The Open University of Sri Lanka
Department of Electrical & Computer Engineering
Final Examination - 2007/2008
ECX 4233 – Communications

068

Closed Book

Time : 0930 - 1230

Date : 28 - 04 - 2008

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

Q1. (a) List the sequence of operations including signaling that are taken place during a successful telephone call between 2 subscribers.

(b) Briefly explain what is meant by the terms: *in-band signaling, out-band signaling, channel associated signaling and common channel signaling.*

(c) Briefly describe the following terminology related to telephony.

(i) ON/OFF hook
(ii) Side tone
(iii) 2-wire to 4-wire conversion
(iv) DTMF Dialing

Q2. (a) Briefly explain how digital signals have more immunity to noise than analog signals.

(b) T1 carrier systems were designed to combine PCM and TDM techniques for transmission of 24 channels of 64kbps bandwidth with each channel capable of carrying digitally encoded voice band telephone signals of data. In a T1 frame format the first bit is used for frame alignment.

(i) What is the bandwidth of voice band telephone signals?
(ii) What is the sampling frequency used for digitizing these voice signals?
(iii) Show how the bandwidth becomes 64kbps for these voice channels.
(iv) What is the duration of a single T1 frame?
(iv) Calculate the transmission bit rate of the T1 carrier described above.

Q3.(a) Briefly explain what 'Grade of service' means and how it affects in designing a telephone exchange.

(b) Define the Erlang's B formula and give the main assumptions made in deriving this.

(c) A trunk line goes from a central switching office to a PBX contains 4 circuits. If the average call duration is 3 minutes and offered traffic intensity during the busy hour is 2 Erlangs, determine each of the following.

(i) Busy hour calling rate
(ii) Grade-of-service
(iii) Amount of lost traffic
(iv) Probability that only 2 circuits are occupied
(v) Probability that more than 3 circuits are occupied

Q4. (a) Differentiate the following:

(i) The busy hour and the busiest hour
(ii) Traffic volume and traffic intensity
(iii) Full availability and limited availability
(iv) A loss switching system and a delay switching system

(b) Briefly explain the advantage of using traffic tables.

(c) During the busy hour, a telephone company establishes 150 outgoing calls of an average holding time of 2 minutes. It receives 220 incoming calls of average holding time of 3 minutes. The company expects to have a Grade of Service (blocking probability) of 0.01 for both incoming and outgoing calls. Use the given traffic table (see Table Q4 on page 3) to answer the following.
How many circuits should the company provide if:

(i) incoming and outgoing calls are handled on separate group of lines?
(ii) a common group of lines is used for both incoming and outgoing calls?

Q5. (a) What are the basic differences between SDH and PDH transmission?

(b) Compare and contrast CDMA (Code Division Multiple access) technology with GSM technology in mobile communication.

(c) Briefly describe the following related to cellular communication

(i) Co-channel interference
(ii) Cell splitting
(iii) Handoff
(iv) Roaming

(d) Write the sequence of operations takes place during a successful call from a mobile telephone subscriber to a land line subscriber.

Q6. A generator of 1V at 1 kHz supplies power to a 100km open wire line terminated with its characteristic impedance. The primary line constants are : $R = 10.4\Omega / km$, $L = 0.0036H / km$, $G = 0.8 \times 10^{-6}\, mho / km$, $C = 0.00835\mu F / km$.

Calculate,

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

Q7.(a) Briefly explain how standing waves are formed in transmission lines.

(b) Draw the standing wave patterns for the following load conditions with proper explanations.

(i) load impedance = 0
(ii) load impedance = infinity
(iii) load impedance = characteristic impedance

(c) Consider a lossless transmission line with a characteristic impedance of 50 Ω and a length of 0.1 λ where λ is the wavelength. If a load impedance 30+j20 is connected to this line, use a Smith Chart to find,

(i) the VSWR
(ii) the voltage reflection coefficient
(iii) the input impedance
(iv) the input admittance of the line.

You should clearly show how you get these values with sketches on the Smith Chart.

Q8 (a) Define the gain of an antenna.

An aerial is fed with 12kw of power to produce the same field strength at a given point as a half wave dipole fed with 24kw of power. Assume the gain of a half wave dipole relative to an isotropic radiator is 2.15dB. Calculate the gain of the aerial,

(i) relative to a half wave dipole

(ii) relative to an isotropic radiator

(b) The above aerial is modified to produce double the field strength at the same point described in (a), with the same input power of 12kw. Calculate the new aerial gain relative to a half wave dipole.

(c) If the above aerial has a radiation resistance of 5 Ω and a loss resistance of 2 Ω, calculate the current fed into the aerial.

(d) State the main differences between PAL and NTSC systems.

Table Q4 Traffic-capacity table for full-availability groups

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	37.5
7	2.9	2.5	2.2	1.6	57	46.9	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	11.5	73	62.0	58.9	56.4	51.8
24	16.6	15.3	14.2	12.2	74	62.9	59.8	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	59.5
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

The Complete Smith Chart

Black Magic Design