

Mock Midterm Test: XMUT220 Signals and Systems

Instructions:

1. Write your name and student ID on each page of your answer sheets.
2. Write your answers in the order of the questions, with proper labelling of each question number and part.
3. Show your solution steps clearly.
4. Correct answers without solution steps will not get full marks.
5. Calculator is permitted.
6. **Cheating is a serious offence; if you are caught cheating in any forms, you will be reported.**

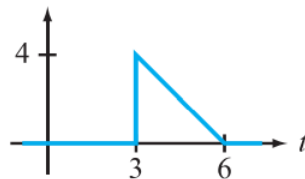
There are five (5) questions in this examination, answer all questions.

Total marks: 50 marks.

Time allowed: 2 hours.

Q1 Signals [12 marks]

- a) Given the waveform of $x(t)$ as shown below, generate and sketch (draw) the waveforms of:



1a) $x(3t + 6)$ [2 marks]

1b) $x(-3t + 6)$ [2 marks]

1c) $x(-3t - 6)$ [2 marks]

You must indicate your working steps and label on your sketches the important numbers clearly.

- b) Determine the period of each of the following signals. If they are not periodic, indicate clearly that they are not periodic.

2a) $x_1(t) = 6 \cos (2\pi t/3)$ [2 marks]

2b) $x_2(t) = 7 \cos (2t/3)$ [2 marks]

2c) $x_3(t) = 6 \cos (2\pi t/3) + 7 \cos (2t/3)$ [2 marks]

Q2 Linear and Time Invariant (LTI) Systems [8 marks]

- a) For this system shown below, specify whether or not it is (i) linear, and/or (ii) time-invariant. You must show your reasoning, instead of just giving simple yes or no answers:

$$y(t) = t x(t) \quad [4 \text{ marks}]$$

- b) We observe the following input-output pair for an LTI system:

- $x(t) = 1 + 2\cos(t) + 3\cos(2t)$,

- $y(t) = 6\cos(t) + 6\cos(2t)$,

- $x(t) \rightarrow \boxed{\text{LTI}} \rightarrow y(t)$.

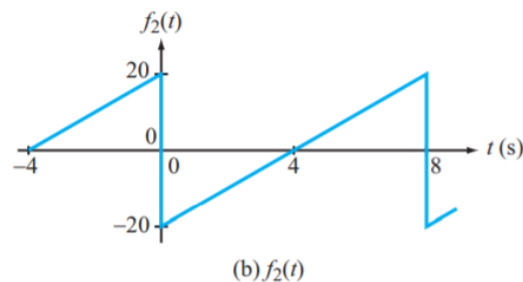
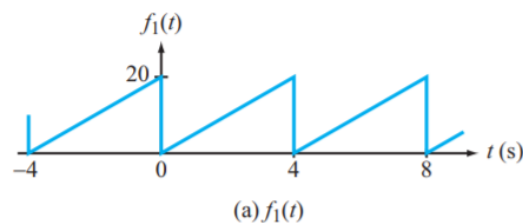
Determine $y(t)$ in response to a new input $x(t) = 4 + 4\cos(t) + 2\cos(2t)$. [4 marks]

Q3 Fourier Series [10 marks]

The Fourier Series of the periodic waveform $f_1(t)$ shown in figure (a) below is given by:

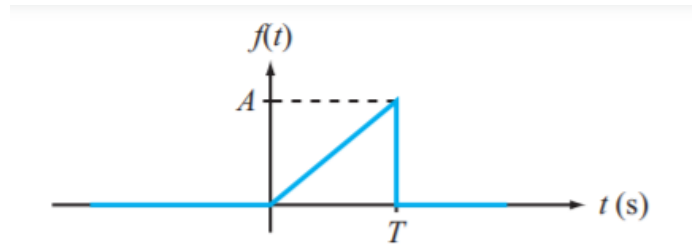
$$f_1(t) = 10 - \frac{20}{\pi} \sum_{n=1}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi t}{2}\right).$$

Determine the Fourier Series of waveform $f_2(t)$ shown in figure (b).



Q4 Fourier Transform [10 marks]

Determine the Fourier Transform of the waveform $f(t)$ as shown below, where $A = 5$ and $T = 3$ s.



Q5 Discrete Time Convolution and DTFT [10 marks]

5a) Compute the following discrete time convolution:

$$\{1, 2, -3\} * u[n]$$

Show your working steps clearly.

[4 marks]

5b) Compute the DTFT of the following signal (simplify your answer to sums of sines and cosines):

$$\{1, 1, 1, 1, 1\}$$

Show your working steps clearly.

[6 marks]

~~~ End of Mid Term test ~~~