Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEM-VIII Examination May 2012

Subject code: 180903

Subject Name: Power System Practice and Design

Date: 14/05/2012 **Time: 10.30 am – 01.00 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q1. A. Explain the following distribution systems with figures. **07**

1. Radial system.
2. Parallel or loop system.
3. Network or grid system.

Q1. B. What are corona losses? Discuss its significance and permissible limit. Explain Peek's and Peterson's formula for calculating the corona loss. **07**

Q2. A. What is lamp flicker? What are its causes? What type of loads are responsible for it? How can it be reduced? **07**

Q2. B. A single phase a.c. distributor 500 m long has a total loop impedance of $(0.02 + j0.04)\ \Omega$ and is fed from one end at 250 V. It is loaded as under: **07**

1. 50 A at unity power factor, 200 m from the feeding point.
2. 100 A at 0.8 power factor lag, 300 m from the feeding point.
3. 50 A at 0.6 power factor lag, at the far end.

Calculate the total voltage drop in the distributor and the voltage at the far end.

OR

Q2. B. A two conductor street main AB, 500 meters in length is fed from both the ends at 250 V. Loads of 50 A,60 A, 40 A and 30 A are tapped at distances of 100 m, 250 m, 350 m and 400 m from the end A respectively. If the cross section of the conductors is 1 cm^2 and specific resistance of the material of the conductors is 1.7μ Ω-cm, determine the minimum consumer voltage. **07**

Q3. A. Discuss the following factors to be taken into consideration in the mechanical design of a transmission line. **07**

1. Loading on the conductors.
2. Span, sag and tension.
3. Clearance from the ground.

Q3. B. Draw the schematic of an HVDC system and hence explain its principle of operation. Discuss various types of HVDC links used. **07**

OR

Q3. A. How is the selection of arrester voltage rating, discharge current and discharge voltage done? **07**

Q3. B. Explain the use of bundled conductors in EHV transmission lines. Also explain how the spacing, selection of size and number of conductors for the EHV lines is done. **07**

Q4. A. Discuss Kelvin's law to find the most economical conductor size. What are the limitations of this law? **07**

Q4. B. Find the most economical cross-section of a 3 core distributor cable 250 m long supplying a load of 80 kW at 400 V and 0.8 power factor lagging for 4000 hours per annum and open circuited for the remaining of the year. The cost of the cable including installation is Rs. (15a +25) per meter where 'a' is the area of each conductor in sq. cm. Interest and depreciation rate is 10 % and the cost of energy wasted is 10 paisa per unit. The resistance per km of the conductor of 1 cm^2 cross section is 0.173 Ω. **07**

OR

Q4. A. Write a note on Gas Insulated substation. **07**

Q4. B. An overhead transmission line conductor is subjected to a horizontal wind load of 1.78 kg/m and a vertical ice loading of 1.08 kg/m. If the maximum permissible sag is 6 meters and the ultimate strength is 7950kg, calculate the permissible span between the two supports allowing a safety factor of 2. Weight of the conductor is 0.844 kg/m. **07**

Q5. A. Why are earth wires used? Discuss the methods used to improve the effectiveness of the earth wires. **07**

Q5. B. What are the merits and demerits of HVDC transmission ? **07**

OR

Q5. A. It is proposed to transmit 100 MW at 0.9 power factor lagging over a distance of 200 km. Select the line voltage, number of circuits, proper conductor and span for this line making use of the tables attached and hence find the line parameters and line regulation. **07**

Q5. B. For the problem mentioned in Q5. A., estimate the corona loss and find the line efficiency. Make use of the tables attached. **07**

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Note:-The following tables may be used to solve the problem on electrical design of transmission lines given in Q5. A and B.

Table-1.

Line to line voltage (kV)	Line loading (kW-km)
11	24×10^3
33	200×10^3
66	600×10^3
110	11×10^6
132	20×10^6
+166	35×10^6
230	90×10^6

Table-2.

Line to line voltage (kV)	Length of the line in km	
	Minimum	Maximum
66	40	120
110	50	140
132	50	160
166	80	180
230	100	300

Table-3.

Copper equivalent cross sectional area (cm^2)	Safe current carrying capacity in Amp.	
	Copper conductors.	ACSR conductors.
0.1935	82	100
0.2580	102	127
0.3225	118	148
0.3870	135	170
0.4515	153	190
0.5160	170	210
0.5805	185	230
0.6450	200	255
0.9675	275	350
1.2900	340	425
1.6125	400	505
1.9350	460	580
2.2575	520	655
2.5800	570	715
2.9025	625	775
3.2250	670	825

Table-4

Nominal copper area	Number of strands and wire diameter.		Approx. overall diameter.	Calculated resistance per km at 20°C.	Approx. total weight per km.	Calculated breaking load of composite conductor
	Aluminium	Steel				
cm^2	cm	cm	cm	Ω	kg	kg
0.161	6/0.236	1/0.236	0.708	1.0891	106.2	954.8
0.322	6/0.335	1/0.335	1.005	0.5400	214.0	1864.3
0.387	6/0.365	1/0.365	1.097	0.4550	255.0	2204.5
0.484	6/0.409	1/0.409	1.227	0.3640	318.0	2742.0
0.645	6/0.472	1/0.157	1.417	0.2720	395.0	3311.2
0.645	7/0.439	7/0.193	1.458	0.2700	451.0	4152.6
0.805	30/0.236	7/0.236	1.654	0.2200	605.0	5764.0
0.968	30/0.259	7/0.259	1.814	0.1832	728.0	6883.0
1.125	30/0.279	7/0.279	1.956	0.1572	847.0	7953.0
1.290	30/0.299	7/0.299	2.073	0.1370	975.0	9098.0
1.613	30/0.335	7/0.335	2.347	0.1091	1218.0	11306.0

Table-5

Line to line voltage (kV)	Equivalent spacing (m)
11	1
33	1.3
66	2.6
110	5
132	6
166	8
230	10.2

Table-6

Self GMD or GMR of stranded conductors	
Solid round conductor	0.779R
Full Stranding:	
7 - strands	0.726R
19 - strands	0.758R
37- strands	0.768R
61- strands	0.772R
91- strands	0.774R
127- strands	0.776R
Hollow stranded conductors and ACSR(neglecting steel strands):	
30-strands (two-layers)	0.826R
26-strands (two-layers)	0.809R
54-strands (three layers)	0.810R

Table-7

Corona loss calculation									
E/Ed	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2
F	0.012	0.018	0.05	0.08	0.3	1.0	3.5	6.0	8.0