



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ELECTRICAL AND ELECTRONICS ENGINEERING)

SPH 447: TELEPHONE AND TELEPHONY

DATE:

TIME: 2 HRS

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 Marks)

- a) With respect to a PSTN explain the function of each of the following components of the central office switch
(i) Battery
(ii) Current detector
(iii) Dual tone generator
(6 marks)
- b) State the **three** primary functions provided by the switching systems
(3 marks)
- c) State **three** major components of a PBX
(3 marks)
- d) 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
(5 marks)
- e) Explain each of the following as used in the SDH transmission scheme
(i) Container
(ii) Virtual container
(iii) Tributary unit
(6 marks)
- f) State four components of an SDH frame
(4 marks)

- g) 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) A cellular system has the following design parameters:
- Desired $SIR = 15dB$
 - Path loss exponent $n = 4$
 - i. Obtain the required cluster size N to meet the design criterion
 - ii. Determine the worst case SIR for the cluster size in $b(i)$
- (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) Draw the GSM architecture showing all the sub-systems
(ii) Describe the components of the network and switching sub system (9 marks)
- 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. (4 marks)