



MACHAKOS UNIVERSITY

University Examinations for 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (TELECOMMUNICATION AND INFORMATION
TECHNOLOGY)

SPH 447: TELEPHONE AND TELEPHONY

DATE:

TIME:

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) State
- i. two limiting factors in the length of the subscriber loop;
 - ii. **three** ways of extending the length of the subscriber local loop.
- (3 marks)
- b) A local serving switch provides a battery voltage source for the subscriber loop.
- i. State the nominal voltage of this battery
 - ii. Name a **three** functions that this emf source provides
- (4 marks)
- c) State the **three** primary functions provided by the switching systems
- (3 marks)
- d) State **three** major components of a PBX
- (3 marks)
- e) The maximum calls per hour in a mobile cell equals 4000 and the average call holding time is 160 seconds. For a GoS of 2 % determine the:
- i. Offered load
 - ii. Number of channels required to handle the load

(6 marks)

f) Explain each of the following as used in the SDH transmission scheme

- i. Container
- ii. Virtual container
- iii. Tributary unit

(6 marks)

g) State four components of an SDH frame

(4 marks)

h) State three types of supervisory signaling in public telephone networks

(3 marks)

QUESTION TWO (20 MARKS)

a) State and explain any three advantages of SDH over PDH

(6 marks)

b) With the aid of a labelled block diagram show the connection of SDH devices in the SDH physical configuration and describe each component

(10 marks)

c) (i) Draw the SDH frame and show that the line rate calculation of STM-1

(ii) From c(i) obtain the rate of each of the following STM levels

- I. STM-4
- II. STM-16

(4 marks)

QUESTION THREE (20 MARKS)

a) Describe each of the following components of a telephone network

- i. Edge devices
- ii. Local loop
- iii. Central office switch
- iv. Trunk

b) (i) Describe each of the following dialing techniques in telephony

- I. Dual tone multifrequency dialing

II. Pulse dialing

- (ii) Explain the need of a PBX in an organization
- c) A transmission format uses a frame length of 1 ms which is subdivided into 100 time-slots. Each time slot contains 100 bits. Determine the:
 - i. Data rate of the transmission line
 - ii. Data rate of each channel if each time slot corresponds to one fixed-rate channel
 - iii. The number of time slots that must be assigned to a connection requiring a data rate of 2 Mbits/sec

QUESTION FOUR (20 MARKS)

- a) State **two factors** that influences the size of a cellular network (2 marks)
- b) In a cellular network, the total available voice channels to handle traffic are 960. The area of each cell is 6 km^2 and the total coverage area of the system is 2000 km^2 . Determine the:
 - i. System capacity if the cluster size is 4
 - ii. System capacity if the cluster size is 7
 - iii. The number of times the cluster size of 4 have to be replicated to cover the entire cellular area(7 marks)
- c) (i) Draw the TDM frame of each of the following transmission standards
 - I. E system
 - II. T system(ii) Using the frames in (i), determine the bit rate of each of the systems (10 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the evolution and development of wireless networks, clearly stating the distinguishing feature of each generation. (7 marks)
- b) (i) Show that the reuse distance between the co-channels in a cellular network is given by $D = \sqrt{3N} R$.

- I. Network capacity
- II. Cochannel interference

- c)
 - (i) Explain any **two challenges** of the implementation of the 5G networks
 - (ii) Explain the **current** state of implementation of 5G networks in Kenya

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