



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2018

Module Number: EE7210

Module Name: Telecommunication Networks

[Three Hours]

[Answer all questions, each question carries 10.0 marks]

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- Q1 a) i) What is meant by in-band signaling and out-of-band signaling?
ii) What are the main components of SS7 network architecture? Briefly explain their functions.
iii) What is meant by Global Title Translation (GTT) of telecommunication networks?
[4.0 Marks]
- b) i) What are the key characteristics of the Next Generation Network (NGN) architecture?
ii) Briefly explain the layers in the NGN architecture and their functions.
iii) What are the basic functions of the Signaling Gateway (SG) and the Trunk Media Gateway (TMG) of the NGN architecture? Briefly explain.
iv) Compare and contrast the Common Channel Signaling (CCS) with the Channel Associated Signaling (CAS).
[6.0 Marks]
- Q2 a) i) What are the main reasons for operators to move from the softswitch based NGN to the IP Multimedia Subsystem (IMS) based NGN?
ii) Name the main components in IMS based NGN architecture and briefly explain their functions.
iii) An IMS subscriber is successfully attached his home network and trying to make a call to another subscriber in a different IMS domain. Draw a diagram to show the initial INVITE message flow between the calling and called parties. Name all the network nodes involved during the communication.
[4.0 Marks]
- b) i) Draw a diagram to illustrate the main components in Long Term Evolution (LTE) network architecture.
ii) Briefly discuss how the latency and the throughput are improved in an LTE network compared to the 3G Packet Switched (PS) Core network.
[2.0 Marks]
- c) A 10 MHz Frequency Division Duplex (FDD) LTE system uses 10% of the total bandwidth for the guard band with a sub carrier spacing of 15 kHz. The system operates at normal Cycle Prefix (CP) with seven Orthogonal Frequency Division Multiplexing (OFDM) symbols per 0.5 ms time slot. Determine the following.
- Number of sub carriers used in the system
 - Number of resource blocks and resource elements required

- iii) Peak download speed for a category 4 user equipment assuming 64-QAM modulation

[4.0 Marks]

- Q3 a) i) Briefly explain the operation of a step-by-step switch using a diagram.
ii) Explain the advantages of a crossbar switch over a strowger switch.

[3.0 Marks]

- b) A 100-line switching system is designed with 10 output uniselectors as shown in Figure Q3 b). In the first stage, one uniselector is used for each subscriber and in the second stage, one uniselector is used for each number decade. Determine the following.

- i) Switching capacity of the system
ii) Traffic handling capacity of the system
iii) Equipment utilization factor
iv) Blocking probability of the system

[5.0 Marks]

- c) Redraw the 100-line switching system shown in Figure Q3 b) with uniselectors for a non-blocking scheme.

[2.0 Marks]

- Q4 a) Define the following terms in teletraffic engineering.

- i) Call holding time
ii) Grade of Service (GoS)
iii) Traffic intensity

[2.0 Marks]

- b) During a busy hour, 1400 calls were offered to a group of trunks and 14 calls were lost. The average call duration is 3 minutes. Determine the following.

- i) Offered traffic
ii) Carried traffic
iii) Grade of Service (GoS)
iv) Total duration of periods of congestion

[4.0 Marks]

- c) The average call attempt rate on a telephone line is 2 calls/busy hour. Assume that the call attempts follow a poisson distribution,

- i) Determine the probability that one call attempt is in a 10 minutes interval
ii) What is the probability that more than two call attempts are in a 2 minutes interval?
iii) If the average holding time is 3 minutes, what is the offered traffic of the network?

[4.0 Marks]

- Q5 a) i) What is the most widely accepted goal of a firm? How does the net present value of a project relate to this goal?
ii) Discuss the relationships between goal of the firm, financial management and capital budgeting.

iii) Briefly discuss the main stages of a typical and well organized capital budgeting process of a large corporation.

[4.0 Marks]

b) A company proposes to initiate one of two mutually exclusive projects namely, AXE and BXE. The initial capital outlay and the annual cash inflows are as shown in Table Q4 b).

Table Q4 b)

		AXE	BXE
Initial capital outlay		Rs. 2,250,000.00	Rs. 3,000,000.00
Salvage value at the end of the life		0	0
Economic life (in years)		4	7
After tax annual cash inflows (Rs.)	Year 1	600,000.00	500,000.00
	2	1,250,000.00	750,000.00
	3	1,000,000.00	750,000.00
	4	750,000.00	1,200,000.00
	5	-	1,250,000.00
	6	-	1,000,000.00
	7	-	800,000.00

The cost of capital of the company is 16%. Determine the following for each project.

- i) Net Present Value (NPV) of cash inflows
- ii) Internal Rate of Return (IRR)

[6.0 Marks]

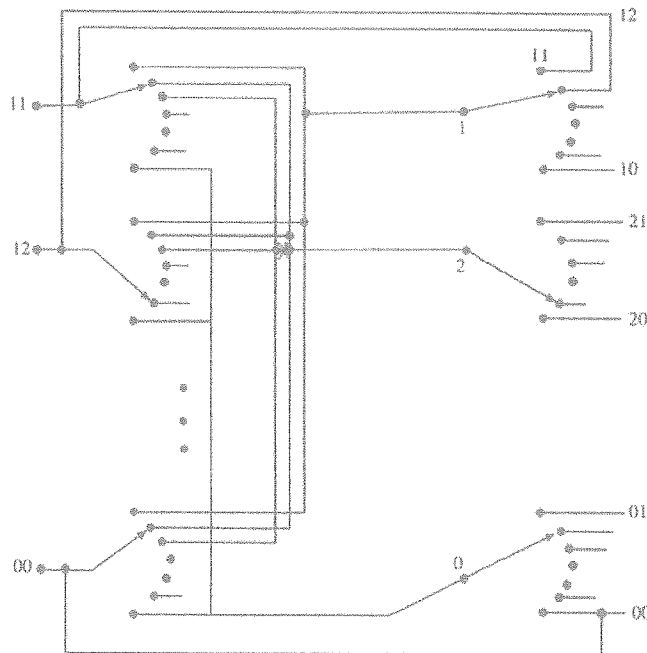


Figure Q3 b)

APPENDIX TABLE 1

Discount factors: Present value of \$1 to be received after *t* years = $1/(1 + r)^t$.

Number of Years	Interest Rate per Year														
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	.990	.980	.971	.962	.952	.943	.935	.926	.917	.909	.901	.893	.885	.877	.870
2	.980	.961	.943	.925	.907	.890	.873	.857	.842	.826	.812	.797	.783	.769	.756
3	.971	.942	.915	.889	.864	.840	.816	.794	.772	.751	.731	.712	.693	.675	.658
4	.961	.924	.888	.855	.823	.792	.763	.735	.708	.683	.659	.636	.613	.592	.572
5	.951	.906	.863	.822	.784	.747	.713	.681	.650	.621	.593	.567	.543	.519	.497
6	.942	.888	.837	.790	.746	.705	.666	.630	.596	.564	.535	.507	.480	.456	.432
7	.933	.871	.813	.760	.711	.665	.623	.583	.547	.513	.482	.452	.425	.400	.376
8	.923	.853	.789	.731	.677	.627	.582	.540	.502	.467	.434	.404	.376	.351	.327
9	.914	.837	.766	.703	.645	.592	.544	.500	.460	.424	.391	.361	.333	.308	.284
10	.905	.820	.744	.676	.614	.558	.508	.463	.422	.386	.352	.322	.295	.270	.247
11	.896	.804	.722	.650	.585	.527	.475	.429	.388	.350	.317	.287	.261	.237	.215
12	.887	.788	.701	.625	.557	.497	.444	.397	.356	.319	.286	.257	.231	.208	.187
13	.879	.773	.681	.601	.530	.469	.415	.368	.326	.290	.258	.229	.204	.182	.163
14	.870	.758	.661	.577	.505	.442	.388	.340	.299	.263	.232	.205	.181	.160	.141
15	.861	.743	.642	.555	.481	.417	.362	.315	.275	.239	.209	.183	.160	.140	.123
16	.853	.728	.623	.534	.458	.394	.339	.292	.252	.218	.188	.163	.141	.123	.107
17	.844	.714	.605	.513	.436	.371	.317	.270	.231	.198	.170	.146	.125	.108	.093
18	.836	.700	.587	.494	.416	.350	.296	.250	.212	.180	.153	.130	.111	.095	.081
19	.828	.686	.570	.475	.396	.331	.277	.232	.194	.164	.138	.116	.098	.083	.070
20	.820	.673	.554	.456	.377	.312	.258	.215	.178	.149	.124	.104	.087	.073	.061

Number of Years	Interest Rate per Year														
	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%	26%	27%	28%	29%	30%
1	.862	.855	.847	.840	.833	.826	.820	.813	.806	.800	.794	.787	.781	.775	.769
2	.743	.731	.718	.706	.694	.683	.672	.661	.650	.640	.630	.620	.610	.601	.592
3	.641	.624	.609	.593	.579	.564	.551	.537	.524	.512	.500	.488	.477	.466	.455
4	.552	.534	.516	.499	.482	.467	.451	.437	.423	.410	.397	.384	.373	.361	.350
5	.476	.456	.437	.419	.402	.386	.370	.355	.341	.328	.315	.303	.291	.280	.269
6	.410	.390	.370	.352	.335	.319	.303	.289	.275	.262	.250	.238	.227	.217	.207
7	.354	.333	.314	.296	.279	.263	.249	.235	.222	.210	.198	.188	.178	.168	.159
8	.305	.285	.266	.249	.233	.218	.204	.191	.179	.168	.157	.148	.139	.130	.123
9	.263	.243	.225	.209	.194	.180	.167	.155	.144	.134	.125	.116	.108	.101	.094
10	.227	.208	.191	.176	.162	.149	.137	.126	.116	.107	.099	.092	.085	.078	.073
11	.195	.178	.162	.148	.135	.123	.112	.103	.094	.086	.079	.072	.066	.061	.056
12	.168	.152	.137	.124	.112	.102	.092	.083	.076	.069	.062	.057	.052	.047	.043
13	.145	.130	.116	.104	.093	.084	.075	.068	.061	.055	.050	.045	.040	.037	.033
14	.125	.111	.099	.088	.078	.069	.062	.055	.049	.044	.039	.035	.032	.028	.025
15	.108	.095	.084	.074	.065	.057	.051	.045	.040	.035	.031	.028	.025	.022	.020
16	.093	.081	.071	.062	.054	.047	.042	.036	.032	.028	.025	.022	.020	.019	.015
17	.080	.069	.060	.052	.045	.039	.034	.030	.026	.023	.020	.017	.015	.013	.012
18	.069	.059	.051	.044	.038	.032	.028	.024	.021	.018	.016	.014	.012	.010	.009
19	.060	.051	.043	.037	.031	.027	.023	.020	.017	.014	.012	.011	.009	.008	.007
20	.051	.043	.037	.031	.026	.022	.019	.016	.014	.012	.010	.008	.007	.006	.005