



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FIFTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE
IN ELECTRICAL AND ELECTRONICS ENGINEERING

EEE 544: TELETRAFFIC ENGINEERING

DATE: 31/7/2017

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

This paper consists of **FIVE** questions. Answer Question **ONE** and any other **TWO** questions

QUESTION ONE (COMPULSORY-30 marks)

- a) Define the following as used in traffic engineering
i) Erlang
ii) Offered traffic
(2 marks)
- b) State **any two** reasons of layering in network protocols
(2 marks)
- c) Table 1 shows communication functions and OSI model layers. Match the communication functions to the relevant layers
(4 marks)
- | OSI model layers | Communication function |
|------------------|------------------------|
| Data link | Bit Synchronization |
| Presentation | Compression |
| Physical | Logical routing |
| Network | Framing |
- d) With respect to ISDN, distinguish between **basic rate interface** and **primary rate interface**
(4 marks)
- e) With respect to local area networks, describe carrier sense multiple access with collision detection (**CSMA/CD**)
(5 marks)

- f) With respect to local access network of a PSTN, briefly describe the following access technique technologies
- i. Wireless local loop (WLL)
 - ii. Twisted pair cable
 - iii. Optical fibre
- (6 marks)
- g) Determine the approximate capacity of a network(i.e. how many channels should be available) if there are 100 subscribers and each of them generates an offered traffic of 40 mErl, for a probability of blocking of :
- i. 20%
 - ii. 1%
- (4 marks)
- h) State **three** advantages of Synchronous Digital Hierarchy (SDH) transmission system over Pleiosynchronous Digital Hierarchy (PDH) system.
- (3 marks)

QUESTION TWO (20 MARKS)

- a) With the aid of a labeled block diagram, show the ISDN generic components, clearly labeling the interfaces between them
- (8 marks)
- b) (i) The Erlang B formula given below is widely used to calculate the blocking probability for incoming calls where P_b is the blocking probability, c is the number of trunks in a network and a is the offered traffic load

$$P_b = \frac{a^c / c!}{\sum_{k=0}^c \frac{a^k}{k!}}$$

- I. The unit used for traffic load in the formula is Erlang. Explain the meaning of 1 Erlang in a communication network
 - II. Given that $a = 0.3$ Erlang and $c = 4$, obtain the blocking probability.
 - III. For fixed c , determine whether P_b increases or decreases as a is increased. Explain your answer.
- (ii) From the subscriber point of view distinguish between reliability and availability as applied to the networks

(12 marks)

QUESTION THREE (20 MARKS)

- (a) (i) Describe the structure of the telephone number hierarchy
(ii) Describe the following signaling schemes
I. Channel associated signaling(CAS)
II. Common Channel Signaling(CCS (10 marks)
- (b) Calls arrive to a pool of 50 modems according to a Poisson process. Calls have an average duration of 20 minutes. Determine the
i. probability that an arriving call finds all modems busy if the arrival rate is two calls per minute
ii. maximum arrival rate that can be handled if the maximum acceptable probability is 1% (10 marks)

QUESTION FOUR (20 MARKS)

- (a) Consider the equipment involved in providing a call between two telephone sets. Sketch a diagram showing the various equipment and facilities between the originating telephone through a single telephone switch and on to the destination telephone suppose that the local loop is implemented with the following technologies:
i. ISDN
ii. ADSL (10 marks)
- (b) (i) Compare the operation of a multiplexer, an add-drop multiplexer, a switch and a digital cross-connect
(ii) Consider a crossbar switch with n inputs and k outputs.
I. Explain why the switch is called a concentrator when $n > k$. Explain the traffic conditions under which this switch is appropriate
II. Explain why the switch is called an expander when $k > n$. Explain the traffic conditions under which this switch is appropriate (8 marks)
- (c) Clearly show how the TCP/IP protocol suite maps on the OSI model. (2 marks)

QUESTION FIVE (20 MARKS)

- (a) (i) With respect to transmission systems, draw the structure of the STM-1 frame
(ii) Using the structure in (i) determine the bit-rate of the STM-a signal. Hence obtain the bit-rate for the STM-4 and STM-16
(iii) With the aid of a block diagram, describe the typical components in the SDH layered communication network. (8 marks)
- (b) Describe the following components in a PSTN
i. Main distribution frame (MDF)
ii. Optical Distribution Frame(ODF) (6 marks)
- (c) With the aid of a block diagram, show the plesiochronous Multiplexing stages (6 marks)