MA205

Board Sheet - Wednesday, 7 August, 2007 or Thursday, 15 November, 2007

Some Reminders to Help You Compute Spring Mass Systems

1) $my'' + \delta y' + ky = F(t)$

2) m =mass:

English Units : $m = w/g \Rightarrow m = \frac{lb}{32\frac{ft}{sec}} = slug$

Metric Units : $m = kg$

3) k = spring constant

English Units : $k = \frac{mg}{ft} \Rightarrow k = \frac{lb \cdot 32\frac{ft}{sec}}{ft} \Rightarrow k = \frac{lb}{ft}$

Metric Units : $k = \frac{N}{m}$

4) $F(t)$ = any driving force

5) $y(0)$ = location of mass at time zero.

6) $y'(0)$ = velocity of mass at time zero.

Now Try it on these Problems

65 Mustang Suspension, and hanging mass problems

- Team 1 : A mass of 0.6 kg is attached to the free end of a suspended spring, stretching the spring 0.4 m beyond its natural length. The mass is then pulled down and additional 1 meter and released from rest.
  - a.) Use Newton's second law to model the position of the mass.
  - b.) Use Mathmatica DSolve and Plot to evaluate the system.
  - c.) Access the following URL to compare your answer.

    `http://www.aiaa.org/tc/sd/Education/physics_of_sd/sdof/index.htm`
  - d.) Add dampening to see how to reduce the amount of oscillations. Check your dampened system in both Mathmatica and the above website.

- Team 2 : An object weighing 4 lbs is attached to the free end of a spring, stretching the spring 6 inches. The spring-mass system is in a medium which creates a damping force numerically equal to the object's velocity.
  - a.) If the object is released from a location 2 feet above it's equilibrium position with a downward velocity of 3 ft/sec, use Newton's second law to model the position of the object.
  - b.) Access the following URL to compare your answer.

    `http://www.aiaa.org/tc/sd/Education/physics_of_sd/sdof/index.htm`
  - c.) Use Mathmatica DSolve and Plot to evaluate the system if a motor applies an external force of $10\cos(8t)$.
  - d.) Vary the dampening to evaluate the effect on oscillations (exclude the motor force). Check your dampened system in both Mathmatica and the above website.

- Team 3 : Major Bowman's 1965 Mustang weighs 3000 lbs which is approximately 2000 lbs on the front wheels and 1000 lbs on the rear wheals. The front springs have a stiffness of 260 lbs/in and the rear springs have a stiffness of 225 lbs/in. The unit conversions can be found by Googling unit conversion.
  - a.) Model the the position of one of the front wheels of the car if the car drove across a 6 inch bump. Assume each front wheel has a weight of 1000 lbs acting on it.
  - b.) Access the following URL to evaluate the system you just modeled (you will have to convert units to metric) assume there is no dampening at this time.

    `http://www.aiaa.org/tc/sd/Education/physics_of_sd/sdof/index.htm`
  - c.) Use Mathmatica DSolve and Plot to evaluate the system and compare it to what you found on the web site.
  - d.) Add dampening (i.e. a shock absorber) to evaluate the effect on oscillations. Check your dampened system in both Mathmatica and the above website. See if you can find the dampening needed to limit oscillations to two.