University Of Misurata
Faculty of Engineering
Mechanical Engineering Department

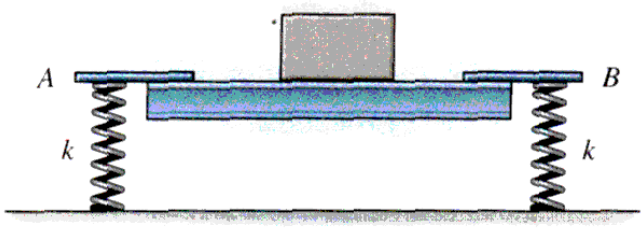
First Exam **Subject: Mechanical Vibrations**
Date: 20:10:2020 **Time: 1:30**

Question 1- A vertically suspended weight of 40 lbs by a steel wire of length 60 in and cross sectional area 0.0015 in^2. Determine the frequency of the weight if the modulus of elasticity of the steel is E = 30 $X10^6$ psi, determine the amplitude of vibration at t=2 s if the initial displacement x_o= 0.02 in and initial velocity $\dot{x} = 1.5$ in/sec.

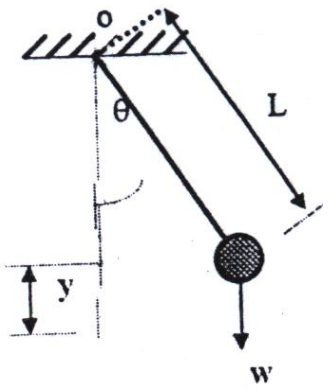
$$x(t) = x_o \cos(\omega_n t) + \frac{x_o}{\omega_n} \sin(\omega_n t)$$

f = 1 /T; $f = \omega_n / 2\pi$; K=EA/L

Question 2- The uniform beam shown in the Fig. below is supported at its ends by two springs A and B each having the same stiffness k. when nothing is supported on the beam; it has a period (T) of vertical vibration of 0.83 s. If a mass of 50 kg placed at the center of the beam, the period of vertical vibration equal 1.52 s. Compute the stiffness of each spring and the mass of the beam.



Question 3- Using Newton's method to write the equation of motion of the pendulum shown in figure. Neglect the mass of the bar.



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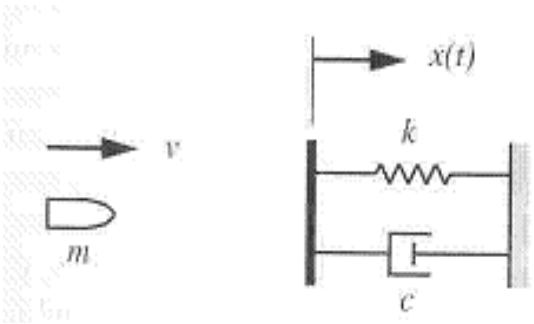
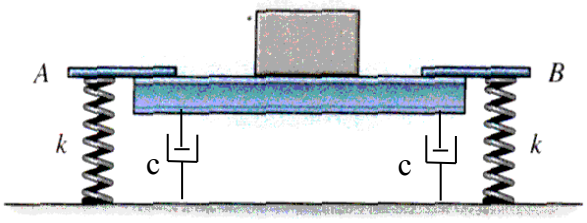
Second Exam **Subject: Mechanical Vibrations**
Date: 17:11:2020 **Time: 1:30**

Question 1- A projectile of mass m=10 kg traveling with v=50 m/s strikes and becomes embedded in a massless board supported by a spring stiffness k = 6.4x104 N/m in parallel with a dashpot of c = 400 N.s/m. Determine the time required for the board to reach the maximum displacement and the value of the maximum displacement.



Question 2- The uniform beam shown in the Fig. below is supported at its ends by two springs A and B each having the same stiffness k. when nothing is supported on the beam; it has a period (T) of vertical vibration of 0.83 s. If a mass of 50 kg placed at the center of the beam, the period of vertical vibration equal 1.52 s. Compute the stiffness of each spring and the mass of the beam**.** Calculate the mass that must be added at the center of the beam such that the whole system becomes a critical damped system if c=5 N.s/m.



Question 3-

a- For any damping factor ζ, proof that the phase angel between the applied force and the displacement is always 90◦ at resonance.

B- For any rotor there is a situation where the non-dimensional MX/me, can be intuitively found. There is another situation where the phase angel ϕ, can be also intuitively found. What are these two situations? Explain in details.