00170

The Open University of Sri Lanka
Department of Electrical & Computer Engineering
Final Examination - 2009/2010
ECX 4233 – Communications **Closed Book**

Time : 0930 - 1230 Date : 18 - 03 - 2010

Answer any 5 questions. Each question will carry equal marks.

Q1. (a) Briefly explain the following types of telephone exchanges and clearly mention their functions:
(i) Local exchange
(ii) Tandem Exchange
(iii) Trunk Exchange
(iv) Private Automatic Branch Exchange [08]

(b) Differentiate the following:
(i) Pulse dialing vs tone dialing
(ii) 2-wire circuits vs 4-wire circuits
(iii) Local battery telephone system vs central battery telephone system
(iv) Ringing signal vs ring-back signal [08]

(c) What advantages does Common Channel signaling have over Channel Associated signaling? [04]

Q2. (a) Give 2 advantages of using multiple stage switching compared to single stage switching? [02]

(b) Consider the following 3-stage switching system which has N incoming trunks and N outgoing trunks and has primary switches with n inlets and tertiary switches with n outlets. Assume that the number of A links and B links are each N. (refer the figure Q2.)

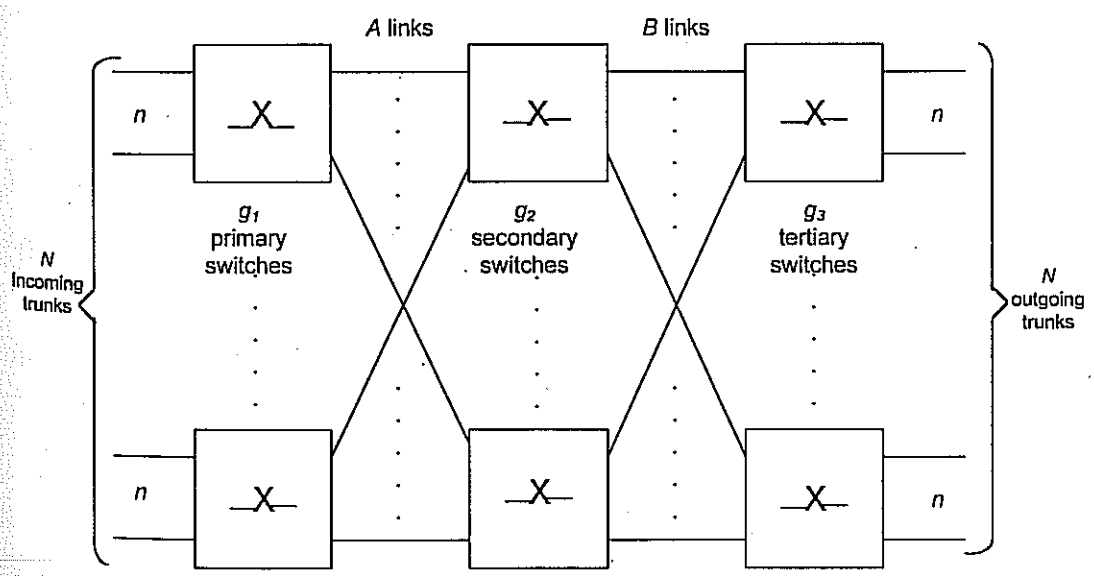

Fig. Q2

(i) Find the size of switches at each stage. [03]
(ii) Obtain an expression for the total number of cross points in terms of N and n. [03]
(iii) Hence find the minimum number of cross points required. [04]
(iv) Design a 3-stage switching network for connecting 100 incoming trunks to 100 outgoing trunks:
   a. when $n = 5$
   b. when $n = 10$ [06]

(Show your answer with clear diagrams with all the required parameters marked on it.)

(v) Give your comments on the 2 switching systems you designed in question (iv). [02]

Q3. (a) State 4 advantages of digital transmission over analog transmission. [04]
(b) "In telephony, Pulse Code Modulation (PCM) samples a signal at 8kHz using 256 quantization levels." According to this statement answer the following questions:
   (i) Briefly explain how the sampling rate is chosen.
   (ii) Draw the complete block diagram of the system.
   (iii) Explain how this system works.
   (iv) Calculate the output bit rate. [10]
(c) Briefly explain how the above scheme is used in forming T1 carrier system. Show it using a complete block diagram. [03]
(d) Explain what PDH is and how T1 carrier system is used in PDH. [03]

Q4.(a) Define the following terms related to a telephone exchange and explain how they affect the performance of the exchange.
   (i) Congestion
   (ii) Availability
   (iii) Grade of service [06]
(b) What is the ideal value for grade of service? Can this value be achieved in practice? Justify your answer. [02]
(c) A particular group of circuits in a telephone exchange carried 200 calls during the busy hour. The durations in seconds of 10 successive calls in the exchange were 160, 100,120, 85, 190, 75, 62, 140, 158, 110. Calculate:
   (i) average holding time
   (ii) the traffic volume
   (iii) the traffic intensity
   (iv) the average number of calls in progress simultaneously. [12]

Q5.(a) State the Erlang's B formula with all the parameters clearly defined. [02]
(b) A full availability group of 5 trunks is offered 4E of traffic. Find,
   (i) the Grade of Service
   (ii) the probability that only 2 trunks are busy
   (iii) the probability that at least 2 trunks are free
   (iv) If one trunk is out of service, what will be the Grade of Service?
   (v) If a 10% increase in the offered traffic in an emergency, what will be the Grade of Service? [12]

(c) Briefly explain advantages of using traffic tables. [02]

(d) Table Q5 gives a part of a traffic table. Clearly explain how you use the given traffic table in following situations:

(i) To find the number of trunks required for a system which has offered traffic of 56E and a GOS of 0.005.

(ii) To find the value of offered traffic for a system which has 74 trunks and a GOS of 0.001. [04]

Number of trunks	1 lost call in			
	50 (0.02)	100 (0.01)	200 (0.005)	1000 (0.001)
	E	E	E	E
68	57.2	54.2	51.9	47.5
79	58.2	55.1	52.8	48.3
70	59.1	56.0	53.7	49.2
71	61.0	57.0	54.6	50.1
72	62.0	58.0	55.5	50.9
73	62.9	58.9	56.4	51.8
74	62.9	59.8	57.3	52.6
75	63.9	60.7	58.2	53.5

Table Q5

Q6. (a) Define the terms characteristic impedance, propagation constant and attenuation constant of a transmission line. [03]

(b) Considering a small section of an open wire transmission line, derive expressions for each of the parameters given in (a). Assume that the primary constants of the line as R,L,C and G. [05]

(c) Hence obtain expressions for the characteristics impedance, the propagation constant and the attenuation constant for the following cases.

(i) Ideal transmission line or lossless line

(ii) High frequency transmission line

Comment on your answers in above (i) and (ii). [05]

(d) A lossless transmission line has a distributed inductance of 0.0036H/km and a distributed capacitance of 0.008 μ F/km. Calculate the characteristic impedance and the propagation constant of the line in terms of the operating frequency. [02]

(e) Considering the length of the above line in (d) as 0.4 km, find

(i) the frequency at which the line length is equivalent to one wavelength and

(ii) the velocity of propagation [05]

(Consider that velocity of propagation in the free space is 3×10^8 *m/sec.)*

Q7.(a) Briefly explain the advantages of Smith Chart in solving transmission line problems. [02]

(b) Explain how Smith chart can be used as an admittance chart. [02]

(c) A transmission line which has a characteristic impedance of 50 Ω ends up with a load impedance of (100 – j50) Ω. If the electrical length of the line is 0.15λ, find the following using the given Smith Chart.

i. the voltage reflection coefficient
ii. the VSWR
iii. input impedance of the line [08]

(d) If a short circuited stub is connected in series to match the line, find the location and the length of the stub. You should clearly show how you get these values with sketches on the Smith Chart. [08]

Q8. (a) Define the gain of an antenna. [01]

(b) Sketch the current and voltage distributions for the following antennas:

i. A half wave centre-fed dipole
ii. A single wavelength long centre-fed dipole
iii. A three and a half wavelength long centre-fed dipole [06]

(c) Define the term radiation resistance of an antenna. Explain its practical significance as a property of transmitting and receiving antennas. [02]

(d) State the main components of an antenna array and briefly explain their functions. [03]

(e) Differentiate the following related to cellular communication:

(i) Cell vs Cluster
(ii) Base Station(BS) vs Mobile Switching Center(MSC)
(iii) Co-channel interference vs Adjacent channel interference
(iv) Call hand off vs Roaming [08]

The Complete Smith Chart

Black Magic Design