00181

The Open University of Sri Lanka
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
ECX4233 Communications 2010/2011
FINAL EXAMINATION **CLOSED BOOK**

DATE : 04-04-2011 **Time : 1400 - 1700**

Answer all questions.

Q1.

(a) List the sequence of operations occur along with the corresponding signals interchanged among the calling subscriber, telephone exchange and the called subscriber during a successful telephone call. *[06]*

(b) Draw the basic block diagram of a subscriber's telephone instrument and mention the function of each block. *[06]*

(c) Briefly explain the following:
- (i) Multi-exchange areas
- (ii) Standard numbering format used in Sri Lanka
- (iii) Dual Tone Multi Frequency (DTMF) signaling
- (iv) No. 7 signaling *[08]*

Q2.

(a) Differentiate the following:
- (i) Space switch vs Time switch
- (ii) Circuit switching vs packet switching
- (iii) Single stage switching vs multiple stage switching *[06]*

(b) A 2-stage space-division network acts as a concentrator, it has M incoming trunks, N outgoing trunks and N links between the two switching stages (where M>N). Two methods of designing the network are as follows:
- (i) To use the same number of switches in each stage, but to have larger switches in the first stage.
- (ii) To use switches in the primary stage which have the same number of inlets as the secondary switches have outlets, but to use different number of switches in each stage.

Show the formation of each of the above switching network using diagrams. You need to mark all the necessary parameters. Obtain expressions for the number of cross points at each case. *[10]*

(c) Use your result in part (b) to design a network of each type for a 2-stage concentrator having 400 incoming trunks and 100 outgoing trunks. How many cross points does each contain? *[04]*

Q3.

(a) Define the Erlang's B formula and state the assumptions that are made when deriving it. *[03]*

(b) Briefly explain what traffic tables are and discuss the advantages of using them. *[03]*

(c) During the busy hour, on average 40 E is offered to a group of trunks. On average, total period during which all trunks are busy is 15 seconds and 3 calls are lost.

Find,
- (i) Grade of service
- (ii) Average number of calls carried by the group
- (iii) Average call duration
- (iv) Probability of less than 3 circuits are occupied
- (v) Probability of at least 2 circuits are free
- (vi) How much the GOS deteriorates if 2 trunks are out of service? *[14]*

Q4.

(a) Briefly explain the types of possible traffic variations that can be occurred in a telephone exchange giving examples. *[04]*

(b) Discuss the status of a telephone exchange for the following two cases:
- (i) When Grade of Service = 1
- (ii) When Grade of Service = 0 *[04]*

(c) Figure Q4 is an often more useful presentation of Erlang's results on traffic theory. It presents the output channel utilization for various blocking probabilities and number of channels. The output channel utilization (ρ) is defined as the traffic carried by each circuit and can be calculated as (carried traffic)/N where N is the number of channels or circuits. Now, use the Fig.Q4 to answer the following. A T1 line which contains 24 telephone circuits is to be used as a trunk group between 2 exchanges.
- (i) How much traffic can the group carry if the blocking probability (B) is 0.1?
- (ii) What is the offered traffic intensity?
- (iii) What conclusion you can make by analyzing this plot on ρ, N and B? *[12]*

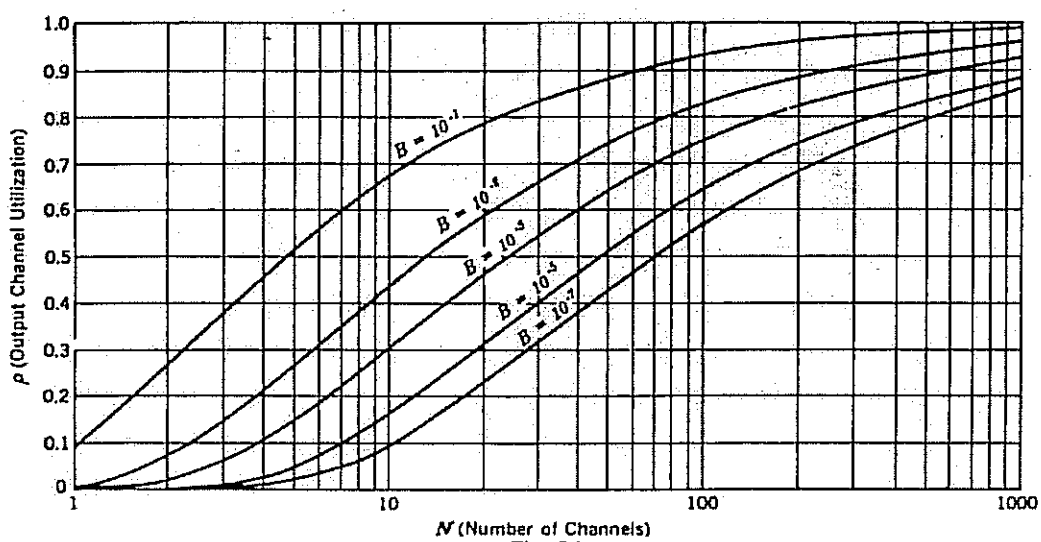

Fig. Q4

Q5.

(a) Magnitude of an analogue signal varies between 0V and 2V. This signal is pulse code modulated by sampling and quantizing with a 3 bit linear quantizer. Find the output bit patterns for each of the following sample values. (Clearly show your calculations.)

(i) 0.2 V
(ii) 0.9 V
(iii) 1.7 V

What is the percentage error in each case?

[10]

(b) A digital E1 carrier frame uses 8-bit time slots and repeats at every 125 μsec.

(i) Draw the frame structure of E1 digital carrier.
(ii) Calculate the size of a single frame in bits.
(iii) Calculate the bit rate of E1 carrier
(iv) Show how E1 carriers mapped into SDH. *[10]*

Q6.

(a) Give 2 advantages and 2 disadvantages of each of the following transmission media. Also give an application for each.

(i) Twisted pair cables
(ii) Coaxial cables
(iii) Fiber optic cables
(iv) Microwave link *[06]*

(b) A generator of 10V at 1 kHz supplies power to a 100km open wire line terminated with its characteristic impedance. The primary line constants are:
$R = 10.4\Omega/km$, $L = 0.0036H/km$, $G = 0.8\times10^{-6}$ *mho / km* and $C = 0.00835\mu F/km$.
Calculate,

(i) Characteristic impedance
(ii) Propagation constant
(iii) Velocity of propagation
(iv) Wavelength of propagation
(v) The amount of power delivered to the load *[14]*

Q7.

(a) Clearly explain the formation of standing waves in transmission lines. *[03]*

(b) Discuss how the following line terminations will affect the Reflection coefficient and VSWR of a transmission line with necessary calculations.

(i) Line terminated with a short circuit
(ii) Line terminated with an open circuit
(iii) Line terminated with its characteristic impedance *[03]*

(c) A transmission line which has a characteristic impedance of 50 Ω ends up with a load impedance of (150 – j100) Ω. If the electrical length of the line is 0.2 λ, find the following using Smith Chart.

(i) the voltage reflection coefficient
(ii) the VSWR
(iii) input impedance of the line *[08]*

(d) If an open circuited stub is connected in parallel to match the line, find the location and the length of the stub. *[06]*

Note: ***Use the Smith Chart given on page 5. You should clearly show how you get these values with sketches on the Smith Chart.***

Q8.

(a) Illustrate the formation of a Yagi antenna array with a diagram and explain the function of each component. *[04]*

(b) A low frequency transmitting aerial has a radiation resistance of 0.5 Ω and a loss resistance of 1.5Ω. If the current fed into the aerial is 50A, calculate the aerial efficiency. *[03]*

(c) If the above aerial has an effective length of 1.2m and situated in a field strength of 12mV/m, calculate the voltage induced in the aerial. *[03]*

(d) Briefly explain the following related to mobile communications:

(i) How frequencies are reused in the cellular environment
(ii) The role of a mobile switching centre
(iii) The principle of operation of a CDMA system *[06]*

(e) Briefly describe how VoIP works and discuss its advantages and disadvantages compared to traditional telephone system. *[04]*

The Complete Smith Chart

Black Magic Design