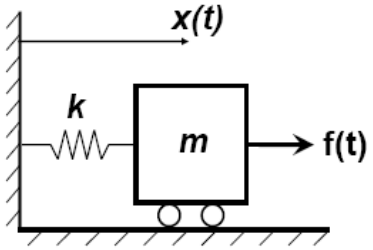
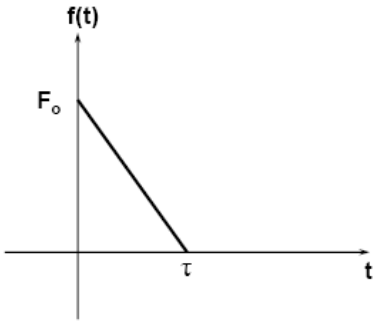
CE 573 – Structural Dynamics
Homework #5

due 16 October 2009, Friday, 1:30pm

1) A 2 kg mass attached to a linear elastic spring of stiffness k = 200 N/m is released from rest when the spring is stretched 10 cm. The coefficients of static and kinetic friction between the mass and the surface that it moves on are $\mu_{static}=\mu_{kinetic}=0.1$, determine the time after release at which the mass sticks, i.e. it stops moving. Find the final position of the mass.

2) An undamped single-degree-of-freedom system is excited with a triangular forcing function as shown below. The system weighs 483 lb, is initially at rest, and moves horizontally on a frictionless surface. Assuming that the linear spring stiffness constant k = 60 lb/ft, F_o = 4500 lb, and τ = 1 sec, find x(t), i.e. the displacement of the mass in time. Take g= 32.2 ft/sec^2. Solve for x(t) both analytically and numerically (using your numerical algorithm from HW#1).





3) You are asked to compare the effects of load time-profile on the response of an elevated water tower. Let's say one can model the tower as a SDOF with natural period T and negligible damping. There are three kinds of loads you choose to compare: 1) a rectangular load pulse with zero rise time and active for a duration of t_d; 2) a triangular load pulse, similar to the one in problem #2, with zero rise time and end time t_d; 3) an isosceles triangular load pulse over a duration of t_d (a symmetric triangular with apex at time $t_d/2$). <u>All loads have the same impulse.</u>

a) If t_d = 0.2 T, sort the loads in order of decreasing maximum displacement they would cause.
b) If t_d = 0.5 T, sort the loads in order of decreasing maximum displacement they would cause.
c) Is it possible for the loads type 1 and type 2 to cause the same maximum displacement? Consider the region of 0.1 T $\leq t_d \leq$ 0.5 T for the loading duration? If yes, which type of loading causes the tower reach its maximum displacement in shorter time?

Hint: Use the graphs given by Biggs.