MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

EEE 401: COMMUNICATION SYSTEMS II

DATE: **TIME:**

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.

QUESTION ONE (COMPULSORY) (30 MARKS)

a) (i) Demonstrate thorough understanding of quantization noise. (5 marks)

(ii) Define the following: -

1. Distortion. (2 marks)
2. Interference. (3 marks)

b) (i) A continuous-time signal $x(t)$ is obtained at the output of an ideal lowpass filter with a cut-off frequency $\omega_c = 1{,}000\pi$. If impulse-train sampling is performed on $x(t)$, which of the following sampling periods would guarantee that $x(t)$can be recovered from its sampled version using an appropriate lowpass filter? (6 marks)

1. $T = 0.5 \times 10^{-3}$.
2. $T = 2 \times 10^{-3}$.
3. $T = 10^{-4}$.

(ii) State the Sampling Theorem. (4 marks)

c) Distinguish between the following: -
(i) Thermal Noise and Shot Noise. (5 marks)
(ii) BPSK and BFSK. (5 marks)

QUESTION TWO (20 MARKS)

(a) Starting with Hartley-Shannon Law, derive a relationship for the Channel in the presence of white noise as bandwidth is increased without limit. (15 marks)

(b) Give possible applications of this system depicted in (a) above. (5 marks)

QUESTION THREE (20 MARKS)

Channel 1 of a two channel PAM system handles $0 - 8\ kHz$ signal the second channel handles $0 - 10\ kHz$. The two channels are sampled at equal intervals of time using very narrow pulses at the lowest frequency that is theoretically adequate. The samples are time multiplexed and passed through a low pass (LP) filter before transmission. At the receiver, the pulses in each of the two channels are passed through appropriate holding circuits (i.e., sample-hold) and LP filters.

(a) What is the minimum clock frequency of the PAM system? (7 marks)

(b) What is the minimum cut-off frequency of the LP filter used before transmission that will preserve the amplitude information on the output pulse.

(8 marks)

(c) What would be the minimum bandwidth if these channels were frequency multiplexed using normal AM and SSB techniques. (5 marks)

QUESTION FOUR (20 MARKS)

(a) (i) Explain in detail the principles of PCM. (6 marks)
(ii) Mention advantages and disadvantages of PCM over other modulation methods. (4 marks)

(b) Describe a method whereby PCM signals may be generated from analogue signals for transmission over a communication network and translated back to the original analogue signal at the receiver. (10 marks)

QUESTION FIVE (20 MARKS)

(a) Show that for a PCM system, the post-detection Signal-to-Noise Ratio (SNR) is given be $3q^2m^2$, where q is the quantization level and m is the signal strength. (10 marks)

(b) (i) State what Noise in Communication Systems is. Give examples. (4 marks)
(ii) Obtain an expression for Obtain an expression for the bandwidth required to transmit a PCM signal. (6 marks)