TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE (ELECTRICAL & ELECTRONIC ENGINEERING)

EEE 2313 : SIGNALS & COMMUNICATION I

END OF SEMESTER EXAMINATION

SERIES:MAY 2016

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Attempt **Question ONE (Compulsory)** and any other **TWO Questions**

Do not write on the question paper.

Question ONE

a. i. Define convolution

ii. Prove the time convolution theorem, that is,
$x_1(t) * x_2(t) \leftrightarrow X_1(\omega)X_2(\omega)$ (7 marks)

b. Describe with the aid of a diagram, the elements of a communication systems, stating the functions of the different signals in the communication system. (5 marks)

c. Determine if a CT system with input-output relationship given by $y(t) = \frac{dx(t)}{dt}$ is linear (5 marks)

d. Classify the following signal in terms of power and energy
$x_1(t) = Acos(\omega t + \frac{\pi}{4})$

e. Find the generalized Fourier representation of the function
$f(x) = \begin{cases} 1, & -1 < t > 1 \\ 0, & Elsewhere \end{cases}$

over the interval $(-2, +2)$ using the set of orthogonal functions
$\phi_n(t) = \sin\left(n\frac{\pi}{4}t\right), n = 0,1,2 \ldots \ldots$ (13 marks)

Question TWO

a. Prove the Parseval's theorem and conclude Rayleigh's theorem from it.

(5 marks)

b. Write down the exponential form and sketch the double sided spectra of the signal

$$g(t) = \cos(\omega t) + \frac{1}{2}\cos\left(3\omega t + \frac{3}{4}\right)$$ (7 marks)

d. The input ***x(t)*** and the impulse response ***h(t)*** of a continuous time LTI system are given by
$x(t) = u(t)$ $h(t) = e^{-\propto t}u(t),$ $\propto > 0$
Determine the output y(t)

(8 marks)

Question THREE

a. (i) Sketch the signal $f(x) = \begin{cases} x-6, & 0 \le x \le 5 \\ x, & elsewhere \end{cases}$

ii. Delay the signal by 2 seconds. Write down an equation for the resultant signal and sketch the new signal.

iii. Flip $x_1(t)$ around the y-axis and delay the signal by 3 seconds. Write down an equation for the resultant signal and sketch the new signal. (6 marks)

b. For the following signal determine if:

i. periodic and period

ii. deterministic

$$\cos^2(\sqrt{3}t) - 1)$$ (5 marks)

c. (i) Describe three properties that characterize a linear system

(ii) Determine whether the following systems is linear or not:

$$y[n] = T\{x[n]\} = nx^2[n]$$ (6 marks)

d. Define the following terms as used in signals and communication

i) Spectral density

ii) Autocorrelation

(3 marks)

Question FOUR

a. (i) Mathematically define the term linear modulation and explain all the relevant terms involved

(ii) Highlight THREE types of linear modulation involving a single message signal. (5 marks)

b. (i) Sketch the block diagram of Quadrature –Carrier Multiplexing (QAM) transceiver system.

(ii) Explain the operation of the system in (i). (8 marks)

c. (i) Distinguish between a baseband and a pass-band PCM transmission system.

(ii) Sketch a block diagram of a baseband transmission system explaining the functional operation.

(7 marks)

Question FIVE

a. Suppose that the modulating signal *m(t)* is a sinusoid of the form

$$m(t) = a\cos 2\pi f_m t \qquad f_m << f_c$$

Determine the DSB-SC AM signal and its upper and lower sidebands (7 marks)

b. The message signal m(t) has a bandwidth of 10 KHz, a power of 16 W and a maximum amplitude of 6. It is desirable to transmit this message to a destination via a channel with 80-dB attenuation and additive white noise with power-spectral density $S_n(f) = \frac{N_0}{2} = 10^{-12}\,W/Hz,$ and achieve an SNR at the modulator output of at least 50 dB. What is the required transmitter power and channel bandwidth if the following modulation schemes are employed?

i) SSB AM

ii) Conventional AM with modulation index equal to 0.8 (13 marks)