ME 460/660, Mechanical Vibration — Final Exam, Fall 1997

Closed book, closed notes. Use one $8\frac{1}{2} \times 11$ formula sheet, front and back. Test books will be provided.

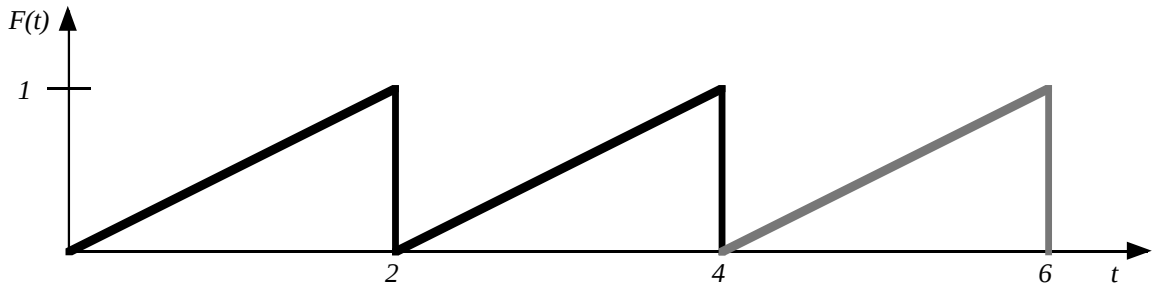
1. Define the following variables and state which ones are parameters of a system and which ones define the state of a system. (2 points each, 30 total)

   (a) ω
   (b) ω_{dr}
   (c) ω_b
   (d) M
   (e) K
   (f) $\tilde{\mathrm{K}}$
   (g) P
   (h) S
   (i) $\mathbf{x}(0)$
   (j) $\mathbf{x}(t)$
   (k) $v(t)$
   (l) c
   (m) ζ
   (n) δ
   (o) T

2. On what principle is the Energy Method based? As a result, when is it *invalid* to use the Energy Method? (10 points)

3. A machine was started up earlier today and has been run at a constant speed since. An accelerometer placed on the machine picks up a single frequency. What is the variable name of that frequency (write the variable), and what does it represent? (5 points)

4. Determine the Fourier series representation of the function shown below. (20 points)



5. It is desired to mechanically isolate a CD player in a car from the vibration of the vehicle. The vehicle vibrates at a frequency ω_b. Should the natural frequency of the CD player on its support be higher than, lower than or equal to ω_b? Should the support have high or low damping? Consider only isolation with respect to ω_b. (15 points)

6. A MDOF system is defined by the following matrices:
   $M = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$, $K = \begin{bmatrix} 2 & -1 \\ -1 & 4 \end{bmatrix}$
   Determine the natural frequencies and their corresponding mode shapes. Be sure to label which mode is mode 1, and which mode is mode 2. (20 points)

7. Obtain the equations of motion for the system below. Assume the disks roll without slipping. *They are not solid disks! Put your answer in terms of the variables shown in the figure* (20 points):