



MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 432: TELEMETRY AND COMMUNICATION

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

Answer **QUESTION ONE** and **ANY OTHER TWO** questions.

Question 1 carries **30** marks and the others carry **20** marks each.

YOU MAY USE:

You may need to use the following constants:

$c=2.998 \times 10^8 \text{ m/s}$, Boltzmann's constant, $K = 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$, Plank's constant=
 $6.63 \times 10^{-34} \text{ m}^2 \text{ kg/s}$

QUESTION ONE (COMPULSORY) (30 MARKS)

- What are the important properties of a carrier signal? (3 marks)
- Provide a reason as to why modulation is important in communication. (2 marks)
- Identify the factors affecting signal propagation and transmission. (3 marks)
- Define crosstalk and explain how its effects can be minimized. (3 marks)
- Show that from the linear units of power levels, the gain or loss in a fibre is given in dB scale. (3 marks)

- f) Identify the three forms of dispersion. (3 marks)
- g) Differentiate between lumped and distributed elements of a transmission line (2 marks)
- h) Define the following terms;
 - i) Carrier wave (2 marks)
 - ii) Shannon-Hartley theorem (2 marks)
- i) The output power of a transmitter is measured to be 2 mW before launch. What will be the gain or loss if the light is passed through a crystal with an output power of 18 mW? (3 marks)
- j) Identify the two domains of signals and describe how they can be achieved interchangeably (4 marks)

QUESTION TWO (20 MARKS)

- a) Show that the group delay, τ_g is given by $\frac{1}{v_g}$ where v_g is the group velocity. (10 marks)
- b) Describe the different types of analogue modulation schemes. (6 marks)
- c) Identify any four forms of digital modulation techniques. (4 marks)

QUESTION THREE (20 MARKS)

- a) While labelling its parts, sketch the components of a carrier wave. (4 marks)
- b) Show that the bandwidth of a carrier wave is twice the modulating frequency. (7 marks)
- c) Describe any two multiplexing techniques. (4 marks)
- d) Using an illustrative sketch of attenuation versus wavelength, identify the wavelengths with minimum losses in a fibre. (5 marks)

QUESTION FOUR (20 MARKS)

- a) Discuss the advantages and disadvantages of double sideband suppressed carrier. (5 marks)
- b) Describe the phenomena of intersymbol interference and identify ways to counter its effects. (5 marks)
- c) Describe the working principle of a Nyquist filter. (4 marks)
- d) Describe the following modulation techniques:
 - i) Frequency shift keying (3 marks)
 - ii) Quadrature amplitude modulation (3 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the following process;
- i) Signal averaging (5 marks)
 - ii) Phase sensitive detection (5 marks)
- b) At the transmitter, the signal power is 23 mW. The input SNR is 40 dB. The channel offers 3 dB attenuation (splitting into half the signal power) to the signal and the output noise is thrice the input noise level. Determine the SNR at the output. (6 marks)
- c) Identify any four sources of noise in a communication link. (4 marks)