KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SCE 430: COMMUNICATION SYSTEMS

DATE: Monday 16th April, 2012 **TIME:** 2.00 p.m. – 4.00 p.m.

INSTRUCTIONS:

(i) *There are **Five** questions.*
(ii) *Question No.1 is **Compulsory** and carries **30 Marks.***
(iii) *Select any **other Two** questions, each of which carries 20 Marks.*
(iv) *Define all symbols used.*
(v) *Marks will be awarded for procedure, methodologies used and not necessarily on the final answer.*

Q1. (a) (i) Show that the frequency spectrum of an amplitude modulate signal has two sidebands. (4 MARKS)

(ii) Explain what frequency modulation of a signal is and show how it compares to AM. (4 MARKS)

(iii) Draw the schematic diagram of a *varactor diode* based Phase Modulator circuit. (2 MARKS)

(b) (i) Using relevant spectral diagram(s) demonstrate thorough understanding of:-

1. White Noise. (3 MARKS)
2. Narrowband Noise. (2 MARKS)

(ii) Using a suitable shematic diagram explain the operation of a Balanced FM demodulator. (5 MARKS)

(c) (i) In FM commercial broadcasting certain techniques are applied to improve *SNR*.

1. Name the techniques. (2 MARKS)

2. With the aid of suitable diagrams, briefely demonstrate how they operate. (4 MARKS)

(ii) Give a comparative analysis of *PCM* and other analog modulation systems. (4 MARKS)

Q2. (a) A double side band AM radio transmitter gives a power output of 5kW when the carrier is modulated with a sinusoidal signed to a depth of 95%. If after modulation by a speech signal which produces an average modulation depth of 20%, the carrier and one side band are supressed, determine the mean output power in the remaining side band. (10 MARKS)

(b) Consider an amplitude modulated signal $S(t) = A_c[1+A_m\text{Cos}\omega_m t]\text{Cos}\omega_c t$. Derive the expression for the total normalised power in $S(t)$. (5 MARKS)

(c) A DSB (suppressed carrier) signal of the form $m(t)\text{Cos}\omega_c t$ is to be demodulated. Show that multiplying this signal by $\text{Cos}\omega_c t$ in a product modulator reproduces $m(t)$. (5 MARKS)

Q3. (a) Given below is an *FM* signal $S(t)$ which contains noise. Draw the phasor diagram for $S(t)$ when the signal is dorminant and give the *SNR*. (5 MARKS)

$$S(t) = A_c\text{Cos}[\omega_c + \varphi_c(t)] + r(t)\text{Cos}[\omega_c + \varphi_c(t)]$$

(b) Explain the operation of the frequency shift keying scheme. (5 MARKS)

(c) The Radio Frequency Bandwidth of a frequency modulation transmitter is 100 KHz when a 5KHz modulating signal is applied to the input. What Bandwidth is required if the modulating signal level is reduced by 6dB. (10 MARKS)

Q4. A single information Channel carries voice frquencies in the range 50 – 3,300Hz. The channel is sampled at an 8KHZ rate and the resulting pulses are transmitted over either PAM or PCM system.

(a) Calculate the minimum bandwith of the PAM system. (5 MARKS)

(b) In the PCM system, the sample pulses are quantized into eight levels and transmitted as binary digits. Find the transmission Bandwidth of the PCM system, and compare with that of (a). (10 MARKS)

(c) Explain the need for repeated and eaqualizers in conmmincation systems. (5 MARKS)

Q5. (a) (i) State Carson's rule. (4 MARKS)

(ii) Using relevant schematic diagrams, explain how a PCM signal is obtained from an analog baseband signal. (8MARKS)

(b) From first principles, show that the capacity of a white bandlimited Channel, C, is related by the Signal Power, *S*, and Noise Power, *N*, and Bandwidth, B, by:-

$C = B \ln(1 + {}^{S}/_{N})$. (8 MARKS)