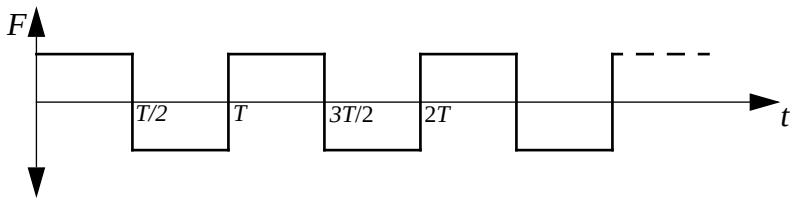
ME 460/660 Exam 2, Spring 1994

1) A fan of 45 kg has an unbalance that creates a harmonic force of 10 N (the unbalance causes a 10 N force on the fan). A spring damper system is designed to minimize the force transmitted to the base of the fan. A damper is used having a damping ratio of ζ=0.2. The spring stiffness is 4.5×10^8 N/m. Calculate the maximum force that is transmitted to the ground when the fan is running at 10,000 rpm. (20 points)

2) Find the response of a single degree of freedom system excited by two impulses, the first being at t=0 with $\hat{F} = 1$ and the second occurring at $t=\omega_d$ with $\hat{F} = -e^{-\zeta/(\sqrt{1-\zeta^2})}$. (20 points)

3) At very low frequencies, the receptance magnitude for a SDOF system is 0.02 m/N. For the same system, the magnitude of the inertance transfer function for very high frequencies is 0.1 $m/N \cdot s^2$. If the maximum magnitude of the receptance is 10 m/N, what is the mass, stiffness and damping in the system to **two (2)** decimal places. (20 points)

4) Find the Fourier series for a square wave of period T (shown below), and write the steady state solution for a damped SDOF system excited by the square wave. The amplitude of the square wave is F. (20 points)



5) The mass matrix of a system is given as M=diag(4,4). The initial conditions are $\mathbf{x}(0) = [0.5\ 0.5]^T$ and $\dot{\mathbf{x}}(0) = [0\ 0]^T$. The first natural frequency and mode shape are given as ω_1=2 rad/sec and $\mathbf{u}_1 = 1/(2\sqrt{2})[1\ 1]^T$, and ω_2=4 rad/sec and $\mathbf{u}_2 = 1/(2\sqrt{2})[1\ -1]^T$. Find the response of the system. (20 points)