EE 102 # Homework #1 **Fall 2001**

Professor Paganini **Due Wednesday 10/3/01**

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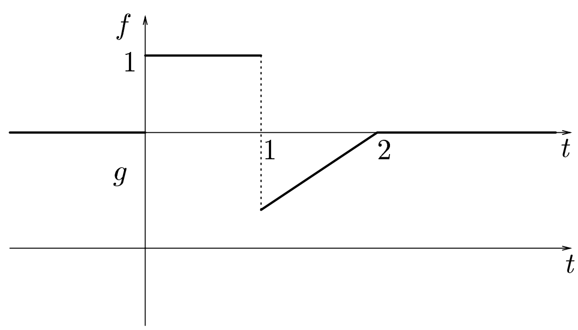
1. Review of integration.

   (a) Evaluate the integrals $\int_0^\pi t\cos(t)dt$ and $\int_0^\pi t^2\sin(t)dt$.

   (b) For a differentiable function f, derive the identity

   $$\int_0^t f(t-\tau)d\tau = tf(t) - \int_0^t \tau f'(\tau)d\tau$$

   (c) The figure below contains a picture of a function $f(t)$. Find the function $g(t) = \int_{-\infty}^t f(\tau)d\tau$ and sketch it under $f(t)$.



2. Review of complex numbers

   (a) Find the following complex numbers (real and imaginary parts):

   $$(1)\ e^{-\frac{27}{2}\pi i}, \quad (2)\ (i)^{i^6}$$

   (b) Change these complex numbers into exponential form:

   $$(1)\ \alpha = \sqrt{3} - i, \quad (2)\ \beta = -i.$$

   (c) For the numbers in part (b), compute $\alpha^3/\bar{\beta}$, where $\bar{\beta}$ is the complex conjugate of β.

   (d) Find the complex roots to the polynomial equation $z^6 - 27 = 0$.

3. Given the differential equation for $t \geq 0$

$$\frac{dy(t)}{dt} + y(t) = \frac{dx(t)}{dt} - 2x(t)$$

- Let $x(0) = 0$ and $y(0) = 0$; solve for $y(t)$ in terms of $x(t)$.

4. For each of the following systems with input $x(t)$ and output $y(t)$, find out whether they are (i) linear, (ii) time invariant, (iii) causal. Justify your answer.

   (a) $y(t) = x(t+1) - 3$.

   (b) $y(t) = e^t x(t)$.

   (c) $y(t) = \int_t^\infty x(\tau)d\tau$.

   (d) The system where $y(t)$ is equal to $x(t)$ when $x(t) > 0$, and zero otherwise.