Massachusetts Institute of Technology
Department of Aeronautics and Astronautics
Cambridge, MA 02139

16.003/16.004 Unified Engineering III, IV
Spring 2009

Problem Set 12

Name: _____

Due Date: 5/8/2009

	Time Spent (min)
S16	
S17	
S18	
F17-18	
SPL13	
Study Time	

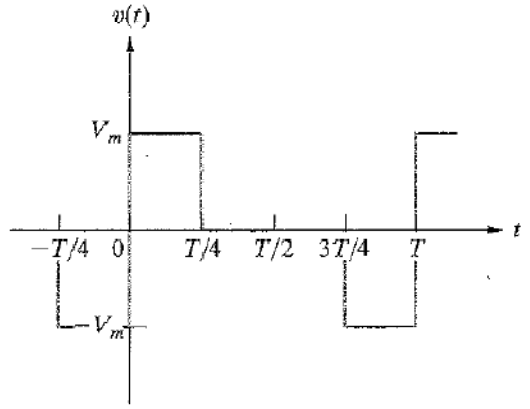
Announcements:

S16: (10 points)

a)

Use the exponential form of the Fourier series to write an expression for the voltage shown in Fig. P16.43.

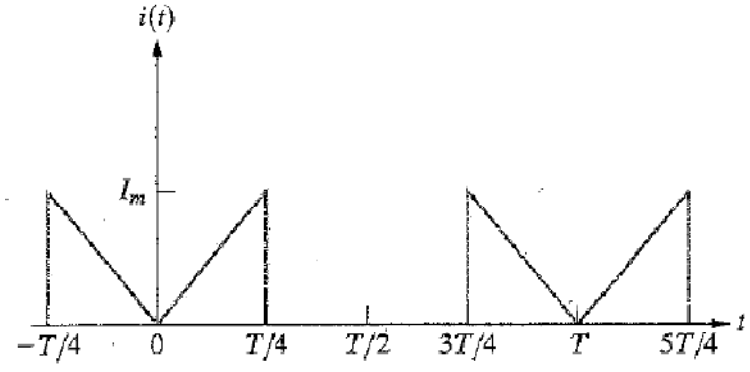
Figure P16.43



b)

Derive the expression for the complex Fourier coefficients for the periodic current shown in Fig. P16.44.

Figure P16.44



S17: (10 points)

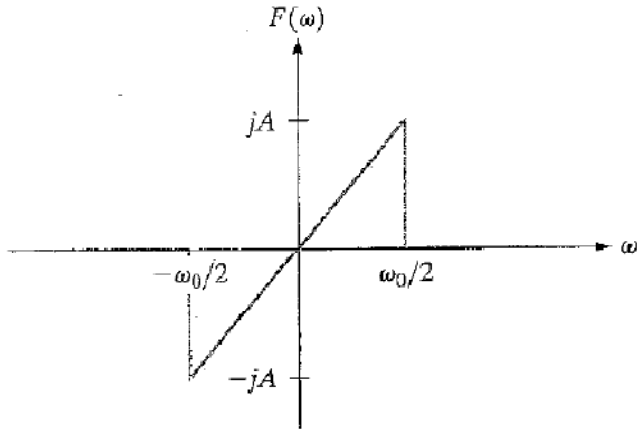
The Fourier transform of $f(t)$ is shown in Fig. P17.3.

a) Find $f(t)$.

b) Evaluate $f(0)$.

c) Sketch $f(t)$ for $-10 \leq t \leq 10$ s when $A = 2\pi$ and $\omega_0 = 2$ rad/s. *Hint:* Evaluate $f(t)$ at $t = 0, 1, 2, 3, \ldots, 10$ s and then use the fact that $f(t)$ is even.

Figure P17.3



S18: (10 points)

Find the Fourier transform of each of the following functions. In all of the functions, a is a positive real constant and $-\infty \leq t \leq \infty$.

a) $f(t) = |t|e^{-a|t|}$;

b) $f(t) = t^2 e^{-a|t|}$;

c) $f(t) = e^{-a|t|} \cos \omega_0 t$;

d) $f(t) = e^{-a|t|} \sin \omega_0 t$;

e) $f(t) = \delta(t - t_0)$.

A wall with a supersonic flow over it has a shallow triangular depression as shown. The upstream Mach number is $M_\infty = 1.6$ and the pressure is $p_\infty = 1$.

a) Sketch the flow pattern, and determine the pressure p_a on the first angled facet. Also obtain the surface Mach number M_a, and then p_{o_a}, which will be needed for part b).

b) Determine the pressure p_b on the second angled facet. Also obtain the surface Mach number M_b, and then p_{o_b}, which will be needed for part c).

c) Determine p_c, M_c, and p_{o_c} well behind the depression.