00084

THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

FINAL EXAMINATION - 2012/2013

ECX4233 – COMMUNICATIONS **(Closed Book)**

ANSWER ANY FIVE QUESTIONS.

Date 08.08.2013 ***Time: 9:30-12:30 hrs.***

Q1.

(a) Draw a block diagram of a hierarchical PSTN and state the number planning procedure for the same network. **(4Marks)**

(b) Compare and contrast the following in television broadcasting. **(2x4Marks)**

i. NTSC and PAL
ii. Negative and positive modulation in TV broadcasting
iii. Field blanking and line blanking
iv. Chrominance and luminance

(c)

i. Draw the block diagram of a cellular communication network highlighting the important units. State their main functions. **(3Marks)**
ii. State why a single, high power base station at a very high altitude cannot service the whole island. Why do we need multiple cellular base stations to serve the total coverage area? **(2Marks)**
iii. What is CDMA? Briefly explain the underlying principle behind CDMA. **(3Marks)**

Q2.

(a) Define the following with respect to telecommunication switching. **(2x4Marks)**

i. Space switching
ii. Full availability
iii. Multi-stage switching
iv. Stored program control

(b) Consider the following full available switching system which has N incoming trunks and N outgoing trunks and has n primary switches and n tertiary switches. Further, the number of links connecting primary and secondary stages as well as secondary and tertiary stages are each L (See figure-Q2 below).

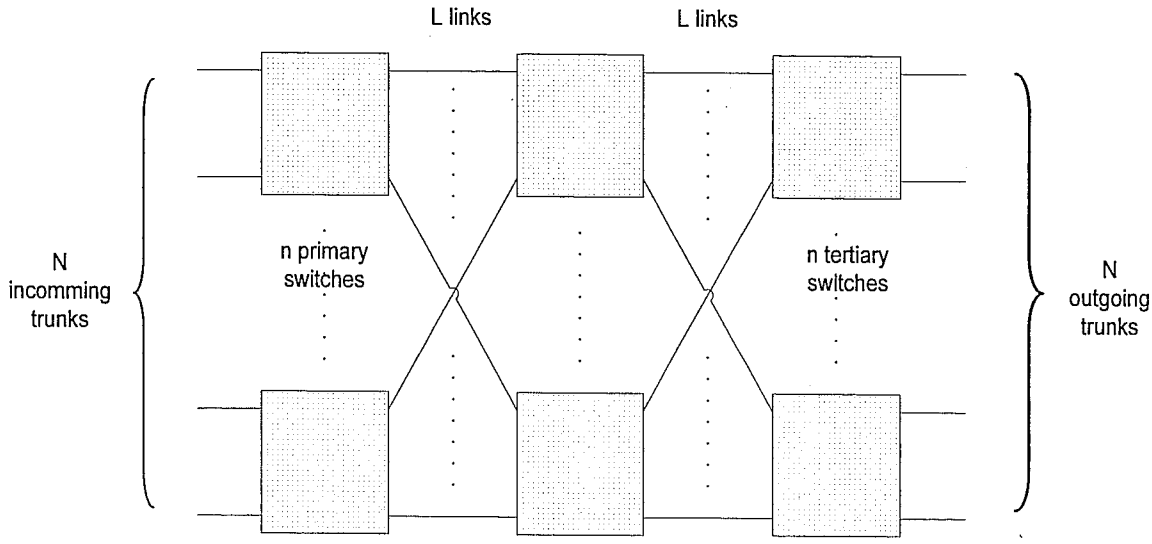


Figure-Q2

i. Find the size of the switches at each stage. **(4Marks)**
ii. Find an expression for the total number of cross points. **(3Marks)**
iii. Hence find the optimum number of primary stage switches for a minimum number of cross points. **(3Marks)**
iv. Assume that the middle stage is removed from the switching matrix. Comment on the change in blocking. **(2Marks)**

Q3.

(a) Describe the basic steps involved in PCM coding highlighting the special requirements in different stages. **(6Marks)**

(b) A certain PCM system uses 256 levels and the signal frequencies handled fall in the $0 - 12.5kHz$ range. A number of similar subscriber data streams are multiplexed together to a single bit stream. Due to the receiver equipment limitations, the minimum bit duration in this multiplexed stream is $125ns$. Calculate the following.
i. The individual bit rate **(2Marks)**
ii. The number of subscribers which can be accommodated in the multiplexed stream. **(2Marks)**
iii. The total multiplexed stream bit rate. **(2Marks)**

(c) Differentiate SDH and PDH and discuss the possibility to multiplex a conventional E1 signal with this multiplexed PCM stream under the two schemes. **(4Marks)**

(d) What are the advantages of CCS over CAS? Explain how CCS is accommodated in an E1. **(4Marks)**

Q4.

(a) Define the following. **(2x4Marks)**

i. Erlang
ii. Average holding time
iii. busy hour
iv. blocking systems

(b) State the basic assumptions we make in deriving the Erlang's first formula for the lost call systems. **(2Marks)**

(c) During the busy hour a switching system receives 80 calls with average call duration of 3 minutes. If the system is consisted of 8 trunks,

i. Find the GOS. **(2Marks)**
ii. If one additional trunk is added, calculate the percentage improvement in GOS. **(2Marks)**

(d) Starting from the Erlangs' first formula derive the recurrence relation

$$E_{1,N}(A) = \frac{AE_{1,N-1}(A)}{N + AE_{1,N-1}(A)}$$

Hence calculate the new GOS if one trunk fails in the system in (c) i. **(6Marks)**

Q5.

(a) What is the benefit of using teletraffic tables? **(2Marks)**

(b) A company operating a small exchange has 120 outgoing calls of average duration 2 minutes and receives 200 calls with average call duration of 3 minutes during the busy hour. The company wishes to obtain a GOS of 1%. How many exchange lines it should have

i. if the incoming and outgoing calls are handled separately. **(5Marks)**
ii. if the incoming and outgoing calls are handled in one group. **(5Marks)**
(Use the attached traffic table)

(c) In general is it always advantages to have trunk (line) groups as large as possible? Support your answer. **(3Marks)**

(d) If the calls are treated as one group as in (b) i., and if a total of 27 circuits are provided, use the attached traffic tables to find the probability that an incoming call finds at least one free line. **(5Marks)**

Q6.

(a) Write short notes on the following. **(2x3Marks)**

a. Smith chart
b. Prime center
c. constant VSWR circles

(b) A transmission line with a characteristic impedance of 50Ω is terminated with a load of $(20 + j50)\ \Omega$. If the input impedance of the line is $(45 + j100)\Omega$ and the line is fed with a 1kHz sinusoidal signal, using the attached Smith chart find,

a. VSWR **(2Marks)**
b. Voltage reflection coefficient **(3Marks)**
c. length of the line **(3Marks)**

(c) If the line is to be impedance matched with a single series stub, show the matching steps in the same Smith chart. (You should clearly show the working and the important values calculated.) **(6Marks)**

Q7.

(a) Compare the characteristics of the wired transmission lines unshielded twisted pair, shielded twisted pair, coaxial cable and fiber optics. **(2x4Marks)**

(b) What is a standing wave? Discuss its importance in transmission lines. **(2Marks)**

(c) A certain transmission line has the following parameters per kilometer.
$R = 0.01\Omega, L = 1\mu H, G = 1\mu S, C = 0.001\mu F$
Calculate the following at $1.59kHz$.

i. Characteristic impedance **(3Marks)**
ii. Phase velocity **(3Marks)**
iii. The percentage to which the voltage of the travelling wave decreases over a kilometer. **(4Marks)**

Q8.

(a) Define the following with respect to antennas. **(2x4Marks)**

i. Beam width
ii. Gain
iii. Directivity
iv. Isotropic radiator

(b) Draw the radiation patterns for a Yagi antenna array. Compare it to that of a half wavelength dipole and that of a parabolic antenna. **(3Marks)**

(c) What is benefit of using a folded dipole? **(2Marks)**

(d)

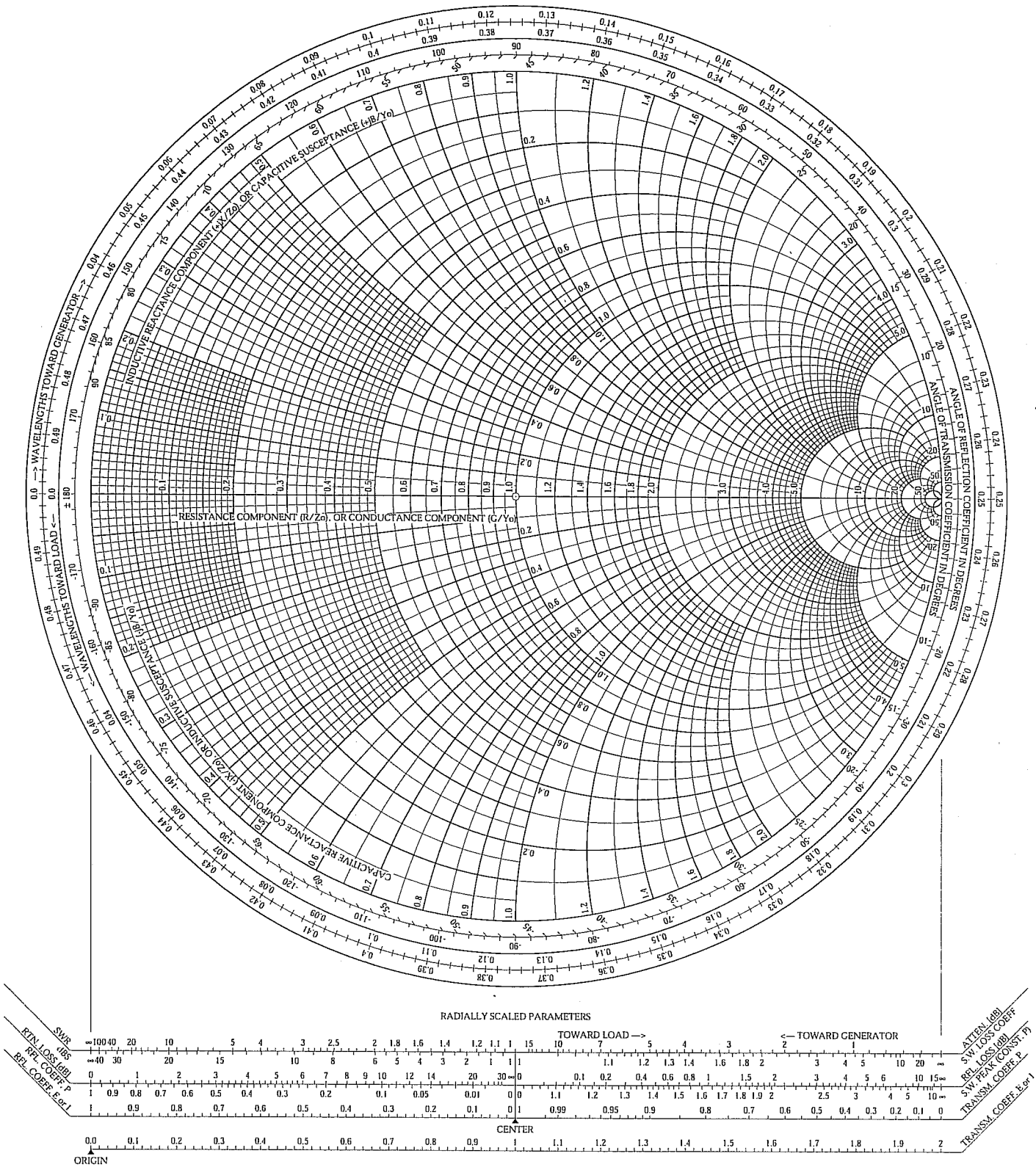
i. A parabolic antenna is fed with $2kW$ of power. The radiation and loss resistances of this antenna are $1.5\ \Omega$ and 0.1Ω respectively. Calculate the transmitted power and the efficiency. **(3Marks)**

ii. If the beam is dispersed over a solid angle of 4×10^{-5} Steradians, calculate the electrical field strength generated in an antenna with $Z_0 = 10\Omega$ kept at a $10m$ distance from the parabolic antenna. **(4Marks)**

(Hint: One Steradian is the solid angle generated at a point by a surface of area r^2 at a distance r from the point)

Erlang loss formula table

Number of trunks	1 lost call in 50 (0.02)	100 (0.01)	200 (0.005)	1000 (0.001)	Number of trunks	1 lost call in 50 (0.02)	100 (0.01)	200 (0.005)	1000 (0.001)
	E	*E*	*E*	*E*		*E*	*E*	*E*	*E*
1	0.020	0.010	0.005	0.001	51	41.2	38.8	36.8	33.4
2	0.22	0.15	0.105	0.046	52	42.1	39.7	37.6	34.2
3	0.60	0.45	0.35	0.19	53	43.1	40.6	38.5	35.0
4	1.1	0.9	0.7	0.44	54	44.0	41.5	39.4	35.8
5	1.7	1.4	1.1	0.8	55	45.0	42.4	40.3	36.7
6	2.3	1.9	1.6	1.1	56	45.9	43.3	41.2	37.6
7	2.9	2.6	2.2	1.6	57	46.8	44.2	42.1	38.3
8	3.6	3.2	2.7	2.1	58	47.8	45.1	43.0	39.1
9	4.3	3.8	3.3	2.6	59	48.7	46.0	43.9	40.0
10	5.1	4.5	4.0	3.1	60	49.7	46.9	44.7	40.8
11	5.8	5.2	4.6	3.6	61	50.6	47.9	45.6	41.6
12	6.6	5.9	5.3	4.2	62	51.6	48.8	46.5	42.5
13	7.4	6.6	6.0	4.8	63	52.5	49.7	47.4	43.4
14	8.2	7.4	6.6	5.4	64	53.4	50.6	48.3	44.1
15	9.0	8.1	7.4	6.1	65	54.4	51.5	49.2	45.0
16	9.8	8.9	8.1	6.7	66	55.3	52.4	50.1	45.8
17	10.7	9.6	8.8	7.4	67	56.3	53.3	51.0	46.6
18	11.5	10.4	9.6	8.0	68	57.2	54.2	51.9	47.5
19	12.3	11.2	10.3	8.7	69	58.2	55.1	52.8	48.3
20	13.2	12.0	11.1	9.4	70	59.1	56.0	53.7	49.2
21	14.0	12.8	11.9	10.1	71	60.1	57.0	54.6	50.1
22	14.9	13.7	12.6	10.8	72	61.0	58.0	55.5	50.9
23	15.7	14.5	13.4	11.6	73	62.0	58.9	56.4	51.8
24	16.6	15.3	14.2	12.2	74	62.9	59.6	57.3	52.6
25	17.5	16.1	15.0	13.0	75	63.9	60.7	58.2	53.5
26	18.4	16.9	15.8	13.7	76	64.8	61.7	59.1	54.3
27	19.3	17.7	16.6	14.4	77	65.8	62.6	60.0	55.2
28	20.2	18.6	17.4	15.2	78	66.7	63.6	60.9	56.1
29	21.1	19.5	18.2	15.9	79	67.7	64.5	61.8	56.9
30	22.0	20.4	19.0	16.7	80	68.6	65.4	62.7	58.7
31	22.9	21.2	19.8	17.4	81	69.6	66.3	63.6	58.7
32	23.8	22.1	20.6	18.2	82	70.5	67.2	64.5	59.6
33	24.7	23.0	21.4	18.9	83	71.5	68.1	65.4	60.4
34	25.6	23.8	22.3	19.7	84	72.4	69.1	66.3	61.3
35	26.5	24.6	23.1	20.5	85	73.4	70.1	67.2	62.1
36	27.4	25.5	23.9	21.3	86	74.4	71.0	68.1	63.0
37	28.3	26.4	24.8	22.1	87	75.4	71.9	69.0	63.9
38	29.3	27.3	25.6	22.9	88	76.3	72.8	69.9	64.8
39	30.1	28.2	26.5	23.7	89	77.2	73.7	70.8	65.6
40	31.0	29.0	27.3	24.5	90	78.2	74.7	71.8	66.6
41	32.0	29.9	28.2	25.3	91	79.2	75.6	72.7	67.4
42	32.9	30.8	29.0	26.1	92	80.1	76.6	73.6	68.3
43	33.8	31.7	29.9	26.9	93	81.0	77.5	74.3	69.1
44	34.7	32.6	30.8	27.7	94	81.9	78.4	75.4	70.0
45	35.6	33.4	31.6	28.5	95	82.9	79.3	76.3	70.9
46	36.6	34.3	32.5	29.3	96	83.8	80.3	77.2	71.8
47	37.5	35.2	33.3	30.1	97	84.8	81.2	78.2	72.6
48	38.4	36.1	34.2	30.9	98	85.7	82.2	79.1	73.5
49	39.4	37.0	35.1	31.7	99	86.7	83.2	80.0	74.4
50	40.3	37.9	35.9	32.5	100	87.6	84.0	80.9	75.3


RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
WAVELENGTHS TOWARD GENERATOR —>
<— WAVELENGTHS TOWARD LOAD

RADIALLY SCALED PARAMETERS
TOWARD LOAD —>
<— TOWARD GENERATOR
SWR
RTN. LOSS (dB)
REFL. COEFF. P
REFL. COEFF. E or I
ATTEN. (dB)
S.W. LOSS COEFF
REFL. LOSS (dB)
S.W. PEAK (CONST. P)
TRANSM. COEFF. P
TRANSM. COEFF. E or I
CENTER
ORIGIN