Midterm for ELEC 242 FALL 2020

Signals and Systems I (Concordia University)

Concordia University
Department of Electrical and Computer Engineering
November 4th, 2020, 2:45-4:00 PM

ELEC 242 Continuous-Time Signals and Systems
Midterm Exam

Instructor: Jun Cai

Open-book exam (Course notes and textbooks only).

Read all questions completely and carefully before answering them.

Justify your solutions. Incomplete, unjustified and vague answers will receive relatively little credit.

Simplify your answers as much as possible.

Cheating will not be tolerated.

The marking scheme is shown in the left margin and [30] constitutes full marks.

Attach both cover page and question sheets with your solutions.

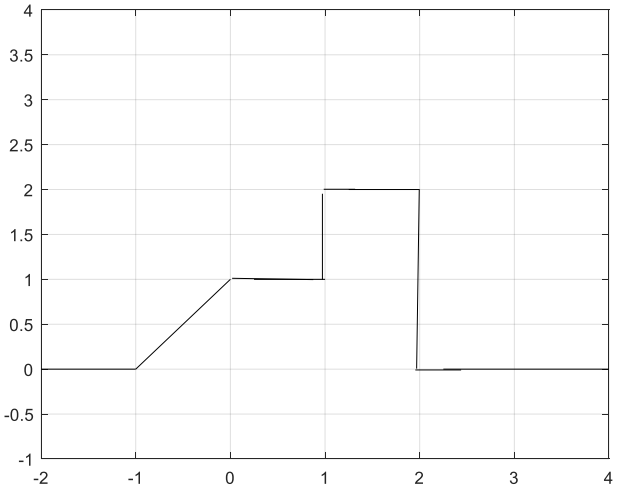
Name and Student ID:

Signature of the student for originality of his/her exam paper:

1. (6 points) Given the function: $x(t) = 10 + 6\cos(10t - \frac{\pi}{4}) + 4\sin(12t + \frac{\pi}{6}) + \cos(20t)$, answer the following questions.
   (a) (2 points) Determine the fundamental frequency and period of the signal.
   (b) (3 points) Compute the Fourier coefficients of the Fourier series for $x(t)$.
   (c) (1 point) Compute the average power of the signal.

2. (8 points)
   (a) (3 points) Given a system with the impulse response: $h(t) = u(t+2) - u(t-1)$. Determine which of the characteristics (BIBO stable, Causal, and Memoryless) are true for the system. Justify your answer.
   (b) (5 points) Given the input: $x(t) = \begin{cases} e^{-t} & 0 \le t \le 2 \\ 0 & \text{otherwise} \end{cases}$, determine the system output $y(t)$ by using graphical convolution.

3. (6 points) Given the function x(t) shown in the figure below.



   Sketch and properly label all relevant information for the following functions:
   (a) (2 points) $x(1 - 3t)$
   (b) (1 point) $x(t) \cdot u(1 - t)$.
   (c) (1 point) $x(t) \cdot [u(t) - u(t - 1)]$.
   (d) (2 points) $x(t) \cdot \delta(t - \frac{3}{2})$.

4. (10 points) Consider a system, which has characteristic functions of $Q(D) = (D^2 - 4D + 4)(D - 8)$ and $P(D) = 1$. Given the input signal $x(t) = e^{-t}u(t)$ and the system initial states of $y(0) = 1$, $y'(0) = 1$, $y''(0) = 1$, answer the following questions.
   (a) (1 point) Represent the system in the form of linear differential equation.
   (b) (4.5 points) Calculate the zero-input response $y_{zi}(t)$.
   (c) (4.5 points) Calculate the zero-state response $y_{zs}(t)$.