# OKLAHOMA STATE UNIVERSITY

## SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
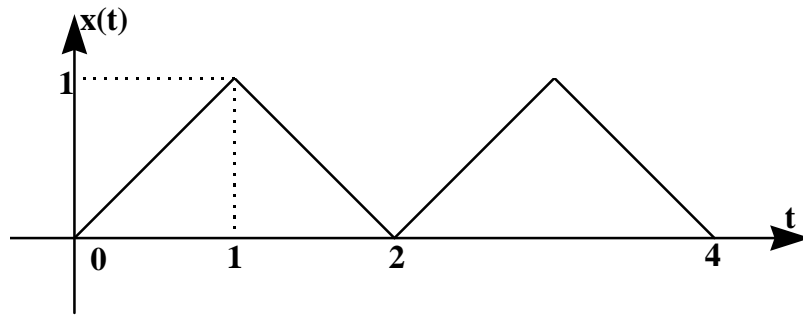
**ECEN 3413 Controls I**
**Spring 1998**
**Final Exam**

**Name : _____**

**Student ID: _____**

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**Problem 1**: (*Laplace transform*)

Determine the Laplace transform of the following signal, $x(t)$, with six periods (only two periods are shown in the graph).

**Problem 2**: (*z transform*)

A discrete-time system has the transfer function

$$H(z) = \frac{-0.4z^{-1} - 0.5z^{-2}}{1 - 1.3z^{-1} + 0.4z^{-2}},$$

a) find an analytical expression for the step response.

b) write a MATLAB program to find the impulse response (as accurate as you could).

**Problem 3**: (*time response*)

Determine the transfer function $E_o(s) \big/ E_i(s)$ of the electrical circuit shown below. Suppose that the input $e_i(t)$ is given by

$$e_i(t) = \begin{cases} E_i & 0 < t < t_1 \\ 0 & \text{elsewhere} \end{cases}.$$

Obtain the output $e_o(t)$. Assume that $R_2 = 1.5R_1$, $C_2 = C_1$, and $R_1 C_1 = 1$. Assume also that the initial charges in the capacitors are zero.

**Problem 4**: (*frequency response*)
Consider the electrical circuit shown below. If the input voltage $e_i(t) = E_i \cos\omega t$, what is the output voltage $e_o(t)$ at steady state ?