The Open University of Sri Lanka
Department of Electrical & Computer Engineering
Final Examination - 2006/2007
ECX 4233 – Communications **Closed Book**

Time : 0930 - 1230 Date : 21 - 04 - 2007

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

Q1. (a) Using the hierarchical structure of a general telecommunication system, explain how the following processes are carried out.
   i. Numbering
   ii. Routing
   (b) List the main functions carried out by a telephone exchange.
   (c) Briefly explain how a local exchange differs from a trunk exchange.
   (d) Modern switching systems use Stored Program Control (SPC) for controlling. Briefly explain the operation of SPC.
   (e) What is the purpose of having a MDF and an IDF in a telephone system?

Q2. (a) Make a block diagram of the essential elements of a PCM communication link and explain how it works. In particular, indicate how, say, four voice channels might be carried by a single PCM link.
   (b) Briefly describe the following terms.
   i. S-T-S switching
   ii. ISDN
   iii. GSM
   iv. Frequency reuse in cellular communication

Q3.(a) Define the terms traffic intensity, Erlang and average holding time related to telephone traffic.
   (b) Explain the types of possible traffic variations that can be occurred in a telephone exchange giving examples.
   (c) 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	320	290	250	270	300	290	168	150

Table Q3

(i) If the average holding time is 56 seconds, draw the traffic profile from 0800 to 1700 hours.

(ii) Hence find the busiest hour and the busy hour.

Q4.

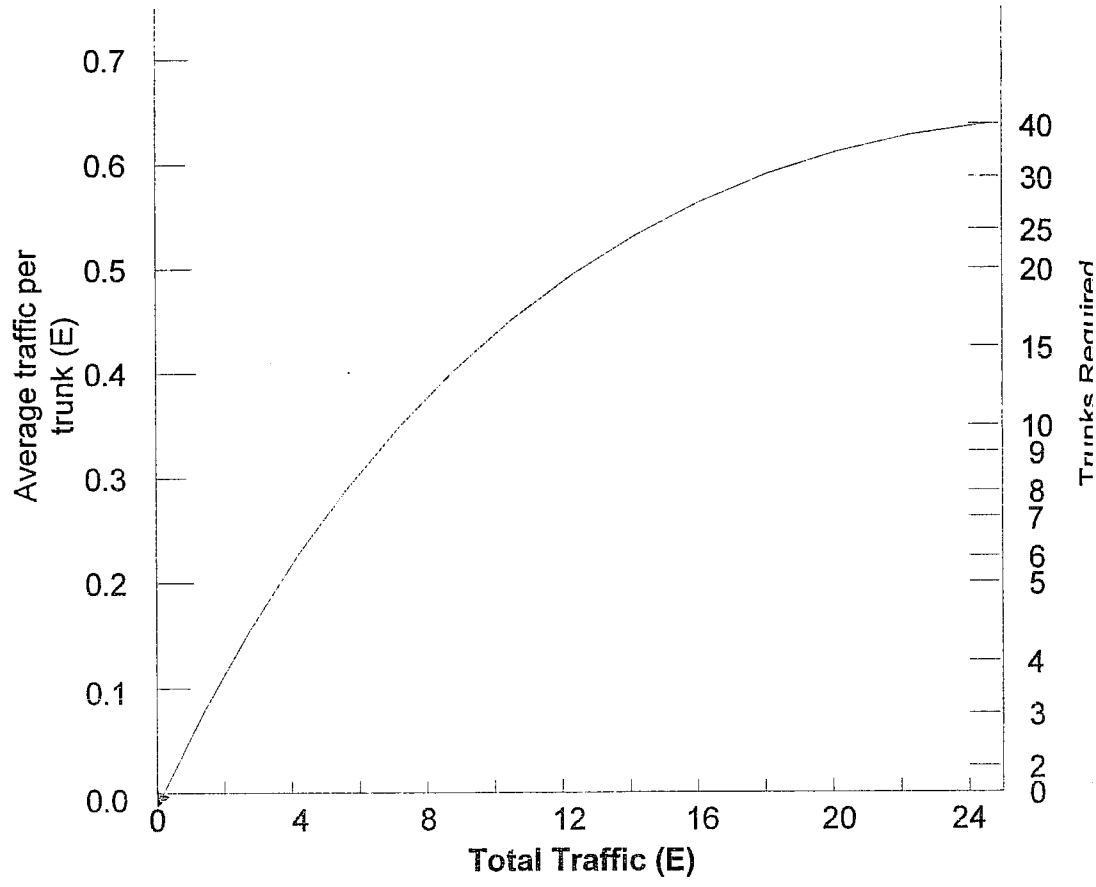

Figure Q(4)

(a) Fig. Q(4) gives the trunk occupancies (or probabilities of finding the trunks busy) for full availability groups of various sizes for a grade of service of 0.002.
Using the figure (Q4) justify the following statement.
"Large group of trunks are more efficient than small groups. Therefore it is better to concentrate traffic onto a single large group of trunks than to handle it by several small groups of trunks."

(b) In a full availability switching system, 10E of traffic is offered over a group of 5 trunks during the busy hour.
Find,

(i) The probability that all trunks are busy

(ii) The probability that all trunks are free

(iii) The probability that at least 3 trunks are busy

Comment on the condition in (i) above.

Q5. (a) What is meant by multiplexing?

(b) Explain the difference between FDMA (Frequency Division Multiple Access) and TDMA (Time Division Multiple Access).

(c) Briefly explain how CDMA (Code Division Multiple access) is advantageous compared with the above two techniques in (b).

(d) What is meant by Voice over IP? Explain how it is advantageous compared to the existing telephone systems.

(e) Assume that you are working in a large scale business organization. What are the specifications that you consider when purchasing a new PABX to your organization?

Q6.(a) Rank the following transmission line technologies in terms of their inherent bandwidths.

(i) Coaxial cable
(ii) Open wire pair
(iii) Twisted wire pair
(iv) Optical fiber

In applications where the radiation of energy is undesirable, which of these technologies would be least likely to be used and which would be most likely to be used?

(b) Describe the differences between (stepped index) multimode and monomode optical fibers. What advantages do the monomode fibers give?

(c) The points A, B, C and D shown in the given Smith Chart (page 5) represent some load points in a transmission line. If the characteristics impedance of the line is given as $50\,\Omega$, find

(i) the corresponding load impedance for each point.
(ii) the corresponding admittance for each point
(iii) Reflection Coefficient and VSWR for each point

Q7. (a) Define the term propagation constant of a transmission line giving an expression for this.

(b) 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 of (i) and (ii).

(c) A lossless transmission line has a distributed inductance of 1.4mH/km and a distributed capacitance of $0.06\,\mu$ F/km. Calculate the characteristic impedance and the propagation constant of the line.

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

(i) the frequency at which the line length is equivalent to one wavelength
(ii) the velocity of propagation

Q8. (a) Explain the term *isotropic radiator*. How do practical antennas differ from the isotropic ideal?

(b) Define the terms *directivity* and *gain* of an antenna.

(c) The radiated power of a low frequency transmitting antenna is 750W. If the radiation resistance and the loss resistance of the antenna are 3 Ω and 0.2 Ω respectively, find,

(i) the current fed into the antenna

(ii) the input power and

(ii) the efficiency of the antenna

The Complete Smith Chart (ZY)