Code No: NR412103 **NR**

IV B.Tech I Semester Supplementary Examinations, November 2005
THEORY OF VIBRATIONS
(Aeronautical Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) A simply supported beam with a concentracted load acting on the mid-span is shown in figure 1. Neglecting the mass of beam find the natural frequecy of the system.

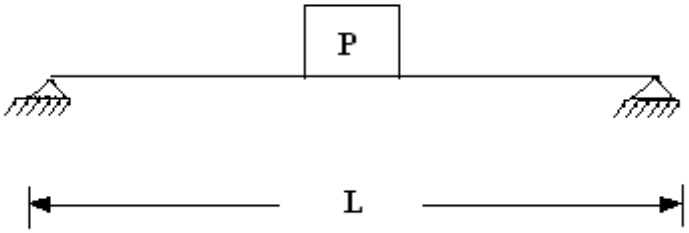

Figure 1:

(b) Determine the natural frequency of a simple spring-mass system by Newton's Law of motion, using elaborated sketches. [16]

2. The mass 'm' is attached to one end of a weightless stiff rod which is rigidly connected to the center of a homogeneous cylinder of radius 'r' as shown in figure 2. If the cyclinder rolls without slipping, what is the natural frequency of the oscillation of the system. Make use of Newton's Law of motion method and Rayley's method. [16]

3. Consider spring-mass system shown in figure 3. Neglect the mass of the slender uniform rod holding the mass 'm'. For small oscillations, calcuate the frequency of oscillation of the mass. [16]

4. The coefficient of friction between the dry surfaces of the block and the plane as shown in figure 4 is f_1, a constant value. The constant friction force is always acting against motion to produce coulomb damping. Investigate the motion of the block, if it is given a displacement x_0 from the centre position, where the springs are unstressed. [16]

5. Use Lagrange's equation to find the equations of motion for two degrees of freedom spring-mass system as shown in figure 5. [16]

6. (a) Describe the stodola method for the calculation of principle modes and natural fequencies of free undamped vibrating systems.

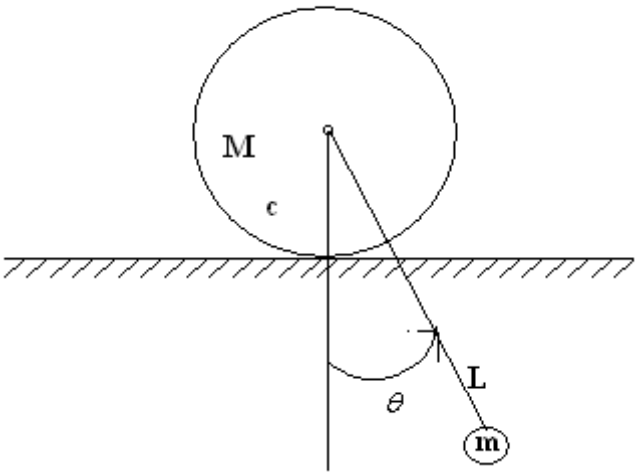

Figure 2:

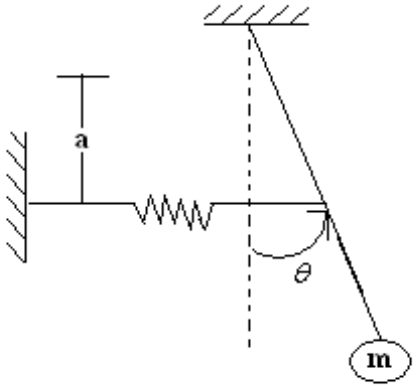

Figure 3:

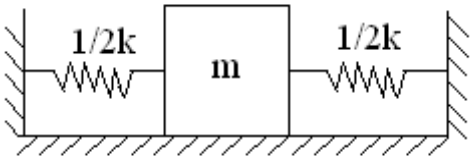

Figure 4:

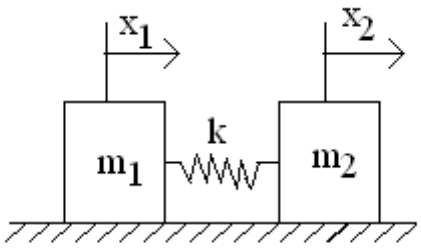

Figure 5:

(b) Describe a simplified spring-mass vibration pick-up for measuring the vertical acceleration of a moving vehicle with a sketch and its physics. [16]

7. Explain the problem of divergence of an elastic wing. Consider a 2-D example and show that the divergence velocity $U_{di\vartheta} = \sqrt{\frac{2k_\alpha}{\rho e c^2 a}}$, where 'k_α' is the spring contant and 'e' is the eccentricity of the aerodynamic centre, and 'a' is the $C_L - \alpha$ curve slope.

[16]

8. Write detailed notes on:

   (a) Phenomeon of Flutter

   (b) Phenomeon of Aileron Reversal [16]

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