(b) Find the weight of the conductor per meter length if the ultimate strength is 5758 kg, sag is 2.0 metre, factor of safety is 2 and the overhead line has a span of 250 meters.

(c) Describe the effect of wind pressure and ice deposition on sag in overhead lines.

6 + 2 + 4 = 12

Group – E

8. (a) Derive A, B, C, D constants for a medium transmission line represented by nominal-π configuration.

(b) A 3-phase overhead long transmission line has a total series impedance per phase of $200\angle 80°\ \Omega$ and a total shunt admittance of $0.0013\angle 90°$ siemens per phase. The line delivers a load of 80 MW at 0.8 power factor lagging and 220 kV between the lines. Determine the sending end voltage and sending end current.

6 + 6 = 12

9. (a) What is synchronous condenser? How it helps to improve power factor of the system?

(b) How step rate tariff and block rate tariff differ from each other?

(c) A D.C. two wire distributor AB is 450 meters long and is fed at both ends at 250 V. The distributor is loaded as shown in Fig.-3. The resistance of each conductor is 0.05 ohm per km. Find the point of minimum potential and its potential.

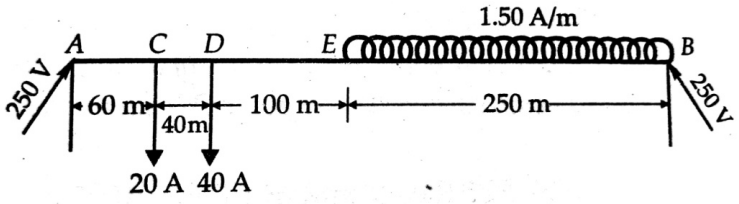

Fig.3

(1 + 3) + 3 + 5 = 12

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) The insulation resistance of a single core cable is 200 MΩ/km. The insulation resistance for 5 km length is
(a) 40 MΩ (b) 1000 MΩ (c) 200 MΩ (d) 8 MΩ.

(ii) The diameter of each strand is d then the diameter of n-layer stranded conductor will be
(a) (2n+1)d (b) 2n(n+1)d
(c) (2n-1)d (d) 2(n+1)d

(iii) Ferranti effect happens in transmission line when the line is
(a) short and loaded (b) long and loaded
(c) long and unloaded (d) medium and loaded.

(iv) Which type of insulators are used on 132 kV transmission lines?
(a) Pin type (b) Disc type
(c) Shackle type (d) Both Pin and Shackle type.

(v) The reactive power transfer over a line mainly depends on
(a) V_S (b) V_R (c) $|V_S| - |V_R|$ (d) power angle δ.

(vi) The thickness of insulation layer provided on the conductor, in cables, depends upon
(a) operating voltage (b) current to be carried
(c) power factor (d) power angle.

(vii) Which material is used as moderator in a certain type of nuclear power reactor?
(a) Uranium-235 (b) Heavy water
(c) Cadmium (d) Plutonium-239.

(viii) 100 % string efficiency means
(a) zero potential across each insulator disc
(b) equal potential across each insulator disc
(c) one of the insulator disc shorted
(d) infinite potential across each insulator disc.

(ix) Distributor is designed mainly from the point of view of
(a) current carrying capacity (b) voltage drop in it
(c) operating voltage (d) operating frequency.

(x) Transposition of transmission line is done to
(a) reduce line loss (b) reduce skin effect
(c) balance line voltage drop (d) reduce corona.

Group – B

2. (a) A steam power station of 100 MW capacity uses coal of calorific value 7421 kCal/kg. Thermal efficiency of the station is 31% and electrical efficiency is 93%. Calculate coal consumption per hour when the station is delivering its full rated output.

(b) How is nuclear waste disposed of in nuclear power station?

(c) Name any two materials used for control rods in nuclear power station.

(d) Explain the essential factors which influence the selection of site for hydroelectric power plants.

4 + 3 + 1 + 4 = 12

3. (a) Draw and explain the schematic layout of a Nuclear power station.

(b) What is meant by the phenomenon "water hammer" in hydroelectric power plant? How a surge tank helps in reducing water hammer effect?

8 + 4 = 12

Group – C

4. (a) Explain briefly the 'skin effect' phenomenon in a transmission line.

(b) What is the meaning of 30/7 ACSR conductors? Explain the advantages of ACSR conductors, when used for overhead lines.

(c) In a single phase line (as shown in Fig.1), conductors a and a′ in parallel form forward circuit while conductors b and b′ in parallel form the return path. Calculate the total inductance of the line per km assuming that the current is equally shared by the two parallel conductors. Conductor diameter is 1.8 cm.

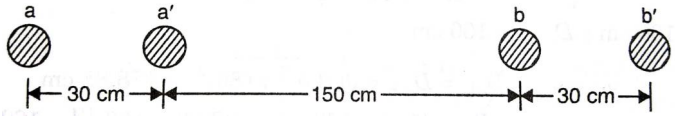

Fig.1

3 + (1 + 2) + 6 = 12

5. (a) Show that the most economical size of conductor in a single-core cable is obtained when radius of cable sheath **(R)** equals **(e × r)** where **e** is the base of natural log and **r** is the radius of conductor.

(b) What is meant by grading of cables?

(c) A single-core cable used on 33 kV, 50 Hz has a conductor diameter 10 mm and inner diameter of sheath 25 mm. The relative permittivity of insulating material used is 4. Determine
(i) Capacitance of the cable per km,
(ii) Maximum electrostatic stress in the cable,
(iii) Charging current per km.

4 + 2 + 6 = 12

Group – D

6. (a) What are the methods of reducing corona effects?

(b) Determine (i) the critical disruptive voltage (ii) the visual critical voltage and (iii) the corona loss under foul weather condition for 3-phase line 200 km long, conductor diameter 1.2 cm; 2.5 m delta spacing. Air temperature 30°C, corresponding to an approximate barometric pressure of 74 cm of mercury, operating voltage 220 kV at 50 Hz, surface irregularity factor 0.85.

(c) What are the advantages and disadvantages of corona?

3 + 6 + 3 = 12

7. (a) For the following arrangement (in Fig.2), calculate (i) the voltage distribution (in terms of 'V') over a string of three suspension insulators and (ii) string efficiency.

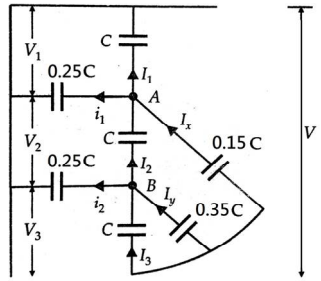

Fig.2