UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

Department of Electrical and Electronic Engineering

SUPPLEMENTARY EXAMINATION
JULY 2012

Title of Paper:

SIGNALS & SYSTEMS I

Course Code: **EE331**

Time: **THREE(3) Hours**

Instructions:

1. Answer any **FOUR** questions.
2. Each question carries 25 Marks
3. Marks for different sections are shown in the right-hand margin.

DO NOT OPEN THE PAPER
UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR.

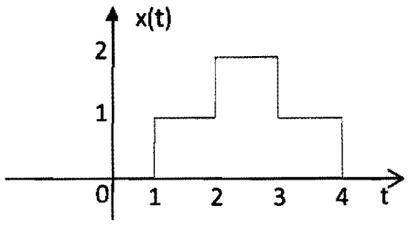
QUESTION 1

(a) Sketch and give the mathematical expressions of the following signals:

(i) discrete-time unit sample (4)

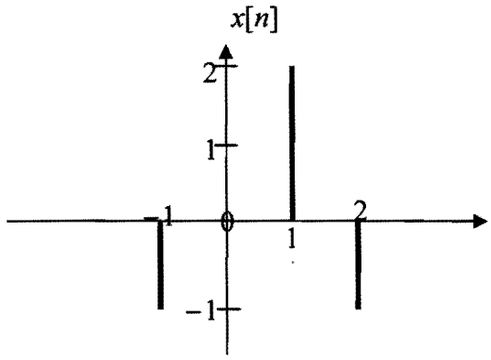
(ii) continuous-time unit step (4)

(b) Sketch and label the even and odd components of the following signal. (6)



(c) Differentiate between a causal system and a non-causal system. (4)

(d) Express the following signal in terms of the unit step, $u[n]$ (3)



(e) Express the following signal in terms of its even and odd components. (4)

$$v(t) = e^{-at}u(t)$$

QUESTION 2

(a) Determine if the following system is: (i) time-invariant, (ii) Linear, (iii) Causal. (8)

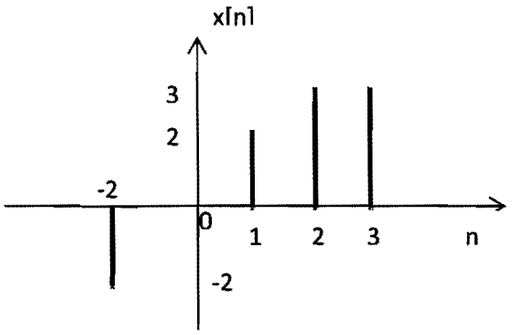
$$y[n] = x[1-n]$$

(b) Determine if the following signal is periodic or not. If periodic, determine the fundamental period

$$x(t) = \sin 2t + \sin \pi t$$ (4)

(c) Sketch and label the signal $x(t) = -3rect(5t-3)$ (4)

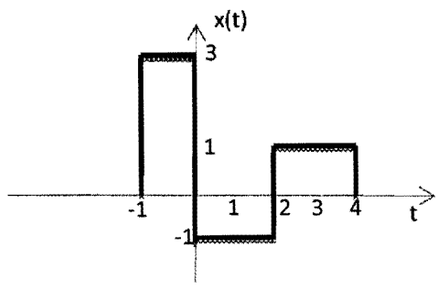
(d) Given the following discrete-time signal, $x[n]$, sketch $x[2n]$ (3)



(e) Use the sifting property of the impulse delta function to simplify the following expression. (2)

$$\int_{-2}^{4}(3t^3+4)\partial(t-2)dt$$

(f) Is the following signal an energy signal or a power signal? Determine its energy or power (4)



QUESTION 3

(a) Show that the following signals are aliased signals. (6)

$$a(t) = \cos\omega_o t \quad \text{and} \quad b(t) = \cos(\omega_o + \omega_s)t$$

, where $\omega_s = 2\pi f_s$ is the sampling frequency in $^{rad}/_{S}$

[hint: $\cos(\alpha + 2n\pi) = \cos\alpha$]

(b) Determine the output of a Linear-Time-Invariant system defined by an impulse response of $\partial[n] - 3\partial[n-1] + 2\partial[n-3]$ when it is fed with a discrete-time input,

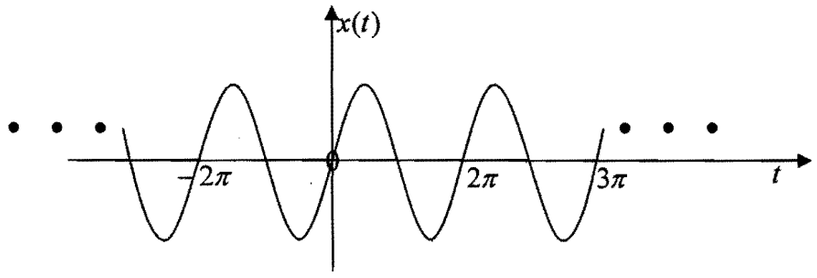
$$2\partial[n] + \partial[n-1] + \frac{1}{2}\partial[n-2] - 2\partial[n-4]$$ (8)

(c) Sketch the signal $x[n] = u[n+3] - u[n] + 0.5^n u[n]$ (3)

(d) Sketch the following signal for three periods only. (3)

$$x(t) = \begin{cases} -t, & -2 \le t < 0 \\ t, & 0 \le t < 1 \end{cases}, \text{ Period, } T = 3$$

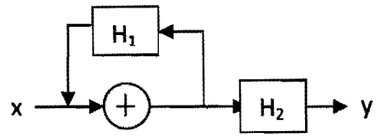
(e) Give any five classifications that define the following signal. (5)



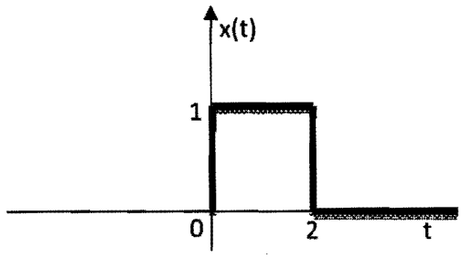
QUESTION 4

(a) What is the fundamental frequency of the following harmonics; 42 Hz, 77 Hz and 105 Hz? (2)

(b) Determine the input-output relationship for the system shown below. (5)



(c) Find the Laplace Transform $X(s)$ and the ROC of the following signal. (4)



(d) Find the inverse Laplace transform of the following. (5)

$$H(s) = \frac{s+17}{s^2+4s-5}$$

(e) Sketch a block diagram representation of the system defined by the following difference equation.(4)

$$y[n] + \frac{3}{5}y[n-1] = 5x[n]$$

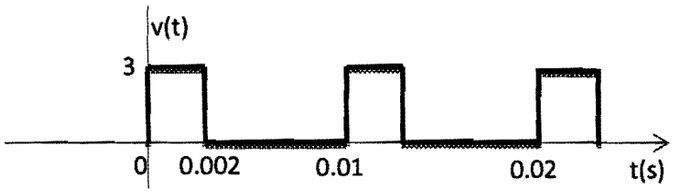
(f) Derive the trigonometric Fourier series from the exponential Fourier series. (5)

QUESTION 5

(a) (i) Find the 0 Hz term and the first two trigonometric Fourier series coefficients of the following voltage signal. (10)

(ii) Plot the single-sided line spectra. (5)

(iii) What is the total power in these components? (5)



b. Find the exponential Fourier representation of the following signal. (5)