



The Open University of Sri Lanka  
 Department of Electrical & Computer Engineering  
 Final Examination - 2005/2006  
 ECX 4233 - Communications

Time : 09.30 - 12.30

Date : 25 - 04 - 2006

Answer any 5 questions.

1. (a) Briefly explain the following terms.
    - (i) Local Exchange
    - (ii) Trunk Exchange
    - (iii) Transit Exchange (06 marks)
  - (b) Explain why a large city has several telephone exchanges, instead of a single large one. What type of exchange are you using to interconnect these multiple exchanges? (02 marks)
  - (c) Consider a telephone call which is made between A and B who are belonged to the same telecommunication service provider. Using national telecommunication hierarchical structure, indicate routing paths for the following cases.
    - (i) If A and B are in the same local area.
    - (ii) If A and B are in different local areas but in the same secondary switching center area.
    - (iii) If A and B are in different local areas and in different secondary switching center areas. (09 marks)
  - (d) Suppose A is making a telephone call with another subscriber, C who is belonged to a mobile telephone company. Then what will be the routing path ? (Include the path within the mobile network as well.) (03 marks)
2. (a) With the help of a diagram, explain the principle of operation of a Two Wire to Four Wire hybrid circuit. (04 marks)
  - (b) Compare and contrast the properties of Open wire, Coaxial and Optical fiber cables. (06 marks)
  - (c) What are the possible signaling tones that can be received to the calling party in the process of making a call? State both the tone and the corresponding operation. (Consider the cases of both successful and unsuccessful connections.) (02 marks)
  - (d) Compare channel associated signaling with common channel signaling. (04 marks)
  - (e) What is stored program control (SPC)? Discuss the advantages of SPC automation in telephone switching. (04 marks)
3. (a) Explain the differences between *Traffic Offered* and *Traffic Carried* with regard to a telephone exchange. (04 marks)
  - (b) What is the unit of traffic? (01 mark)

- (c) During the busy hour 1140 calls were offered to an exchange. The average call duration was 3 minutes. The Grade of Service of the exchange is 1%. Estimate,
- (i) Offered Traffic to the exchange (03 marks)
  - (ii) Carried Traffic by the exchange (03 marks)
  - (iii) Lost traffic (03 marks)
  - (iv) Number of trunks in the exchange using the **Table Q3**. (03 marks)
  - (v) If the number of trunks of the exchange is increased by 3, what is the new Grade of Service? (03 marks)

Number of trunks	1 lost call in			
	50 (0.02) E	100 (0.01) E	200 (0.005) E	1000 (0.001) 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 Q3.** : Traffic capacity table

4. (a) Define *Grade Of Service* and *Full Availability* regarding a telephone exchange. (02 marks)
- (b) State the assumptions that are made when using Erlang's B formula. (02 marks)
- (c) A small telephone exchange in a city has a full availability group of 5 circuits. During the busy hour, on average, 30 E is offered and the average holding time of a subscriber is 55sec. Find,
- (i) the number of busy hour call attempts. (03 marks)
  - (ii) the probability that no circuits are occupied at a given time (03 marks)
  - (iv) the probability that at least 3 circuits are occupied at a given time. (03 marks)
  - (v) the Grade of Service of the exchange. (03 marks)
  - (vi) the Grade of Service for a 15% overload. (04 marks)
5. (a) Briefly describe the following techniques.
- (i) Pulse Code Modulation
  - (ii) Cross Bar Switching
  - (iii) Call hand-off in mobile communication
  - (iv) ISDN
  - (v) GSM (15 marks)

- (b) 'Time Switching' and 'Space Switching' are considered in terms of digital switching techniques. State at least one advantage and disadvantage of each technique. What advantages are gained by combining these techniques?  
(05 marks)
6. (b) The primary constants of a uniform transmission line are as follows:  
 $R = 0.01 \Omega$ ,  $L = 1 \mu H$ ,  $G = 1 \mu \text{ mho}$ ,  $C = 0.001 \mu F$  per km.  
 At 1.59KHz, calculate,  
 (i) the characteristic impedance of the line  
 (ii) the phase velocity of the wave on the line  
 (iii) the percentage to which the voltage of the travelling wave decrease over the line of 1km length.  
(20 marks)
7. (a) Briefly describe how standing waves arise in transmission lines. (03 marks)  
 (b) Define the standing wave ratio, S (SWR) and provide the formula for computing it if you know the magnitude of the reflection coefficient. What are the bounds (limits) for S? (03 marks)  
 (c) Briefly explain what a Smith chart is and its uses. (04 marks)  
 (d) Make a rough sketch of an impedance Smith Chart, with circles:  $r=0.5, 1, 2$ ;  $x=-2, -1, -0.5, 0.5, 1, 2$  and mark the open end point, short end point and perfectly matched point of the load on it.  
***(Important note: Printed Smith Charts will not be provided. You are required to draw your own Smith Chart for this question.)*** (08 marks)  
 (e) Briefly explain how you use this Smith Chart to find the VSWR for a particular load point. (02 marks)
8. (a) For a transmitting antenna define:  
 (i) Directivity  
 (ii) Gain  
 (iii) beam-width  
 (iv) Efficiency (08 marks)  
 (b) Sketch the current and voltage distributions for the following.  
 (i) A single-wavelength long centre-fed dipole  
 (ii) A half-wave centre-fed dipole  
 (iii) A two-wavelengths long centre-fed dipole (06 marks)  
 (c) What is an antenna array? Explain the action of directors and reflectors in a Yaggi antenna. (03 marks)  
 (d) A monopole antenna is placed in an electric field of 0.12mV/cm. If the effective length of the antenna is 90cm, calculate the voltage induced in the antenna. (03 marks)