Exam 1

Z. Rezki

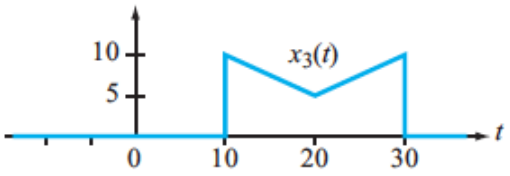
May 2, 2023

Instructions

- Exam duration: **1 hours and 30 minutes.**
- Please show your derivation for each question. A response given without details will not be considered.
- The exam is open-book. Open-book exam means the students can have access to their lectures, homework solutions, personal notes, whether they are on paper or on laptop/computer/tablets. However, browsing internet and/or posting questions on blogs and/or forum are not allowed.

Exercise 1 (25%)

Given the waveform of $x_3(t)$, generate and plot the waveform of:



1. $x_3(-\frac{t}{2}+1)$.
2. Determine the energy of $x_3(t)$.

Exercise 2 (25%)

Consider an LTI system with input $x(t) = u(t) + u(t-1) - 2\,u(t-2)$, impulse response $h(t) = e^{-t}u(t)$ and output $y(t)$.

1. Draw a figure depicting the value of the output $y(t)$ for each of the following values of t: $t = -1$, $t = 1$, $t = 2$ and $t = 2.5$.

2. Derive $y(t)$ analytically and plot it.

Exercise 3 (30%)

An RCL series circuit has the transfer function

$$H(s) = \frac{R}{sL + 1/(sC) + R}$$

where $R = 1k\Omega$, $L = 1mH$ and $C = 1nF$.

1. Is the system BBO stable?
2. Find the impulse response of the circuit, in time domain.
3. Find the response to a step function, in time domain.

Exercise 4 (20%)

1. A system is described by the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} = 4\frac{dx}{dt} - 6$. This system is definitely linear.

   (a) Yes

   (b) No

2. A system is time-invariant if delaying the input signal $x(t)$ by a constant T generates the same output $y(t)$, but delayed by exactly the same constant T.

   (a) Yes

   (b) No

3. Both the systems described by $y_1(t) = 3\frac{dx}{dt}$ and $y_2(t) = \frac{x(t+2)}{x(t-1)}$ are time-invariant and linear.

   (a) Yes

   (b) No

4. The impulse response $h(t)$ of a system is simply the response to a unite step function $u(t) = 1$, for $t > 0$.

   (a) Yes

   (b) No

5. A memoryless system is a system whose output $y(t)$ at time instant t depends only on the input at time instant t.

   (a) Yes

   (b) No