UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: October 2019

Module Number: EE7210 **Module Name: Telecommunication Networks**

[Three Hours]

[Answer **all questions**, each question carries 10 marks]

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 and name its elements and reference points.

iii) Briefly explain different service configurations used in ISDN.

(4.0 Marks)

b) A typical 1.1 MHz Discrete Multi-Tone (DMT) Asymmetric Digital Subscriber Line (ADSL) system uses Channel 0 for voice, Channels 6-30 for the uplink, and Channels 31-255 for the downlink. The system supports n-QAM modulation, where n varies from 4 to 32768. The symbol frequency is 4 kHz.

i) Draw a diagram to show the functional components in an ADSL system.

ii) Briefly explain the Discrete Multi-Tone (DMT) technology used in ADSL.

iii) Calculate the maximum throughputs for the uplink and the downlink.

iv) Explain what is meant by rate adaptation in ADSL.

(6.0 Marks)

Q2. a) i) Briefly explain the Common Channel Signaling (CCS).

ii) What are the main components of a SS7 signaling network?

iii) Explain why Stream Control transmission Protocol (SCTP) is a better option for signaling information transport. Compare the advantages of SCTP over Transmission Control Protocol (TCP).

(4.0 Marks)

b) i) What are the key characteristics of the Next-Generation Network (NGN)?

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 operations of stateful and stateless proxy servers and mention the components in the IMS based NGN architecture that show these operations.

(6.0 Marks)

Q3. a) i) Draw a diagram to show the 3G Packet Switched (PS) core network architecture and identify its main interfaces.

ii) Briefly explain the function of DNS servers in the above network.

(4.0 Marks)

b) i) Briefly explain the following terms.

I. Capital budgeting
II. Non-discounting techniques
III. Discounting techniques

ii) What is the most widely accepted goal of a firm and how does the net present value of a project relate to that goal?

iii) A company proposes to undertake one of two mutually exclusive projects namely, AXE and BXE. The initial capital outlay and the annual cash inflows of these two projects are shown in Table Q3 b) i). The company's cost of capital is 16%. Calculate the following for each project.

I. Net present value of cash flows
II. Internal rate of return

Note: Use the provided Table Q3 b) ii) for your calculations.

(6.0 Marks)

Q4. a) What is meant by switching in telecommunication networks?

(1.0 Mark)

b) What is Switching Matrix of a switching system?

(1.0 Mark)

c) Briefly explain the meanings of trunk and trunk call system in a telecommunication network.

(1.0 Mark)

d) Explain the limitations of a manual exchange in a telecommunication network?

(1.0 Mark)

e) Explain the operations of a Strowger switch and a Crossbar switch.

(1.0 Mark)

f) Illustrate and explain the Stored Program Control (SPC) process of switching systems.

(2.0 Marks)

g) List four types of connection establishment in telecommunication networks and explain the operation of each connection.

(2.0 Marks)

h) Explain the difference between one-sided and two-sided matrix configurations in space switching.

(1.0 Mark)

Q5. Refer 2G and 3G security architectures shown in Figure Q5 a) i) and Q5 a) ii) to answer the following questions.

a) i) Where is the authentication secret key **K** stored in the security architectures?

ii) What is the bit length of Confidentiality Key (CK) and Integrity key (IK)?

iii) What is the purpose of the SQN element used for Universal Mobile Network Service (UMTS) authentication?

iv) Does UMTS have end-to-end security? Explain why.

v) Illustrate the MILENAGE algorithm used in UTMS authentication?

vi) What does the **f0** function do?

(6.0 Marks)

b) i) Which type of cipher function is **A5** cipher?

ii) What does the **A3** function do?

iii) What does the **A8** function do?

iv) Briefly explain the terms: authentication, authorization, and accounting (AAA) used in the authentication process?

(4.0 Marks)

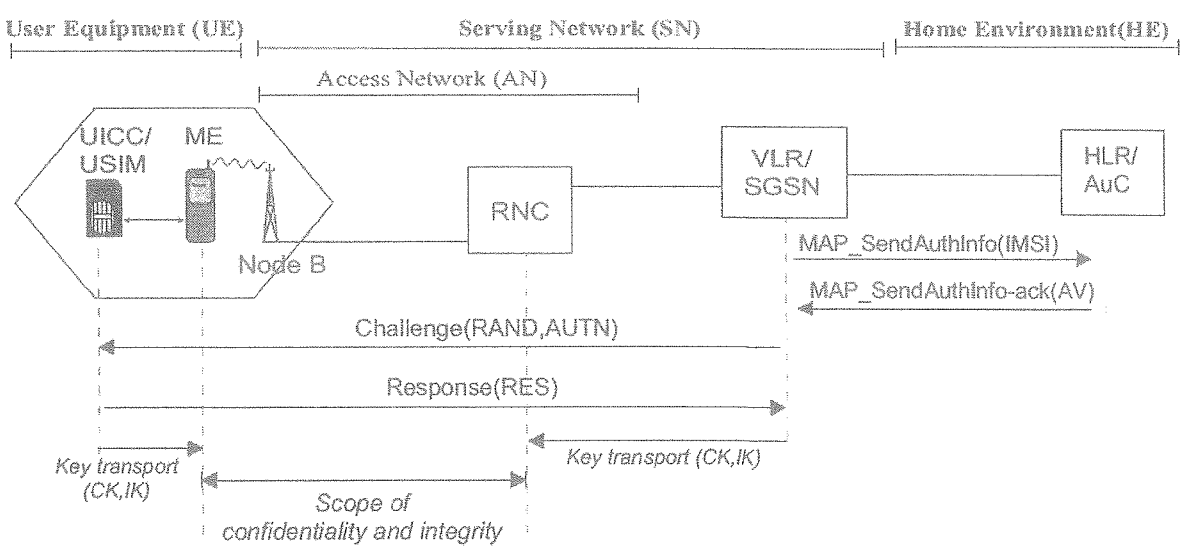

Figure Q5 a) i): The UMTS (3G) Access Security Architecture.

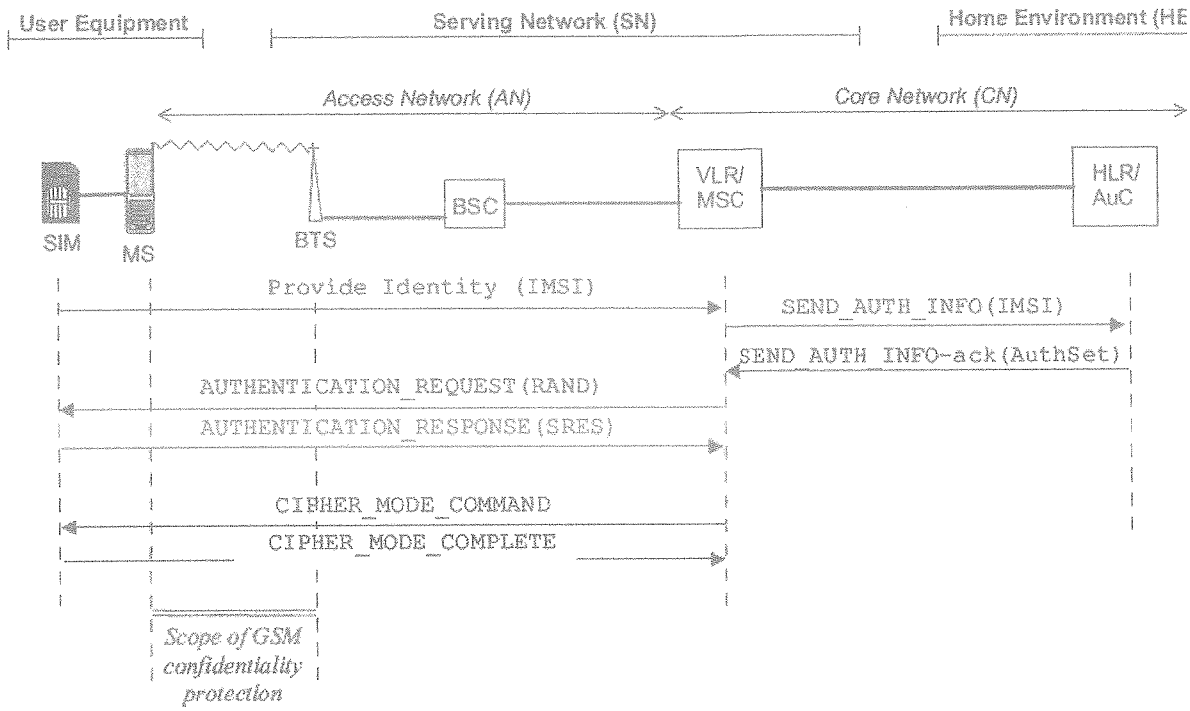

Figure Q5 a) ii): The 2G Access Security Architecture.

Table Q3 b) i): The initial capital outlay and annual cash inflows.

		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 (years)		4	7
After tax, annual cash inflows	Year 1	Rs. 600,000	Rs. 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

Table Q3 b) ii).

Discount factors: Present value of 1 Rs 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	.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