



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 8 Examination in Engineering: December 2015

Module Number: EE8258

Module Name: Telecommunication Networks

[Three Hours]

[Answer all questions, Question 01 and 02 carry 10 marks each. Question 03 and 04 carry 15 marks each.]

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- Q1 a) i) Draw a block diagram to illustrate the main elements in a LTE (Long-Term Evolution) network. [1 Mark]
- ii) Identify the main interfaces of the LTE network. [1 Mark]
- iii) Briefly describe the functions of eNodeB, MME (Mobility Management Entity) and HSS (Home Subscriber Server). [3 Marks]
- b) A 2G site is configured using 4/4/4 configuration. Each cell has two SDCCCH (Standalone Dedicated Control Channel) time slots and four PDCH (Packet Data Channel) time slots for data traffic.
- i) How many time slots are available for voice traffic?
[Hint: cell must have a timeslot to transmit BCCH] [1 Mark]
- ii) What is the available capacity for 2% blocking probability?
[Hint: Use the provided Erlang B table to determine blocking probability] [1 Mark]
- iii) According to the planned traffic profile, the Erlang per subscriber requirement is 25milli Erlang. What is the total number of simultaneous subscribers that can be served from this cell? [1.5 Marks]
- iv) What is the total number of simultaneous subscribers, if the half rate (HR) is used on five available time slots for voice traffic? [1.5 Marks]
- Q2 i) State three main reasons to reuse frequencies in GSM. [1.5 Marks]
- ii) What are the methods of minimizing the co-channel interference in GSM? [1.5 Marks]
- iii) What are the two types of frequency hopping? Explain one of them. [3 marks]

- iv) State the two parameters used to control frequency hopping. Explain the functions of each parameter.

[4 Marks]

Q3 a) Define the following terms regarding telecommunication traffic.

- i) Busy hour call attempts (BHCA)
- ii) Grade of service (GoS)
- iii) Traffic intensity

[3 Marks]

b) Discuss the following terms assuming a simple mathematical model used to analyze teletraffic problems.

- i) Pure chance traffic
- ii) Statistical equilibrium

[2 Marks]

c) Based on the assumption made in part b), explain the three distributions used for call arrivals and terminations.

[3 Marks]

d) A group of 10 trunks is offered 4Erlang of traffic. Using the Erlang lost call formula, determine the following.

- i) Grade of service (GoS)
- ii) The probability that only one trunk is busy
- iii) The probability that only one trunk is free
- iv) The probability that at least one trunk is free

[7 Marks]

Q4 A Mobile operator has planned to implement a 2G site in Hapugala area to cover a coverage hole. Initial planned cost of setting up the site is 8,500,000 LKR. The planned net yearly income (after deducting the operational expenses) is assumed as shown in Table Q4.

a) Calculate the payback period based on the non-discounted cash flow. Comment on the profitability of the project

[2 Marks]

b) Assuming a 10% cost of capital, determine the following.

- i) Discounting factor
- ii) The present value of the planned future cash flows

[2 Marks]

c) Calculate the payback period based on the discounted cash flow method. Comment on the profitability of the project.

[3 Marks]

d) Calculate the IRR (Internal Rate of Return) of the project. Comment on the profitability of the project.

[3 Marks]

e) During the third year, company plans to upgrade the 2G coverage to a LTE coverage. The additional investment required for eNodeB antenna is 2,500,000 LKR. The net income from the fourth year is increased from 2,000,000.00 LKR. Assume that the 2G coverage and the 2G traffic will remain the same. Analyze the profitability of upgrading the site to provide the LTE coverage.

[2 Marks]

f) Comment on the profitability when 2G and LTE service implementation/revenue are considered together as one project.

[3 Marks]

Table Q4

End of Year	Cash Flow (LKR)
1	1,500,000.00
2	2,500,000.00
3	2,500,000.00
4	2,000,000.00
5	2,000,000.00

Erlang B Traffic Table

Maximum Offered Load Versus B and N
B is in %

N/B	0.01	0.05	0.1	0.5	1.0	2	5	10	15	20	30	40
1	.0001	.0005	.0010	.0050	.0101	.0204	.0526	.1111	.1765	.2500	.4286	.6667
2	.0142	.0321	.0458	.1054	.1526	.2235	.3813	.5954	.7962	1.000	1.449	2.000
3	.0868	.1517	.1938	.3490	.4555	.6022	.8994	1.271	1.603	1.930	2.633	3.480
4	.2347	.3624	.4393	.7012	.8694	1.092	1.525	2.045	2.501	2.945	3.891	5.021
5	.4520	.6486	.7621	1.132	1.361	1.657	2.219	2.881	3.454	4.010	5.189	6.596
6	.7282	.9957	1.146	1.622	1.909	2.276	2.960	3.758	4.445	5.109	6.514	8.191
7	1.054	1.392	1.579	2.158	2.501	2.935	3.738	4.666	5.461	6.230	7.856	9.800
8	1.422	1.830	2.051	2.730	3.128	3.627	4.543	5.597	6.498	7.369	9.213	11.42
9	1.826	2.302	2.558	3.333	3.783	4.345	5.370	6.546	7.551	8.522	10.58	13.05
10	2.260	2.803	3.092	3.961	4.461	5.084	6.216	7.511	8.616	9.685	11.95	14.68
11	2.722	3.329	3.651	4.610	5.160	5.842	7.076	8.487	9.691	10.86	13.33	16.31
12	3.207	3.878	4.231	5.279	5.876	6.615	7.950	9.474	10.78	12.04	14.72	17.95
13	3.713	4.447	4.831	5.964	6.607	7.402	8.835	10.47	11.87	13.22	16.11	19.60
14	4.239	5.032	5.446	6.663	7.352	8.200	9.730	11.47	12.97	14.41	17.50	21.24
15	4.781	5.634	6.077	7.376	8.108	9.010	10.63	12.48	14.07	15.61	18.90	22.89
16	5.339	6.250	6.722	8.100	8.875	9.828	11.54	13.50	15.18	16.81	20.30	24.54
17	5.911	6.878	7.378	8.834	9.652	10.66	12.46	14.52	16.29	18.01	21.70	26.19
18	6.496	7.519	8.046	9.578	10.44	11.49	13.39	15.55	17.41	19.22	23.10	27.84
19	7.093	8.170	8.724	10.33	11.23	12.33	14.32	16.58	18.53	20.42	24.51	29.50
20	7.701	8.831	9.412	11.09	12.03	13.18	15.25	17.61	19.65	21.64	25.92	31.15
21	8.319	9.501	10.11	11.86	12.84	14.04	16.19	18.65	20.77	22.85	27.33	32.81
22	8.946	10.18	10.81	12.64	13.65	14.90	17.13	19.69	21.90	24.06	28.74	34.46
23	9.583	10.87	11.52	13.42	14.47	15.76	18.08	20.74	23.03	25.28	30.15	36.12
24	10.23	11.56	12.24	14.20	15.30	16.63	19.03	21.78	24.16	26.50	31.56	37.78
25	10.88	12.26	12.97	15.00	16.13	17.51	19.99	22.83	25.30	27.72	32.97	39.44
26	11.54	12.97	13.70	15.80	16.96	18.38	20.94	23.89	26.43	28.94	34.39	41.10
27	12.21	13.69	14.44	16.60	17.80	19.27	21.90	24.94	27.57	30.16	35.80	42.76
28	12.88	14.41	15.18	17.41	18.64	20.15	22.87	26.00	28.71	31.39	37.21	44.41
29	13.56	15.13	15.93	18.22	19.49	21.04	23.83	27.05	29.85	32.61	38.63	46.07
30	14.25	15.86	16.68	19.03	20.34	21.93	24.80	28.11	31.00	33.84	40.05	47.74
31	14.94	16.60	17.44	19.85	21.19	22.83	25.77	29.17	32.14	35.07	41.46	49.40
32	15.63	17.34	18.21	20.68	22.05	23.73	26.75	30.24	33.28	36.30	42.88	51.06
33	16.34	18.09	18.97	21.51	22.91	24.63	27.72	31.30	34.43	37.52	44.30	52.72
34	17.04	18.84	19.74	22.34	23.77	25.53	28.70	32.37	35.58	38.75	45.72	54.38
35	17.75	19.59	20.52	23.17	24.64	26.44	29.68	33.43	36.72	39.99	47.14	56.04
36	18.47	20.35	21.30	24.01	25.51	27.34	30.66	34.50	37.87	41.22	48.56	57.70
37	19.19	21.11	22.08	24.85	26.38	28.25	31.64	35.57	39.02	42.45	49.98	59.37
38	19.91	21.87	22.86	25.69	27.25	29.17	32.62	36.64	40.17	43.68	51.40	61.03
39	20.64	22.64	23.65	26.53	28.13	30.08	33.61	37.72	41.32	44.91	52.82	62.69
40	21.37	23.41	24.44	27.38	29.01	31.00	34.60	38.79	42.48	46.15	54.24	64.35
41	22.11	24.19	25.24	28.23	29.89	31.92	35.58	39.86	43.63	47.38	55.66	66.02
42	22.85	24.97	26.04	29.09	30.77	32.84	36.57	40.94	44.78	48.62	57.08	67.68
43	23.59	25.75	26.84	29.94	31.66	33.76	37.57	42.01	45.94	49.85	58.50	69.34