



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF _____

DEPARTMENT OF

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

**FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR
OF**

EES423: ANALOGUE AND DIGITAL COMMUNICATIONS SYSTEMS

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

- a) Define the following terminologies (6marks)
- i. Modulating index
 - ii. Discrete memoryless system
 - iii. Latency
 - iv. Throughput
 - v. Bandwidth
 - vi. IoT
- b) Describe how Massive MIMO systems are influencing the future (3marks)
- c) Define attenuation, and state any three factors that cause attenuation in data cables (4marks)
- d) State the function of the following components in a digital communication system (4marks)
- i. Input transducer
 - ii. Source encoder
 - iii. Channel encoder
 - iv. Digital modulator
- e) The tuned circuit of the Oscillator in a simple AM transmitter employs 40_____ and 12nF capacitor. If the oscillator output is modulated by audio frequency of 5KHz, What are the lower and upper sideband frequencies and Bandwidth required to transmit the AM wave? (5marks)
- f) Draw the frequency domain of DSBFC system (4marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS

QUESTION TWO (20 MARKS)

- a) Given a random process $x(t) = A \cos(\omega t + \theta)$ where

- A, Ware constants and \mathbf{P} is a uniform random variable. Show that $x(t)$ is ergodic in both mean and auto correlation (10marks)
- b) Define power spectral density (PSD) and discuss any five properties of PSD (6marks)
- c) Derive the input and output relationship of a random process applied through a _____ filter (4marks)

QUESTION THREE (20 MARKS)

- a) Define Huffman coding and enumerate four steps involved in its algorithmic development (5marks)
- b) Compare the Haffman coding and Shannon –fano coding algorithm for data compression for a discrete memory less source with six symbols. Find a compact code for every symbol if the probability distribution is as follows
 $x_1 = 0.3, x_2 = 0.25, x_3 = 0.2, x_4 = 0.12, x_5 = 0.05$
 Calculate entropy of the source, average length of the code, efficiency and redundancy of the code (10marks)
- c) State any five differences between AM and FM (5marks)

QUESTION FOUR (20 MARKS)

- a) Discuss the following multiple access technologies using equivalent diagrams (7marks)
- I. FDMA
 - II. TDMA
 - III. CDMA
 - IV. OFDMA
- b) State the differences between active RFID and passive RFID (4marks)
- c) Describe three reasons why modulation is extremely necessary in communication systems (3marks)
- d) An audio frequency signal $10 \sin 2\pi x 500t$ is used to amplitude modulate a carrier of _____ Calculate (6marks)
- i. Modulation index
 - ii. Sideband frequencies

- iii. Amplitude of each sideband frequencies
- iv. Bandwidth required
- v. Power delivered to the load of 600Ω