TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 2417: SIGNALS AND COMMUNICATIONS II:

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: SEPTEMBER 2018

TIME: 2 Hours

DATE: SEPTEMBER 2018

INSTRUCTIONS TO CANDIDATES

You have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE QUESTIONS; Question one is compulsory. In addition attempt any other TWO questions

Do not write on the question paper

QUESTION 1 (Compulsory 30 marks)

(a) Describe the following types of noise associated with electronic equipments.
(i) Thermal

(ii) Shot
(iii)Transit time (6 marks)

(b) Show that the overall noise factor of combination of three two port networks connected in cascade expressed in terms of the individual noise factors and gains of the individual networks is given by;

$$F=F_1+\frac{F_2-1}{G1}+\frac{F_3}{G1G2}$$ *(8 marks)*

c) A noise power of -100dBm is available from a receiver antenna system over a 20MHz bandwidth, assuming the room temperature is 293K

i) Determine the noise temperature of the antenna

ii) The antenna is connected to an amplifier whose noise figure is 1.6dB and available gain of 30dB over the effective bandwidth. Determine the available noise power out of the amplifier (8marks)

d) i) State the Wiener Khintchine theorem

ii) Sketch the power spectral density against frequency assuming both positive frequencies for Gaussian white noise (4marks)

e) Consider an FM broadcast system with parameters Δf=75 kHz and B=15kHz.Assuming Sx=0.5, Determine the SNR and calculate the improvement (in dB) over the baseband system (4marks)

QUESTION 2

(a) Define the cross-correlation function of two random variables (2marks)

(b) White noise is passed through low pass ideal filter with bandwidth ±BHz

i. Show that $R(\tau)=P_0 B\frac{\sin 2\pi B\tau}{2\pi B\tau}$

Where P_0 is the power spectral density per Hz for positive frequencies only and R(τ)is the autocorrelation of filtered white noise

ii. Sketch the variation of R(τ)with respect to τ and explain its significance (7marks)

(c) The input to an RC low pass filter in Fig Q2(c) is white noise with power spectral density $\frac{P_0}{2}$ watts/Hz. Determine the output power spectral density and average noise power (7marks)

(d) Show that in an AM system with envelope detection the output SNR is given by SNR=$\frac{\mu^2}{2+\mu^2}\gamma$ where μ is the modulation index for AM and γ is (Assume sinusoidal modulation)

(4marks

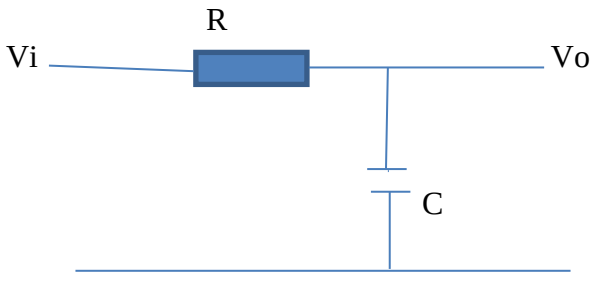

Fig. Q2(c)

QUESTION 3

(a) Explain the meaning of the following terms with respect to discrete memoryless source
   i) Source coding
   ii) Entropy coding (4marks)

b) State the Shannon Hartley theorem (2marks)

c) Explain briefly how ARQ and FEC error codes are used (2marks)

d) Consider a discrete memoryless source with alphabet (S1,S2 ,S3, S4, S5, S6) and probabilities of occurrence (0.3,0.25, 0.2,0.12,0.08 and 0.05);
   (i) Construct a Shannon-Fano code for this source and determine the efficiency of the code
   (ii) Repeat for the Huffman code and compare the results
   (8marks)

e) A terminal is used to enter alphanumeric data into a computer. The CRT is connected to the computer through a voice grade telephone line having a usable frequency range of 300Hz to 3200 Hz and output signal to noise ratio of 12dB.If each character is encoded using 8bits, calculate
   (i) Capacity of the channel
   (ii) Maximum alphanumeric characters per second that can be transmitted from the terminal of the computer without errors (4marks)

QUESTION 4

a) With the aid of a well labeled block diagram, explain the operations of a super heterodyne FM radio receiver (5marks)

b) Explain with the help of a circuit diagram and waveforms the operation of an FM slope detector (4marks)

c) Explain FOUR factors that influence the choice of the intermediate frequency in any radio system (2marks)

d) A double super heterodyne receiver has intermediate frequencies of 6MHz and 200kHz and is tuned to receive signal at 20 MHz Calculate the frequencies of the first and second local oscillators (2marks)

e) Show that for a series R, L, C circuit that the ratio A of the magnitude of the current at resonance ω_0 to the magnitude of the current at any frequency ω is given by

$$A=\sqrt{1+(\rho Q)^2}$$

where $Q=\frac{\omega L}{R}$ and $\rho=\frac{\omega}{\omega_0}-\frac{\omega_0}{\omega}$ (7marks)

QUESTION 5.

(a) Define a satellite communications transponder (1marks)

b). Draw a well labeled simplified block diagram of C Band communications satellite transponder and briefly explain its operation (5marks)

c) Explain briefly how the same frequency re-use is achieved in satellite communication (4marks)

d) Name Four methods used for multiple access of a single transponder by multiple uplink and down link stations (2marks)

e) A satellite communications system has the following parameters:
   Uplink frequency = 12GHz

Transmit earth station antenna diameter =1.3m
Earth station transmitter Power =120W
Location of satellite above earth's surface=36,000km
Satellite Gsat/Tsat=0.0dB
Transmitting earth station antenna efficiency=0.6
Boltzmann's constant=1.38x 10^{-23} J/K
Determine:
(i) EIRP(dBW)
(ii) Free space path loss
(iii)Carrier power received at the satellite(watts)
(iv) Carrier to Noise density ratio at the satellite(dB) (8marks)