R05 SET-2

**Code No : 37148**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**IV.B.TECH - I SEMESTER REGULAR EXAMINATIONS NOV/DEC, 2009**
**THEORY OF VIBRATIONS AND AEROELASTICITY**
**(AERONAUTICAL ENGINEERING)**

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

**Answer any FIVE questions**
**All questions carry equal marks**
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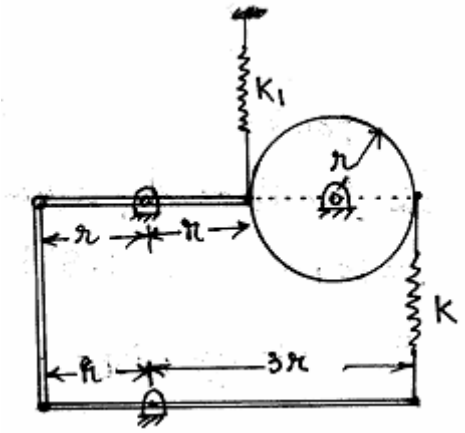
1. a)



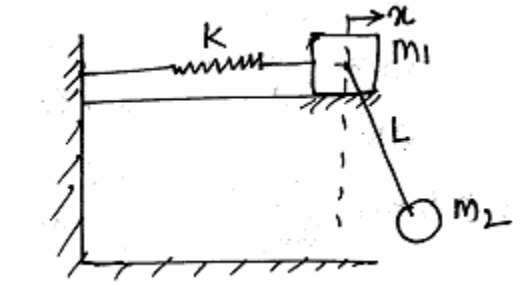

For small oscillations, determine the frequency of oscillation.

b) Explain the difference between energy method and Rayleigh's method. [8+8]

2. An electric motor is supported on a spring and a dash pot. The spring has the stiffness 6400 $N/m$ and the dashpot offers resistance of 500 N at 4 $m/s$. The unbalanced mass 0.5 kg rotates at 5 cm radius and total mass of vibrating system is 25 kg. The motor runs at 420 RPM . Determine
   i) Damping factor
   ii) Amplitude of vibration
   iii) Phase angle
   iv) Resonant speed
   v) Forces exerted by the spring and dash pot on the rotor. [16]

3. a) Write the Lagrange's Equation in its fundamental form for generalized coordinates.

b)



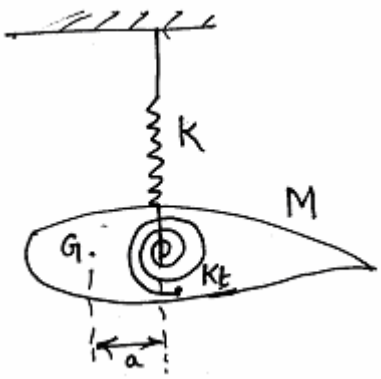

Determine the natural frequency of vibration of the system shown in the figure using Lagrange's equation. [4+12]

4. An aerofoil wing in its first bending and torsional modes is shown. Write the equations of motion for the system and obtain two natural frequencies.

M = 10kg , $I = 0.5\,kg\,m^2$

K = $20\times10^3\,N/m$ , $K_t = 1.2\times10^3\,Nm/radian$

a = 0.2 m [16]




5. Derive the general equation for transverse vibration of beams and provide the solution. [16]

6. A rotor of mass 12 kg is mounted in the middle of 25 mm diameter shaft supported two bearing placed at 900 mm from each other. The rotor is having 0.02 mm eccentricity. If the system rotates at 3000 RPM, determine the amplitude of steady state vibrations and the dynamic force on the bearings.

$E = 2\times10^5\,N/mm^2$

Derive the equations used. [16]

7. The vibrations of a cantilever are given by

$y = A\left(1-\cos\frac{\pi x}{2l}\right)$. Calculate the frequency of vibration using Rayleigh's method

Mass = 50000 kg , l = 30 m , I = 0.02 $m^4$ $E = 2\times10^{11}\,N/m^2$. [16]

8. Explain wing torsional divergence for 2D wing. Show that, the divergence speed,

$$V_d = \sqrt{\frac{2K}{\rho \sec \frac{\delta C_L}{\delta \alpha}}}$$

K-Torsional stiffness,

'ec' distance of aerodynamic centre forward of flexural centre. [16]