Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VIII • EXAMINATION – SUMMER • 2015

Subject code: 180903 **Date: 13/05/2015**

Subject Name: Power System Practice and Design

Time: 10.30AM-01.00PM **Total Marks: 70**

Instructions:

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

Q1. A. Design a transmission line to transmit three phase 90 MW at 0.95 power factor lagging, over a distance of 180 km. Choose the voltage, size of conductor and spacing between the conductors. Calculate the constants of the line and determine the regulation. Find the corona loss per kilometer of the line and the total corona loss. 14

Q2. A. What is a stringing chart? What method is used for stringing the line conductors on the supports. What is the effect of temperature and the modulus of elasticity on the tension of the line? 07

Q2. B. What do you understand by a Gas Insulated Substation. Draw its circuit diagram. What are its advantages as compared to conventional substations? 07

OR

Q2. B. What feature is included in the design of transmission lines so that they are protected against the direct lightening strokes. Explain its working. 07

Q3. A. State and explain the law used to find the most economical conductor size. What are the drawbacks of this law? 07

Q3. B. A 3 core distribution cable is 300 m long and supplies a load of 100 kW at 440 volts at 0.9 p.f. lag for 3000 hours in a year. The cable cost including installation is Rs. (13a + 32) per meter where 'a' is the cross sectional area of each conductor in sq. cm. Cost of energy wasted is 12 paisa per unit and the rate of interest and depreciation is 15 %. The resistance per km of the conductor of 1 cm^2 cross-section is 0.213 ohm. Find the most economical cross-section of the distributor cable. 07

OR

Q3. A. Derive the sag-tension relation for a given span with towers at each end located at unequal levels. 07

Q3. B. An overhead line is erected across a span of 250 m on level supports. The conductor has a diameter of 1.42 cm and a dead weight of 1.09 kg per meter. The line is subjected to a wind pressure of 37.8 kg per sq. m of the projected area. The radial thickness of ice is 1.25 cm. Calculate the sag. Assume a maximum working stress of 1050 kg per sq. cm. One cubic meter of ice weighs 913.5 kg. 07

Q4. A. List and explain the types of primary distribution systems. 07

Q4. B. A 2 wire DC distributor AB is 300 m long and is fed at both the ends A and B. The distributor supplies a uniformly distributed load of 0.25 A/m and concentrated loads of 40 A at C and 60 A at D. The distances AC and BD are 120 m each. The 07

loop resistance of the distributor is 0.1 ohm/100m. Both A and B are maintained at 300 V. Find the currents fed at A and B and the potentials at points C and D.

OR

Q4. A. A single phase distributor has a resistance of 0.2 ohm and a reactance of 0.3 ohms. The voltage and current at the far end 'B' are 240 V and 100 A at 0.8 power factor lag respectively. At the mid-point 'A', the current is 100 A at 0.6 power factor lag with respect to the voltage at 'A'. Find the supply voltage and the phase angle between the supply voltage and the voltage at the far end 'B'. 07

Q4. B. In a power system, sudden changes in the intensity of illumination of lamps is found. What is this phenomenon called? What are its causes. Suggest remedial measures if any. 07

Q5. A. Discuss steps for design of the earthing grid. 07

Q5. B. What are the merits of HVDC transmission ? Are there any de-merits? 07

OR

Q5. A. Comment upon the location of the lightning arrester in a substation. Justify your answer. 07

Q5. B. Discuss the operation of the equipments used in HVDC system. 07

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Note:-The following tables may be used to solve the problem on electrical design of transmission line given in Q1.

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.

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-3

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-4

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-5

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

Table-6

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

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