AS 3030 Vibrations (Aug- Dec 2010)

Assignment 1 (Sept 3, 2010)

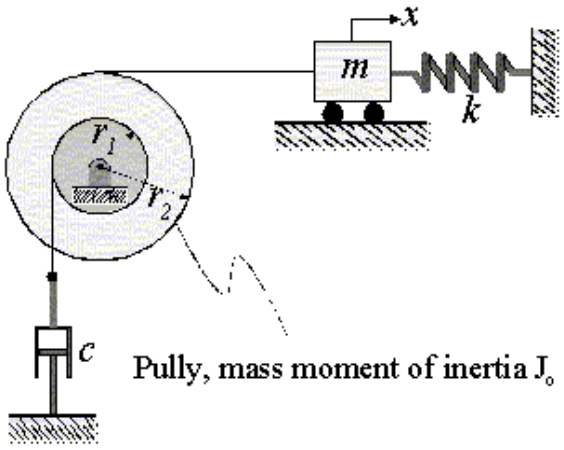
1. A bullet of mass m=10gm traveling at a speed of 100m/s hits and embeds into a stationary massive flexible support (M = 10kg, K=100KN/m).

(a) Explain the physics of the problem subsequent to the impact with any assumptions that you need to make. What model can represent the system for analysis ?

(b) Find the maximum deflection in *mm* of the spring element

2. A projectile of mass m = 10kg travelling with a velocity v = 50m/s strikes and becomes embedded in a massless board supported by a spring-dashpot system (in parallel) with stiffness k = 6.4 x10^4 N/m and coefficient of viscous damping c = 400 N.s/m. Determine the time required for the board to reach the maximum displacement and the value of the maximum displacement.

3. The system shown below has a natural frequency of 5 Hz for the following data: m = 10kg, J_o = 5 kg/m^2, r_1 = 10cm, r_2 = 25cm. When the system is disturbed by giving it an initial displacement, the amplitude of free vibration is reduced by 80 percent in 10 cycles. Determine the values of k and c.



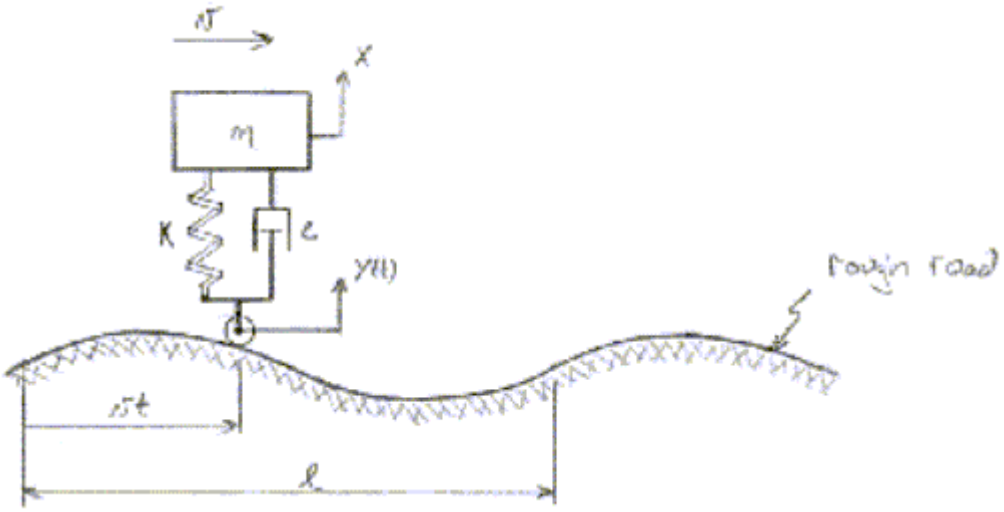
4. A mass-spring-dashpot assembly is observed to oscillate with a period of 2 seconds and the magnitude of consecutive oscillations is reduced by a factor of 4 during each period. If the spring stiffness is 100 N/m, and a harmonic force of magnitude 5 N and frequency 3 rad/sec is applied to this device, what will be the amplitude of the resulting motion and what will be the phase angle of this motion with respect to the applied force?

5. A vehicle is traveling over a rough road at a high rate of speed. The road surface can be assumed as sinusoidal with an amplitude of 20 cm and a wavelength l = 2m. Assume m = 2000 kg, k = 7.9 x 10^6 kg/s^2, c = 1.41 x 10^5 kg/s and the speed of the car is 111.85 mph.

A. Determine the steady-state response of the vehicle (amplitude and phase angle).

B. If the dashpot is removed, what is the most undesirable speed?

C. If the dashpot is included, is the most undesirable speed faster or slower than the speed obtained in Part B? Justify your answer by referring to plots or equations.



6. The addition of damping to an initially undamped spring-mass system increases the period of vibration by 15%. Find the value of the damping ratio.