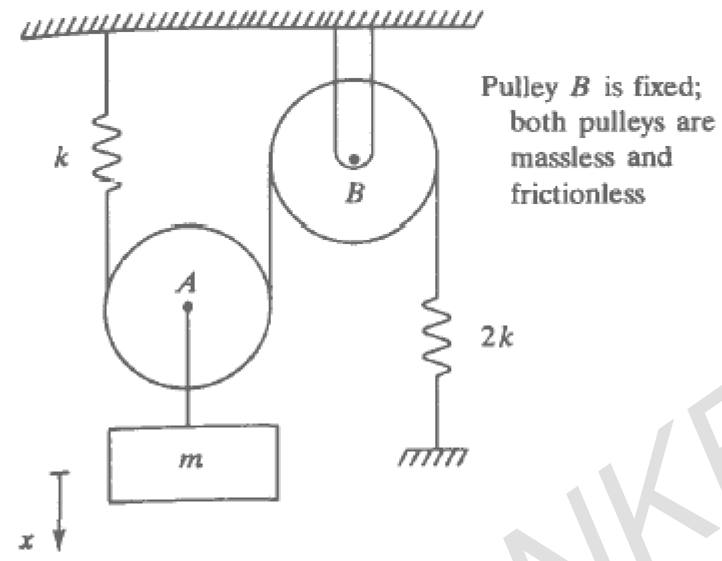

Figure 10:

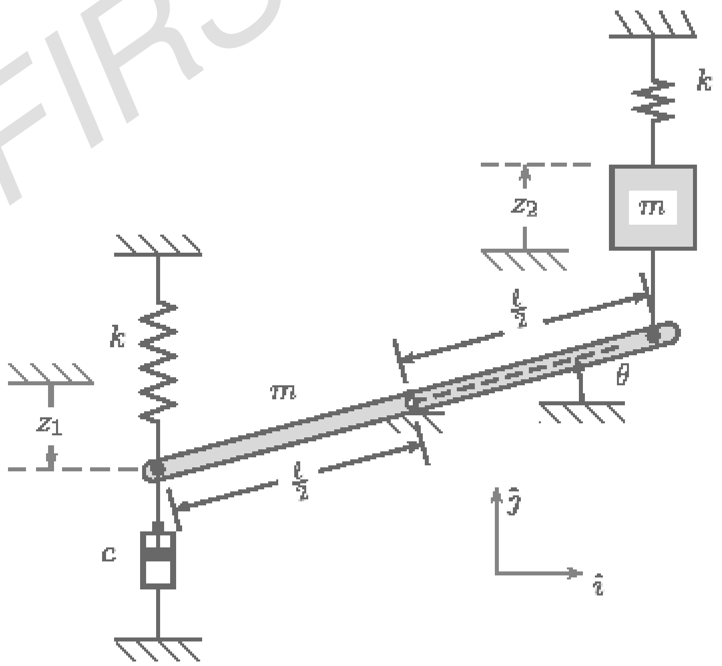

Figure 11:

(b) What value of the damping constant c gives rise to a critically damped system? [16]

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