Total No. of Questions—12] [Total No. of Printed Pages—7

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S.E. (Electrical) (Second Semester) EXAMINATION, 2011

POWER SYSTEM–I

(2008 PATTERN)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answers to the two Sections should be written in separate answer-books.

(*ii*) Neat diagrams must be drawn wherever necessary.

(*iii*) Figures to the right indicate full marks.

(*iv*) Assume suitable data, if necessary.

SECTION I

1. (*a*) What is diversity factor ? State the advantages of the diversity of load in power system. Prove that the load factor of a power system is improved by an increase in the diversity of load. [6]

(*b*) What are the objectives of tariff ? Explain the type of tariff employed for domestic customers. [4]

(*c*) The load on a power plant on a typical day is as under :

Time	**Load** (MW)
12—5 a.m.	30
5—9 a.m.	50
9 a.m.—6 p.m.	90
6 p.m.—10 p.m.	120
10 p.m.—12 p.m.	30

Plot the chronological load curve and load duration curve. Find the energy supplied by the plant in 24 hours. [6]

P.T.O.

Or

2. (*a*) What are the advantages of interconnected operation of power system ? [6]

(*b*) The following data refers to a power station :

(*i*) Annual maximum demand on station is 100 MW

(*ii*) Maximum demand of different loads supplied is 40 MW, 35 MW, 30 MW and 25 MW

(*iii*) Average load factor of the station is 60% and

(*iv*) Capacity of the station : 02 units of 50 MW each and one unit of 25 MW.

Find the number of units of energy supplied annually, diversity factor and plant utilization factor. [6]

(*c*) Discuss the importance and tariff method for encouraging customers to use electricity during off-peak hours. [4]

3. (*a*) Discuss the functions and principle of operation of automatic voltage regulator. Name different types of voltage regulators. [6]

(*b*) Each line of a three-phase system is suspended by a string of three similar insulators. If the voltage across the line side

unit is 19 kV. Calculate line to neutral voltage. Assume that the shunt capacitance between each insulator and earth is 1/10th of the capacitance of the insulator itself. [6]

(*c*) Name different types of insulators used in power system. Give the application of each type of insulator. [4]

Or

4. (*a*) Discuss the necessity of excitation system for alternators. Explain one of the types of excitation system used for alternators in brief. [8]

(*b*) What is string efficiency ? Why is it necessary to have high string efficiency ? State different methods of equalization of potential across each unit of a string of suspension insulators and explain one of them in brief. [8]

5. (*a*) Discuss with reasons :

(*i*) The a.c. resistance of a conductor is more than the d.c. resistance.

(*ii*) Bundled conductor lines have lower inductance than that of a single conductor lines.

(*iii*) In double circuit lines, the configuration of conductors is selected such that the distance between the conductors of the same phase is maximum. [6]

(*b*) Calculate the inductance per phase per km of a 33 kV, 50 Hz three-phase, three conductor line with conductor spacing of 1.4 m and diameter of 1.5 cm for the following configurations :

(*i*) Equilateral spacing

(*ii*) Horizontal spacing.

Assume transposed lines. [6]

(*c*) What is meant by transposition of conductors in an overhead line ? Why is it essential ? How is it carried out ? [6]

Or

6. (*a*) Derive the expression for internal and external flux linkages for a conductor carrying current I and thereafter derive the expression for inductance of a single-phase line. [10]

(*b*) Figure 1 shows a stranded conductor having seven identical strands each of radius *r*. Determine the geometric mean radius (GMR) of the conductor. [8]

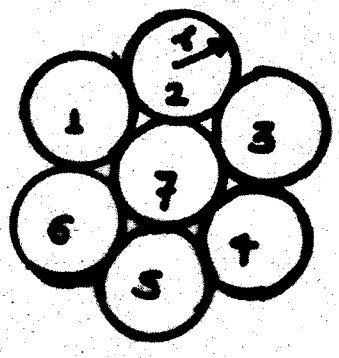

Fig. 1

SECTION II

7. (*a*) Derive an expression for capacitance per phase of a three-phase overhead transmission line with unsymmetrical spacing of conductors assuming transposition. [10]

(*b*) A single-phase line with two parallel conductors each of diameter 20 mm and spacing between the conductors is 3 m. The height of conductors above ground is 6 m. Calculate capacitance of the line :

(*i*) neglecting the effect of earth, and

(*ii*) taking into account the effect of earth. [8]

Or

8. (*a*) What is method of images ? How can it be used to take into account the presence of ground in calculating the capacitance of a single-phase line ? [8]

(*b*) Determine the capacitance and charging current per phase per km for a three-phase double circuit line as shown in figure 2. The line operates at 132 kV and 50 Hz. The diameter of each conductor is 2.5 m. Assume that the line is regularly transposed and neglect the effect of earth. [10]

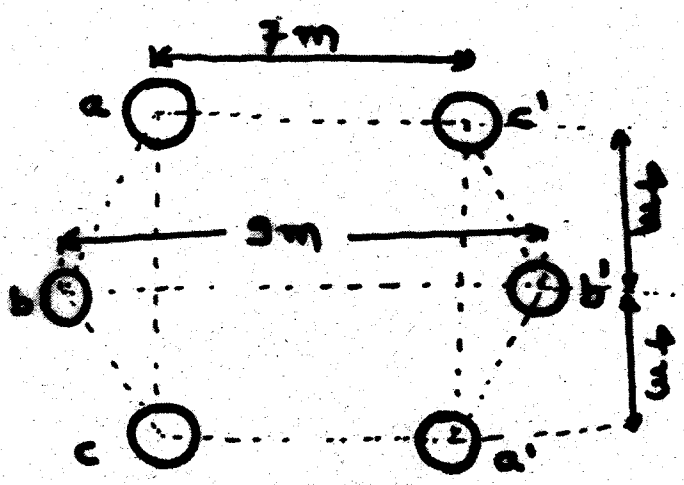

Fig. 2

9. (*a*) Obtain the relationship for the sending end voltage and current in terms of receiving end voltage and current for medium transmission line with nominal tee method. Draw the phasor diagram. Evaluate the generalised circuit constants. [8]

(*b*) A 50 Hz, three-phase transmission line is 275 km long. It has a total series impedance of $35 + j\ 140\ \Omega$ and a shunt admittance of $930 \times 10^{-6} \angle 90°$ ℧. Find A, B, C and D constant using long line equations. [8]

Or

10. (*a*) State Ferranti effect :

The following data refers to a 50 Hz, single-phase transmission line :

Length : 30 km

Load delivered at the receiving end : 6 MW at 0.8 p.f. lagging

Resistance of each conductor : 0.02 Ω/km.

Inductance = 0.7 mH/km.

The voltage at the receiving end is required to be kept at 11 kV. Find the sending end voltage. [8]

(*b*) Derive the expression for parameters of equivalent pi circuit for a long transmission line in terms of line parameters. Draw the equivalent pi model. [8]

11. (*a*) What are the different factors affecting the sag of a transmission line ? How are the effect of wind and ice loading taken into account while determining the resultant loading of the conductor ? [8]

(*b*) Give general classification of underground cables.

A 33 kV (line to neutral) single core cable has conductor of diameter 3 cm and inside diameter of lead sheath is 6 cm. Find :

(*i*) The maximum and minimum dielectric stress in the cable.

(*ii*) Optimal value of conductor radius for the smallest value of maximum stress. [8]

Or

12. (*a*) What is stringing chart ? The weight of an overhead line conductor is 700 kg/km. The ultimate strength is 3000 kg. If safety factor is 2 and span length is 250 m, find :

(*i*) Sag

(*ii*) Total length of line between span

(*iii*) Height above ground at which conductor should be supported if ground clearance required is 8 meters. [8]

(*b*) Derive expression for capacitance of a single core cable. [8]