# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING AND TECHNOLOGY

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

## UNIVERSITY EXAMINATION FOR:

**THIRD YEAR EXAMINATION FOR THE DIPLOMA OF SCIENCE IN ELECTRICAL ENGINEERING (DTIE 6)**

**ETI 2304: COMMUNICATION SYSTEMS II**

END OF SEMESTER EXAMINATION

**SERIES:** DECEMBER 2016

**TIME:** 2HOURS

**DATE: 2016/2017**

**Instructions to Candidates**

You should have the following for this examination
*-Answer Booklet, examination pass and student ID*
This paper consists of 5 questions. Attempt ANY THREE QUESTIONS
**Do not write on the question paper.**

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You are provided:

$Boltzmann's\ constant,\quad K = 1.38 \times 10^{-23} J/K$
$Room\ temperature,\quad T_o = 290\ Kelvin$

**Question 1** (20 marks) - Compulsory

a. Describe the following types of noise in terms of their source and power spectral density
   (i) Thermal noise
   (ii) Flicker noise
   (iii)Partition noise

[6 marks]

b. Using a suitable diagram, explain the operation of an envelope detector in the detection of AM signals. [5 marks]

c. Find the signal to noise ratio in a baseband system with a bandwidth of 5 kHz and noise power spectral density $\frac{N_o}{2} = 10^{-12} W/Hz$ given that a transmission power of 2 kW is used and channel attenuation is 40dB. [4 marks]

d. The first stage of a 2-stage amplifier has a voltage gain of 150, an input resistance of 1500 Ω, an equivalent noise resistance of 700 Ω and an output resistance of 20 kΩ. For the second stage, these values are 500, 50 kΩ, 1200 Ω and 1 MΩ respectively. Calculate the equivalent noise resistance of this 2-stage amplifier [5 marks]

**Question 2** (20 marks)

a) Define noise and state the sources of noise in a communication system [4marks]
b) Describe 3 types of noise and how they can be reduced in a communication system [5 marks]
c) A noise output of a resistor is amplified by a noiseless amplifier having a gain of 60 and a bandwidth of 20Khz. Ammeter connected to the output of the amplifier reads 1mv R.M.S
   i. If the bandwidth of the amplifier is reduced to 5 KHz, gain remaining constant. What is the new meter reading?
   ii. If the resistor is operated at 80'C, what is the resistance value?
   iii. For the same resistor, what bandwidth of amplifier with a gain of 180 is needed for a reading of 300uv? [6marks]

Under the same conditions, two resistors give readings of 3mv and 4.5 mv respectively

   i. what is the ratio of the values of the two resistors
   ii. if the first resistor is 15MΩ, what is the value of the second resistor [5marks]

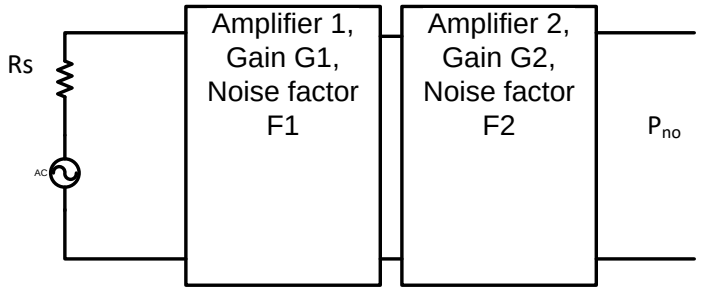
**Question 3** (20 marks)

a. A resistor of value 20 kΩ is connected at the input of an amplifier operating in the frequency range 100 MHz to 120 MHz. determine the rms noise voltage at the input of the amplifier if the ambient temperature is $27^o$ C. [2 marks]

b. Three 12 KΩ resistors are connected in series. For power spectral density ($kT = 10^{-11}W/Hz$) and an effective bandwidth of 5 MHz, determine:

   (i) The noise voltage appearing across the resistors if they are connected in series. [3 marks]
   (ii) How much rms noise voltage which would appear across the three resistors connected in parallel under the same conditions? [3 marks]

c. Derive an expression for the overall noise temperature of the system of cascaded amplifiers below.




[12 marks]

**Question 4** (20 marks)

a. A signal generator of internal resistance of 50 Ω and an EMF of 10 μV is connected to the input of an amplifier that has an effective noise resistance of 1200 Ω and an input resistance of 600 Ω. Calculate the SNR at the input for a noise bandwidth of 1 kHz at room temperature. [5 marks]

b) Calculate the power that must be transmitted from a geostationary satellite to give a power of 116 dB at a receiver on the earth. Assume F = 10 GHz, Gr = 40dB, Gt = 30dB and in addition losses of 5 dB. H = 35855 km[5 marks]

c) Discuss the three types of multiple access methods used in communication systems [6 marks]

d) Calculate the maximum range of a radar system which operates at 3cm with a peak pulse power of 500 kW, if the minimum receivable power is 10-13W,Ao = $5m^2$ and S = $20m^2$
Ao – capture area of antenna
S- Radar cross-section area of the target [4 marks]

**Question 5** (20 marks)

a. Using a suitable diagram, explain the construction and operation of a superhetrodyne radio receiver. [10 marks]

b. Design an FM system that achieves a SNR of 40 dB at the receiver output and that requires the minimum amount of transmitter power. The bandwidth of the channel $B_c = 120\,kHz$; the message bandwidth $W = 10\,kHz$; the average-to-peak power ratio for the modulating signal is $P_{Mn} = 0.5$; and the one sided noise power spectral density is $kT = 10^{-15}\,W/Hz$. What is the required transmitter power if the signal suffers an attenuation of 50 dB during transmission through the channel? [10 marks]