POWER SYSTEM-I
(ELEC 3102)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) In a certain type of nuclear reactors, heavy water is used as
(a) moderator (b) biological shield
(c) fuel (d) never used at all.

(ii) The function of deaerator in a steam power plant is
(a) to reduce dissolved oxygen content in the condensate(feed water)
(b) to preheat the air to save fuel
(c) to heat the water to improve efficiency
(d) to remove the exhaust from chimney.

(iii) The ratio of sum of the individual maximum demands of the consumers to the system maximum demand is known as
(a) demand factor (b) diversity factor
(c) load factor (d) power factor.

(iv) If an ACSR conductor has specification 48/7, it means that it has _____ numbers of aluminium strands and _____ numbers of steel strands.
(a) 7, 48 (b) 6, 47 (c) 48, 7 (d) 47, 6.

(v) Ferranti effect on long overhead lines is experienced when it is
(a) lightly loaded (b) on full load at unity power factor
(c) slightly over loaded (d) on full load at 0.8 power factor lagging.

(vi) A line which connects a consumer to the distributer is called a
(a) feeder (b) distributer (c) service main (d) line.

(vii) Square root of the ratio of line impedance to shunt admittance is called
(a) regulation of the line (b) surge admittance of the line
(c) conductance of the line (b) surge impedance of the line.

(viii) Effect of temperature rise in overhead lines is to
(a) increase the sag and decrease the tension
(b) decrease the sag and increase the tension
(c) increase both
(d) decrease both.

(ix) The voltages across the various discs of a string of suspension insulators having identical discs is different due to
(a) surface leakage current (b) series capacitance
(c) shunt capacitance to ground (d) series and shunt capacitance.

(x) Corona loss increases with
(a) increase in supply frequency and conductor size
(b) increase in supply frequency and reduction in conductor size
(c) decrease in supply frequency and reduction in conductor size
(d) decrease in supply frequency and increase in conductor size

Group - B

2. Draw and explain the schematic layout of a Thermal power station.

(6 + 6) = 12

3. (a) Draw the schematic arrangement of a hydro-electric plant.

(b) Explain how the site of a hydroelectric plant is selected based on various aspects.

(c) Write down the advantages and disadvantages of nuclear power station.

4 + 3 + 5 = 12

Group - C

4. (a) In a single-phase double circuit transmission line as shown in Figure 1, conductors a and a′ are parallel to each other in one conductor, while conductors b and b′ are parallel to each other in the other conductor. Each conductor radius is 2 cm. Determine the loop inductance of the line per kilometre assuming that the two parallel conductors equally share the current.

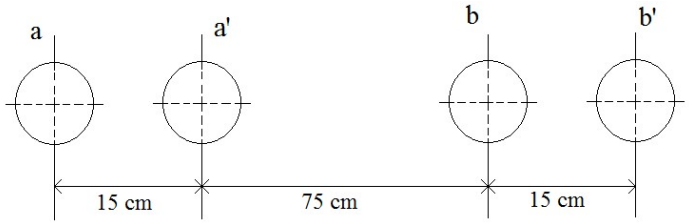

Figure 1

(b) What do you mean by ACSR conductor ? What are the advantages of ACSR conductor ?

(c) What do you mean by transposition of lines? What are its effects on the performance of the line ?

6 + (1 + 2) + (1 + 2) = 12

5. (a) Derive the expression for dielectric stress in a single core cable. Where is the potential gradient maximum in a single core cable and why?

(b) Determine the economic value of the diameter of a single - core cable working on a 66 kV, three phase system. Also calculate the overall diameter of the insulation if the maximum permissible stress in the dielectric is not to exceed 50 kV/cm.

(4 + 2) + 6 = 12

Group – D

6. (a) What are the factors affecting sag? Why too high or too low sag is disadvantageous?

(b) An overhead transmission line has a span of 250 meters between the level supports. With the following data calculate maximum slant sag and maximum vertical sag. Effective diameter of the conductor = 1.88 cm, weight of the conductor=0.87 Kg/m run, ultimate strength = 8100 Kg, radial thickness of ice coating on the conductor = 1.2cm, wind pressure = 38 Kg/m^2 of projected area, factor of safety = 2 and density of ice = 913 Kg/m^3.

(2 + 4) + 6 = 12

7. (a) What are the advantages and disadvantages of corona?

(b) Determine the critical disruptive voltage and visual critical disruptive voltage for a three phase line with operating voltage 132 kV, 50 Hz. The conductor diameter is 1.2 cm, delta spacing between conductors is 2.6 m, temperature of the atmosphere is 27°C, barometric pressure 74 cm of mercury, surface irregularity factor is 0.8.

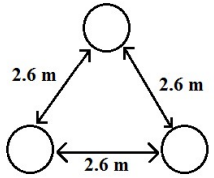

Figure 2

(c) Each line of a 3 - phase system is suspended by a string of 3 similar disc insulators. If the voltage across the unit nearest to the line is 17.5 kV, calculate the line to neutral voltage. Assume that the shunt capacitance between each insulator and earth is 1/8th of the capacitance of the insulator itself. Also find the string efficiency.

3 + 4 + 5 = 12

Group – E

8. (a) Explain Surge Impedance Loading of Transmission line.

(b) A balanced three phase load of 30 MW is supplied at 132 kV, 50 Hz and 0.85 p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20+j40) Ω and the total phase-neutral admittance is (315 × 10^{-6}) Mho. Use nominal-π methods to determine:
(i) A,B,C,D constants of the line (ii) V_s and (iii) Regulation of the line.

3 + (4 + 2 + 3) = 12

9. (a) What is two part tariff? Calculate the number of units to be consumed so that the annual bill on the basis of two part tariff is same as on the basis of flat rate tariff from the following data:
Maximum demand= 10 kW
Two part tariff– Rs 1200 per annum per kW of maximum demand plus Rs 6 per unit consumed.
Flat rate tariff – Rs 7.5 per unit.

(b) An 800 m long, 2-wire DC distributor fed from both ends, is loaded uniformly at the rate of 1.2 A/m run. If the resistance of the distributor is 0.1 Ω/km(go and return) and feed points A and B are maintained at 245 V and 240 V respectively, calculate:
(i) the minimum voltage and its point of occurrence.
(ii) the currents supplied from feeding points A and B.

(2 +4) + (3 +3) = 12