The Open University of Sri Lanka

ECX4233 Communications
FINAL EXAMINATION– 2008/2009 (CLOSED BOOK)

DATE: 18th March, 2009 **0930 hrs – 1230 hrs**

Answer any 5 questions. All questions carry equal marks.

Q1 (a) Draw the generalized hierarchical structure of a telecommunication network and explain functions of each level. Does call routing always occur according to this hierarchical structure? Justify your answer.

(b) Figure Q1 shows the basic block diagram of a subscriber's telephone instrument.

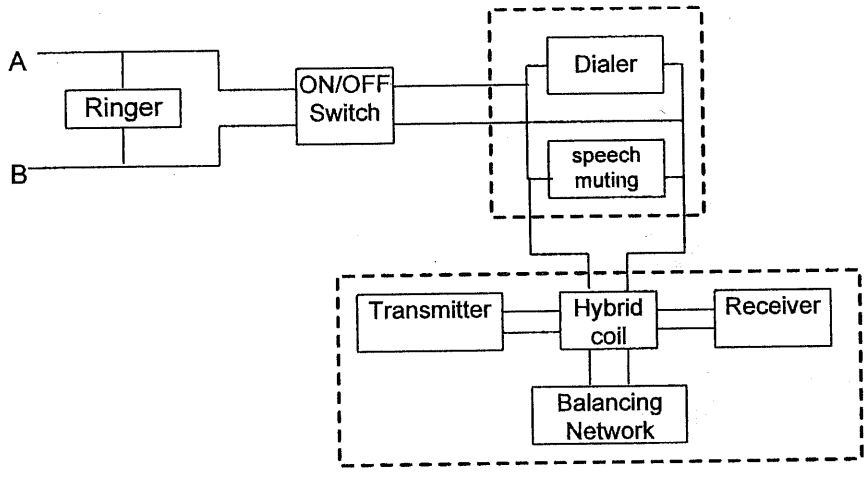

Figure Q1

Use this diagram to answer the following questions.

(i) Write the functions of the following blocks:
1. Ringer 2. ON/OFF switch 3. Dialer
4. Hybrid coil 5. Balancing network

(ii) What is the normal line voltage used between A and B?

(iii) Briefly explain how you get the necessary power to operate subscriber's telephone instrument.

(iv) What are the two main types of dialers? Briefly explain the difference between them.

Q2 (a) List the main functions carried out by a telephone exchange.

(b) Consider a 100 x 100 (100 inlets and 100 outlets) switching system. Find the number of cross points if you use the following types of switches:

i. Single stage rectangle space switch
ii. A 3-stage switch which has 10 number of input stage switching arrays and 10 number of output stage switching arrays and 5 number of center stage switching arrays
iii. A 3 stage strictly non blocking switch which has 10 number of input stage switching arrays and 10 number of output stage switching arrays

(c) Hence give your comments on the 3 types of switches used in (b).

(d) Compare the following switching methods based on their operation:

i. Space switching ii. Time switching iii. Packet switching

Q3 (a) Define the following terms related to telecommunication traffic.

(i) Traffic volume (ii) Erlang (iii) Congestion (iv) Grade of Service

(b) During the busy hour a group of 4 trunks is offered 100 calls having an average duration of 3 minutes. If 2 of the calls fail to find a disengaged trunk, find:

i. traffic offered to the group
ii. traffic carried by the group
iii. Grade Of Service (GOS)
iv. the time during which congestion occurs
v. probability that less than 2 circuits are free
vi. probability that no circuit is occupied

Q4 (a) Write short notes on the following:

(i) Signaling system No. 7
(ii) Stored Program Control
(iii) GSM technology
(iv) Optical fiber

(b) Clearly explain the difference between a cellular telephone service area, a cluster and a cell.

(c) Briefly describe the following terms and mention how they are useful in cellular communication.

(i) Frequency reuse (iii) Sectorization
(ii) Call hand off (iv) Cell splitting

Q5 (a) Briefly explain the following :

(i) Pulse Amplitude Modulation

(ii) Pulse Code Modulation

(iii) Time Division Multiplexing

(b) A PCM-TDM system multiplexes 20 voice-band channels. Each sample is encoded into 8 bits, and a frame synchronizing bit is added to each frame. The sampling rate is 10,000 samples per second. Determine,

(i) the maximum analog frequency of the input voice signal (Mention the theory you used for calculating this value.)

(ii) the frame duration

(iii) the data rate of the line in bits per second

(c) For the European PDH system, describe the composition of the 2.048 Mb/s 30 channel primary multiplex group. (You need to show how the channels are arranged and how the data rate is obtained.)

Q6. (a) What do you mean by the input impedance and the characteristic impedance of a transmission line?

(b) The input impedance of a transmission line which is terminated by an impedance of z_R is given by the following equation.

$$z_{in} = z_0\left(\frac{z_R \cosh \gamma\ell + z_0 \sinh \gamma\ell}{z_0 \cosh \gamma\ell + z_R \sinh \gamma\ell}\right)$$

Where z_{in} = input impedance, z_0 = characteristic impedance , ℓ = length of the line and γ = propagation constant

Using the above equation, find:

i. the input impedance of a line of length ℓ and terminated with z_0

ii. the input impedance of a line of length ℓ and short circuited at the receiving end (z_{sc})

iii. the input impedance of a line of length ℓ *and open* circuited at the receiving end (z_{oc})

iv. Hence derive an expression for z_0 in terms of z_{sc} and z_{oc}. Also find an expression which gives a relationship between γ, z_{sc} and z_{oc}.

(c) A lossless transmission line leading to a broadcast transmitter antenna operates at a frequency of 1.2MHz. It is 100m long and has a characteristic impedance of $500\,\Omega$. Calculate the input impedance if the receiving end is,

(a) open circuited (b) short circuited

You may use the results obtained in part (b). Consider that velocity of propagation in the free space is 3×10^8 *m/sec.*

Q7 (a) A lossless line which has a characteristic impedance of 50 Ω ends up with a load impedance of (20 + j30) Ω. The input impedance of the line is (75 + j40) Ω. Use the Smith Chart (given in page 5) to find ,

(i) the VSWR
(ii) the voltage reflection coefficient
(iii) the length of the line

(b) Briefly explain why you need impedance matching in transmission lines.
(c) What is meant by stub matching?
(d) If an open circuited stub is connected in series to match the transmission line given in part (a), find the position and the length of the stub using the same Smith Chart used in part (a).

(You should clearly show how the readings are taken from the Smith Chart in each case (a) and (d) above.)

Q8 (a) Define the following terms related to an antenna:

(i) Polarization
(ii) Beam width
(iii) Directivity
(iv) Front to back ratio

(b) Clearly explain how each of the above factors may affect to the signal strength of an antenna.
(c) Briefly explain the difference between a broadside array and an end fire array.
(d) What is interlaced scanning in television broadcasting? What is the advantage of using interlaced scanning?

The Complete Smith Chart