# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

## UNIVERSITY EXAMINATION 2016/2017

## BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS

## EEE 4309: SIGNALS & COMMUNICATION

END OF SEMESTER EXAMINATION

## SERIES: DECEMBER 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.**

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**Question ONE**

a. i. Let $x(t)$ be the complex exponential signal $x(t) = e^{j\omega_o t}$ with radian frequency $\omega_0$ and fundamental period $T_o = {}^{2\pi}/_{\omega_o}$. Consider the discrete-time sequence $x[n]$ obtained by uniform sampling of $x(t)$ with sampling interval $T_s$. That is, $x[n] = x(nT_s) = e^{j\omega_o nT_s}$

Find the condition on the value of $T_s$ so that $x[n]$ is periodic.

ii. Find the even and odd components of $x(t) = e^{jt}$ (6 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)

c. A carrier wave signal $y_1(t) = A\sin\omega_C t$ is amplitude modulated by a single frequency sinusoidal signal $y_2(t) = B\sin\omega_m t$. Determine the expressions for the upper side and lower side frequency components of the modulated wave (6mks)

d. Determine if a CT system with input-output relationship given by $y(t) = 5x(t) + 3$ is linear (5 marks)

e. Classify the following signal in terms of power and energy
$x(t) = Acos\left(\omega t + \frac{\pi}{4}\right)$ (4 marks)

f. Sketch the following CT signal:
$x(t) = u(t) + 2u(t-3) - 2u(t-6) - u(t-9)$ (2 marks)

**Question TWO**

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 THREE**

a. State the Dirichlet conditions that a periodic signal x(t) must satisfy for it to have a Fourier series representation.

(3 marks)

b. Determine the Fourier series of the triangular waveform shown in **Figure** Q2. (13 marks)

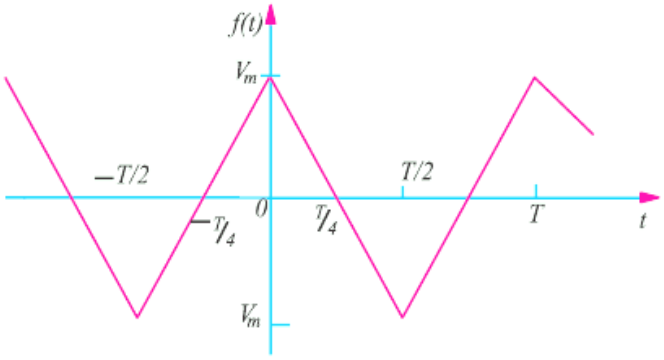


**Figure Q2**

c. Consider the signal $x(t) = e^{-2t}u(t)$. Determine and plot the time-shifted version $x(t-4)$.

(4 marks)

**Question FOUR**

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 15 KHz, a power of 14 W and a maximum amplitude of 5. It is desirable to transmit this message to a destination via a channel with 70-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 60 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 0.4 (13 marks)

**Question FIVE**

a. Prove the Parseval's theorem. (4 marks)

b. Let T represent a discrete-time LTI system. Then show that $T\{z^k\} = \rho z^k$

where z is a complex variable and ρ is a complex constant. (8 marks)

c. The input ***x( t )*** and the impulse response ***h( t )*** of a continuous time LTI system are given by

$x(t) = u(t) \qquad h(t) = e^{-\propto t}u(t), \qquad \propto > 0$

Determine the output y(t) (8 marks)