



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2017

Module Number: EE7210

Module Name: Telecommunication Networks

[Three Hours]

[Answer all questions, each question carries 12.5 marks]

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- Q1 a) i) What are the main components of a traditional Public Switched Telephone Network (PSTN)?
- ii) Draw the Integrated Services Digital Network (ISDN) architecture showing all the elements and the reference points.
- iii) What are the different configurations of ISDN? Briefly explain. [6 Marks]
- b) i) What are the key characteristics of Next Generation Networks (NGNs)?
- ii) Briefly explain the layers in NGN architecture and their functions.
- iii) What are the key advantages of IP Multimedia Subsystem (IMS) based NGN architecture compared to Soft-Switch based NGN architecture?
- iv) Describe the operation of stateful and stateless proxy servers. Which components in IMS architecture do handle this operation? [6.5 Marks]
- Q2 a) i) Briefly explain Common Channel Signaling (CCS).
- ii) What are the main components of a Signaling System 7 (SS7) network?
- iii) Discuss why the Stream Control Transmission Protocol (SCTP) is a better suit for the signaling information transport. Compare advantages of SCTP over the Transmission Control Protocol (TCP). [6 Marks]

- b) The frequency spectrum allocation of a typical 1.1 MHz Discrete Multi-Tone (DMT) ADSL system is shown in Figure Q2. 256 channels of each 4 kHz bandwidth is assigned as, Channel 0 for the voice, Channel 6-30 for the uplink and Channel 31-255 for the downlink.

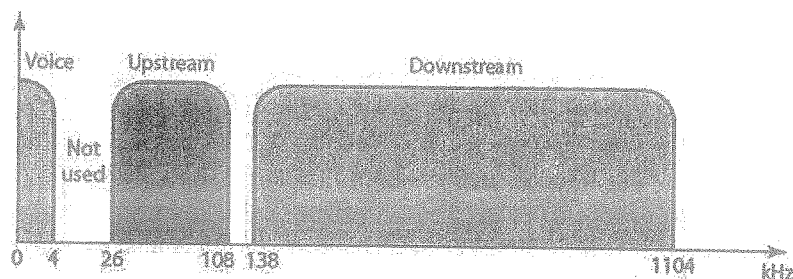


Figure Q2

- i) Define the term ADSL and explain how it differs from other DSL technologies.
- ii) Draw the main functional components in an ADSL network.
- iii) If each channel supports maximum of 15 bits/symbol and the baud rate is 4000 symbols/second. Calculate,
 - I) Maximum downlink speed
 - II) Maximum uplink speed
- iv) Nowadays, the Rate Adaptive ADSL (RADSL) is used in most ADSL applications. Explain what is meant by RADSL.

[6.5 Marks]

- Q3 (a)
- i) Draw a diagram to show the main components of Long-Term Evolution (LTE) network architecture and name the interfaces.
 - ii) What is meant by Service Architecture Evolution (SAE) in LTE networks? What are the advantages of SAE compared to Wideband CDMA (WCDMA) core network?
 - iii) Briefly explain how the spectral efficiency is improved in the LTE technology.

[6 Marks]

- (b) i) Describe the reverse drive operation of a uniselector using a diagram.
- ii) What are the main disadvantages of a Step-by-Step switch?

- iii) A 100 line switching system designed with 100 uniselectors and 24 two motion selectors is shown in Figure Q3. Each uniselector has 24 outputs and each output is connected to a two motion selector. The corresponding outputs of each uniselector are commoned so that all subscribers have access to all two motion selectors.

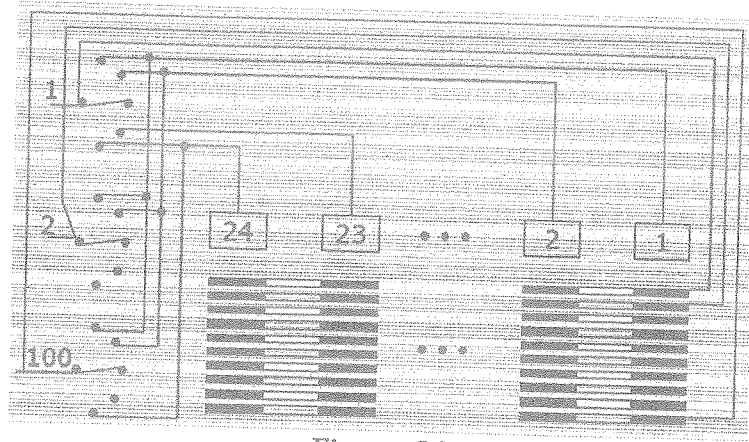


Figure Q3

The function of the uniselector is to seek a free two motion selector for the subscriber. Once the subscriber lifts the handset, his uniselector hunts through the contact positions and seizes a free two motion selector. Determine the following.

- I) Switching capacity of the system
- II) Traffic handling capacity of the system
- III) Equipment utilization factor
- IV) Cost capacity index (Assume that the cost per uniselector is 1 and the cost per two motion selector is 2.)

[6.5 Marks]

Q4 (a) i) Briefly explain the following terms.

- I) Capital budgeting
 - II) Non-discounting techniques
 - III) Discounting techniques
- ii) Machine-A costs Rs. 1,00,000 and it can be payable immediately. Machine-B costs Rs. 1,20,000 and it can be half payable immediately. However, the other half is payable in one year time. The expected cash receipts for both machines are shown in Table 1.

Table 1

Year (at the end)	A/ (Rs.)	B/ (Rs.)
1	20,000	-
2	60,000	60,000
3	40,000	60,000
4	30,000	80,000
5	20,000	-

With 7% of capital cost, which machine should be selected?

- iii) A company proposes to undertake one of the two mutually exclusive projects AXE and BXE. The initial capital outlay and the annual cash inflows are shown in Table 2.

Table 2

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

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

- I) Net present value of cash flows
- II) ~~International~~ Internal rate of return

[7.5 Marks]

- (b) (i) Define the following terms.

- I) Call Holding Time
- II) Grade of Service (GoS)

- (ii) During the busy hour a group of trunks is offered 120 calls having an average duration of 3 minutes. Assume that 3 calls fails to find a disengaged trunk.

- I) What is the Grade of Service of the network?
- II) Determine the carried traffic in Erlangs.
- III) If the traffic arrival has the Poisson distribution, what is the probability that more than 2 calls are received at a monitoring period of 1 minute?

[5.0 Marks]

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	.709	.683	.659	.636	.613	.592	.572
5	.951	.905	.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	.775	.681	.601	.530	.469	.415	.368	.326	.290	.258	.229	.204	.182	.162
14	.870	.759	.661	.577	.505	.442	.386	.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	.196	.179	.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	.019	.017	.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