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The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX4533/ ECX4233 Communications**
Academic Year	: 2017/18
Date	: 03rd February 2019
Time	: 0930-1230hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Four (4)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. Relevant charts/ codes are provided.
6. This is Closed Book Test (CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pens.

Question 1

1. List down four factors one should consider in telephone network planning.
(4 Marks)
2. Draw a block diagram of the general communication system and explain the functions of each block.
(4 Marks)
3. Giving reasons explain why the following parties are interested in global telecommunication standards.
    a. Equipment manufactures
    b. Network operators
    c. Academic experts
    d. The subscribers
(4 Marks)
4. Explain three differences between the RSU (Remote Subscriber Unit) and a Local exchange.
(3 Marks)
5. Briefly explain how a 2W/4W hybrid prevents the signal from the network (receiving pair) looping back to the transmitting pair.
(2 Marks)
6. List three advantages of DTMF dialing over pulse dialing.
(3 Marks)

Question 2

1. Draw a block diagram of an electronic telephone exchange and explain the operation of any 3 submodules.
(4 Marks)
2. A 2-stage space-division full availability switching network acts as a concentrator. It has M incoming trunks, N outgoing trunks and N links between the two switching stages (Where M>N). Number of switches in the second stage is twice as the number of switches in the first stage. Assume all primary switches are identical to each other and all secondary switches are also identical to each other.
    (i) Show the formation of the above switching networks using a diagram. You need to mark all the necessary parameters.
    (ii) Obtain an expression for the total number of cross points.
    (iii) Use your results in part (i) and (ii) to design a network for a 2-stage concentrator having 400 incoming trunks and 200 outgoing trunks. Find the total number of cross points.
    (iv) If you add a middle stage with 9 switches to the above switching network in part (iii), calculate total cross points in modified arrangement.
(14Marks)
3. Explain two advantages of increasing the number of stages in a switching network.
(2 Marks)

Question 3

1. State one disadvantage and three advantages of digital transmission over analog transmission.
(2 Marks)
2. A PCM encoder using linear 8bit quantization and has a voltage range of ±3. 81V.

i. Determine the codeword and percentage of quantization error, when input signal is,

a. -120mV b. 0.5V c. -2.5V

ii. By observing the quantization error calculated in part(ii), explain why linear quantization is not suitable for PAM signals which have low voltage sample values?

iii. Determine the input signal voltage value for the codeword in following two cases.

a. 0110 1001 b. 1001 1011 **(15 Marks)**

3. Differentiate Plesiochronous Digital Hierarchy (PDH) and Synchronous Digital Hierarchy (SDH). Discuss the possibility to multiplex E1 frames to get a 139.264Mbps PDH link. **(3 Marks)**

Question 4

1. Explain why traffic engineering is important in designing telecommunication networks. **(2 Marks)**
2. There are 8000 calls originated during the busy hour in a telephone exchange which has 5000 lines. If the average holding time is 2 minutes:
   (i) Calculate the busy hour calling rate and the offered traffic.
   (ii) If there are 300 calls lost during the busy hour, find the grade of service of the system. **(8 Marks)**
3. Traffic profiles play an important role in analyzing the exact utilization of a circuit group. Normally traffic profiles are drawn by calculating traffic intensity i.e. The plot will be traffic intensity vs. time.
   The following table gives some readings obtained in a particular group of circuits in a local exchange in hourly durations on a normal working day from 0800 to 1700.

Time	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700
number of circuits that are busy	140	180	300	325	250	270	300	290	168	150
Traffic intensity										

If the average holding time is 56 seconds,

(i) Find the traffic intensity of each case and fill the table.
(ii) Draw the traffic profile from 0800 to 1700 hours.
(iii) Hence find the busiest hour.

(8 Marks)

4. Write the importance of Erlang's B formula in tele-traffic engineering? **(2 Marks)**

Question 5

1. Discuss two major trends in the development of optical fibre communication networks. **(2Marks)**
2. What do you understand by "modes in optical fibres"? Compare "single mode" and "multimode" fibres. **(4 Marks)**

3. Worksite is situated 1.5km away from its main office. Office and the site are connected via a fibre optic cable. There are four connectors, two at office side and two at worksite side. Office side connector loss is 1dB each and worksite side connector loss is 0.25dB each. Cable loss is 1dB/km. Sensitivity of the system is set to -20dB. System margin is set to 5dB.
   (i) Calculate the power (Wattage) of the light source that should connect to the fibre.
   (ii) Assuming above mentioned fibre link has two nodes and each node carry equal traffic. One node is dedicated to carrying data traffic and other pair is allocated for voice circuits. Bit rate of total link is 1Gbps. Calculate,
      a. Number of voice channels that can be offered by this system.
      b. Bit rate – distance product

(10 Marks)

4. A signal representing the sequence of data S = 11010010 is to be transmitted using QPSK modulated scheme. Draw the modulated signal. **(4 Marks)**

Question 6

1. A lossless transmission line of electrical length of 0.3λ and characteristic impedance of 50Ω is terminated with a load impedance Z_L= (50 + 100) Ω. Use the Smith chart to find the following (Clearly show your work on the Smith chart, attached on page 6).
   (i) The reflection coefficient of the load.
   (ii) The standing wave ratio of the line.
   (iii) The reflection coefficient at the input. **(8 Marks)**

2. A sensor node connected in a remote location is transmitting a signal to a receiver at 1.2MHz frequency. The peak amplitude voltage of transmitting signal is 5V. Distance between sensor and receiver is connected via a 100m long twin cable which is terminated with an impedance of $300\angle 45\Omega$.
   The primary line constants are , $L = 0.001H/km$, $G = 0.8\times10^{-6} mho/km$ and $C = 0.05\mu F/km$. Calculate,
   (i) Characteristic impedance
   (ii) Propagation constant
   (iii) Velocity of propagation
   (iv) Wavelength of propagation
   (v) Receiving end voltage **(12 Marks)**

Question 7

1. Using appropriate diagrams, explain how frequency reuse concept is used to the optimum use of the available frequency band for communication. **(2 Marks)**

2. A cellular operator is planning a cellular network in a metropolitan area. Total bandwidth allocated to the operator is 70MHz. 1MHz is assigned for control purpose and another 1.1 MHz is reserved for control channels for future needs. bandwidth of a simplex channel is 25kHz. Frequency division duplex channels are used for both voice and control purposes. If frequency reuse factor is 7; find,
   (i) Total number of channels per cell
   (ii) Voice channels per cell
   (iii) If frequency reuse factor changes to 4, calculate (i) and (ii).
   (iv) Hence, comment on the best frequency reuse arrangement for the area. **(12 Marks)**

3. Differentiate following,
   (i) Adjacent channel and co-channel interferences.
   (ii) Soft and hard hand off
   (iii)HLR and VLR **(6 Marks)**

Question 8

1. Explain the following terms reference to the radiation element.
   (i) Beam area
   (ii) Beam efficiency
   (iii)Effective aperture
   (iv) Directivity **(4 Marks)**

2. Consider a free space communicating transmitter antenna with 25dB again and a receiving antenna with a gain of 20dB. Calculate the maximum power received at a distance of 0.5km. Assume the transmitting antenna input is 600W. **(8 Marks)**

3. Write shorts notes to following topics
   (i) Five basic concepts in 5G
   (ii) Packet and circuit switching
   (iii) The advantages of CCS over CAS
   (iv) Optical transport network (OTN) **(8 Marks)**

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Erlang's B Formula

$$P(N,A) = B = \frac{\frac{A^N}{N!}}{1+\frac{A}{1!}+\frac{A^2}{2!}+\frac{A^3}{3!}+.....+\frac{A^N}{N!}} = \frac{\frac{A^N}{N!}}{\sum_{X=0}^{X=N}\frac{A^X}{X!}}$$

Where:

A = Average offered traffic
N = No of outlets (circuits)
r = No of simultaneously occupied outlets or circuits

The Complete Smith Chart

Black Magic Design