UTHM

Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	SIGNAL AND SYSTEM
COURSE CODE	:	BNF 36002
PROGRAMME CODE	:	BNF
EXAMINATION DATE	:	JULY 2024
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS
		2. THIS FINAL EXAMINATION IS CONDUCTED VIA
		☐ Open book
		☒ Closed book
		3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Consider the following continuous signals and determine whether they are power signal or energy signal:

(i) $x_1(t) = e^{-2t} u(t)$

(3 marks)

(ii) $x_2(t) = 5 e^{(j(2\frac{\pi}{9})t)}$

(3 marks)

(iii) $x_3(t) = 4 \sin(6\pi t)$

(3 marks)

(b) A discrete-time signal is shown in **Figure Q1.1**. Sketch and label carefully each of the following signals:

(i) $x[3n - 3]$
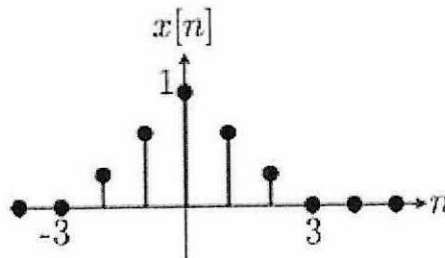
(3 marks)

(ii) $x[n] \, u[4 + n]$

(3 marks)

Figure Q1.1

(c) Determine whether each of the following signals is periodic. If a signal is periodic, specify its fundamental period.

(i) $x(t) = je^{j10t}$

(4 marks)

(ii) $g(t) = 3 \sin(4\pi t) + 7 \cos(3\pi t)$

(6 marks)

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Q2 (a) Compute and plot the convolution y(t) = x(t) ∗ □(t), where.

$$x(t) = e^{-4t} [u(t) - u(t-2)] \text{ and } h(t) = e^{-2t} u(t)$$

(10 marks)

(b) Consider and check the linearity of the following two systems S_1 and S_2.

    (i) $y(t) = x(t^2)$

(5 marks)

    (ii) $y(t) = \sin t . x(t)$

(5 marks)

    (iii) $y(t) = 2 + x(t)$

(5 marks)

Q3 (a) Compute the coefficients a_k using Fourier series analysis equation for the continuous-time periodic signal

$$x(x) = \begin{cases} 1.5, & \& 0 \le t < 2 \\ -2.5, & \& 2 \le t < 3 \end{cases}$$

(7 marks)

(b) Use the Fourier transform analysis to calculate the Fourier transforms of the following signal. Then, sketch and label the magnitude of each Fourier transform

    (i) $e^{-2}(t-1) u(-t-1)$

(5 marks)

    (ii) $\delta(t+1) + \delta(t-1)$

(5 marks)

(c) Use the Fourier transform synthesis equation to determine the inverse Fourier transforms of:

    (i) $X_1(j\omega) = 2\pi\delta(\omega) + \pi\delta(\omega - 2\pi) + \pi\delta(\omega + 2\pi)$

(4 marks)

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(ii) $x_2(jw) = \begin{cases} 2 & 0 \le w \le 2 \\ -2, & -2 \le w \le 0 \\ 0 & |w| > 2 \end{cases}$

(4 marks)

Q4   (a)   Using the definition of Laplace transform, determine the Laplace transform of $f(t) = (\cos(2t) - e^{-2t})(t - 2)$.

(6 marks)

(b)   Demonstrate the inverse Laplace transform of

$$F(s) = \frac{s^2 + 12}{s(s+2)(s+3)}$$

(7 marks)

(c)   The system function of a causal LTI system is

$$H(s) = \frac{s+1}{s^2 + 2s + 2}$$

Determine and sketch the response $y(t)$ when the input is
$$X(t) = e^{-|t|}, \quad -\infty < t < \infty$$

(12 marks)

- END OF QUESTIONS –