UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	SIGNAL PROCESSING
COURSE CODE	:	BWC 40503
PROGRAMME	:	4 BWC
EXAMINATION DATE	:	DECEMBER 2015/JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF FIVE **(5)** PAGES

Q1 (a) Describe briefly the following signals.

(i) Energy signal

(2 marks)

(ii) Periodic signal

(2 marks)

(iii) Random signal

(2 marks)

(b) Determine the type of the following signals.

(i) $x_1(t) = 5e^{-3t}$ where $t \geqslant 0$

(4 marks)

(ii) $x_2(t) = 2cos(2\pi t) + 4sin(\pi t)$ where $-\infty < t < \infty$

(4 marks)

(c) Describe briefly the following types of system.

(i) Linear system

(2 marks)

(ii) Memoryless system

(2 marks)

(iii) Causal system

(2 marks)

Q2 (a) Define and sketch the following elementary signals.

(i) Unit impulse function, $\Omega(t)$

(2 marks)

(ii) Unit step function, $u(t)$

(2 marks)

(iii) Ramp function, $r(t)$

(2 marks)

(b) Sketch the following signals.

(i) $x_1(t) = u(t) - u(-t)$

(4 marks)

(ii) $x_2(t) = r(t-1) + r(-t-1) - r(t) - r(-t) - u(t) - u(-t)$

(4 marks)

(c) Referring to Figure Q2 (c), write the expression for signal $x(t)$ below in terms of the elementary signals $u(t)$ and $r(t)$.

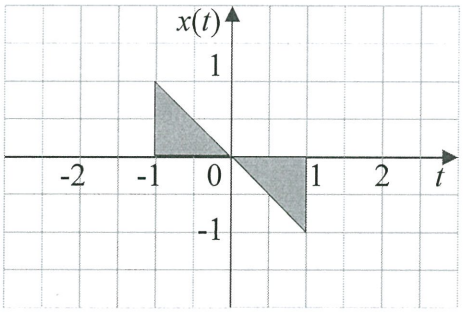

FIGURE Q2(c)

(6 marks)

Q3 (a) Describe briefly a linear time-invariant (LTI) system with the following impulse response $h(t)$.

(i) $h_1(t) = \delta(t)$

(2 marks)

(ii) $h_2(t) = u(t)$

(2 marks)

(iii) $h_3(t) = \frac{d}{dt}\delta(t)$

(2 marks)

(b) Write the mathematical expression relating the input signal $x(t)$ and the output signal $y(t)$ of an LTI system. Describe briefly the output signals of the system for the following input signals.

(i) $x_1(t) = \delta(t)$

(3 marks)

(ii) $x_2(t) = e^{j\omega t}$ where ω is the frequency in rad/s

(3 marks)

(c) Referring to Figure Q3 (c), determine the output signal $y(t)$ of an LTI system for the impulse response $h(t)$ and input signal $x(t)$ as given in the figure below. Describe briefly the difference between the input and the output signals.

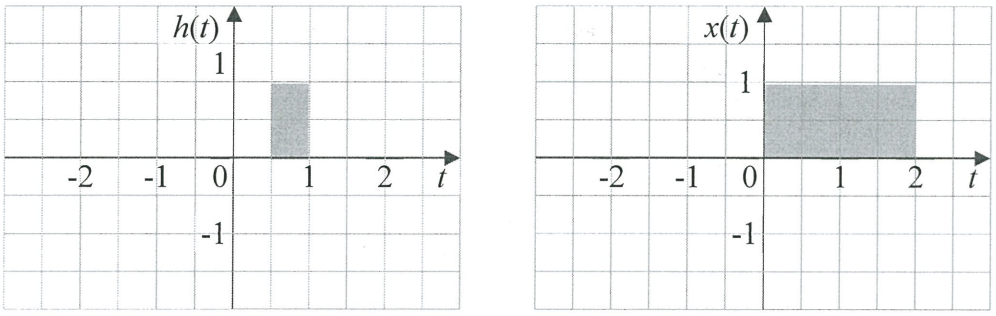

FIGURE Q3 (c)

(8 marks)

Q4 (a) Describe briefly the followings.

(i) Relation between the input and the output signals of an LTI system in frequency domain. Explain all your symbols.

(2 marks)

(ii) Magnitude and phase responses of a system.

(2 marks)

(iii) Power spectrum density (PSD) and energy spectrum density (ESD) of signals.

(2 marks)

(b) Determine the complex Fourier series (CFS) and the Fourier transform of the following signals and sketch the magnitude and phase spectrum.

(i) $x_1(t) = 8sin(3t) + 4cos(6t)$

(4 marks)

(ii) $x_2(t) = \begin{cases} 1 & -2 \leqslant t \leqslant 2 \\ 0 & \text{elsewhere} \end{cases}$

(4 marks)

(c) Describe briefly the followings.

(i) Sampling theorem

(2 marks)

(ii) Sampling process in time domain

(2 marks)

(iii) Sampling process in frequency domain

(2 marks)

Q5 (a) Define and sketch the following elementary discrete-time signals.

(i) Unit impulse function, $\delta(n)$

(2 marks)

(ii) Unit step function, $u(n)$

(2 marks)

(iii) Ramp function, $r(n)$

(2 marks)

(b) A linear, shift-invariant (LSI) system has an impulse response $h(n) = \{1, 2, 1\}$ and input signal $x(n) = \{1, 2, 2, 1\}$ where $n = 0,1,2,3,\ldots$. Calculate the output signal $y(n)$ and sketch all the signals.

(8 marks)

(c) Sketch and describe briefly the magnitude and phase responses of an ideal low-pass filters. Explain all your symbols.

(6 marks)

- END OF QUESTION –