Advanced dynamics of structures / Homework October 17, 2006

a. Obtain the undamped and damped free vibration period of the single-degree-of-freedom system shown in the figure. *W = mg = 300kN* *k = 1500kN/m* $\xi = 0.05$

b. Evaluate the displacement history of the system subjected to the ground motion history $\ddot{v}_g(t)$ by using step by step numerical integration of the Duhamel integral for $0 \le t \le t_1$ by using Simpson rule under the assumption of the homogeneous initial conditions $v(t=0)=0 \quad \dot{v}(t=0)=0$.

$t_o = 0.06s \quad t_1 = 2.0s \quad \Delta\tau = 0.01s$

$$v(t) = -\frac{1}{\omega_D}\int_o^t \exp\left[-\xi\omega(t-\tau)\right]\,\ddot{v}_g(\tau)\sin\omega_D(t-\tau)\,d\tau \qquad 0 \le t \le t_o$$

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t (s)	$\ddot{v}_g(t)/g$
0	*0*
0.01	*0.267*
0.02	*0.533*
0.03	*0.600*
0.04	*0.533*
0.05	*0.267*
0.06	*0*
0.10	*0*
0.40	*0*
2.00	*0*

c. Obtain the response of the system under the assumption that the ground motion $\ddot{v}_g(t)$ can be represented as a impulse loading. Draw the variation of *v(t)* for the two last cases.

$$v(t) = \frac{I}{m\,\omega_D}\exp\left[-\xi\,\omega\,t\right]\sin\omega_D t \qquad I = -\int_o^t m\,\ddot{v}_g(\tau)\,d\tau$$

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