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
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   Which of the following is a base-load plant
          (a) Steam plant   (b) Hydro-plant
          (c) Diesel plant   (d) Nuclear plant.

   (ii)   Sheaths are used in cables to
          (a) provide proper insulation   (b) protect the cable from moisture
          (c) provide mechanical strength   (d) good conductivity.

   (iii) The insulation resistance of a 2 km long cable is 200 MΩ. For a length 20 km, the
          insulation resistance will be
          (a) 20 MΩ   (b) 400 MΩ
          (c) 2000 MΩ   (d) None of the above.

   (iv)   Stringing chart is useful for
          (a) Finding the sag in the conductor   (b) in the design of tower
          (c) in the design of insulator string   (d) finding the distance between the tower.

   (v)   Use of bundle conductors in EHV transmission system provides
          (a) increased line reactance   (b) decreased capacitance
          (c) reduced voltage gradient   (d) increased corona loss.

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

   (vii) ACSR conductor stands for
          (a) Alloy Copper Steel Reinforced   (b) All copper Steel Reinforced
          (c) Aluminium conductor Steel Reinforced (d) None of these.

(viii)   In a string of suspension insulator, maximum voltage appears across the unit
(a) Nearest to the conductor   (b) Nearest to the cross arm
(c) In between two units   (d) None of these.

(ix)   Corona is accompanied by
(a) Violet visible discharge in darkness   (b) Hissing sound
(c) Vibration   (d) all of these.

(x)   The economic size of conductor is determined by
(a) Kelvin's law   (b) Kirchhoff's law
(c) Faraday's law   (d) none of these.

Group – B

2. (a)   A steam power station of 100 MW capacity uses coal of calorific value 6400 kCal/kg. Thermal efficiency of the station is 30% and electrical efficiency is 92%. Calculate coal consumption per hour when the station is delivering its full rated output.

(b)   Explain the mechanism of energy release in nuclear reaction.

4 + 8 = 12

3. (a)   Compare Hydroelectric, nuclear and coal-fired power stations in context of four different attributes

(b)   What are the factors of selection of site for hydroelectric power station?

8+4 = 12

Group – C

4. (a)   Define Skin Effect and Proximity Effect.

(b)   In a single phase line (as shown in Figure-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.
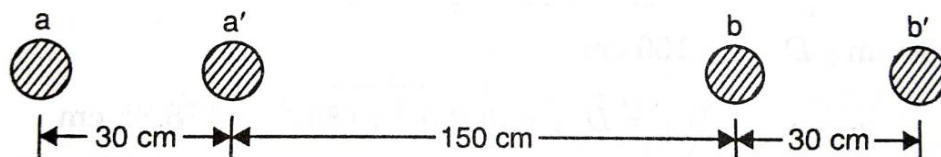

Figure-1

4 + 8 = 12

5. (a)   Prove that g_{max} / g_{min} in a single-core cable is required to D/d.

(b)   Calculate the capacitance and charging current of a three-phase, single-core 33 kV, 50 Hz, 2 km long cable having a core diameter of 2 cm and a sheath diameter of 6 cm. Relative permittivity of the insulation is 3.

6 + 6 = 12

Group – D

6.   (a)   Explain the effect of ice deposition and wind pressure on sag of transmission line.

    (b)   A transmission line conductor at a river crossing is supported from two towers at height of 55 meters and 80 meters above water level. The horizontal distance between the towers is 320 meters. If the tension in the conductor is 2000 kg, find the clearance between the conductor and water at a point midway between the towers. Weight of the conductor per meter is 0.844 kg. Assume that the conductor takes a shape of parabolic curve.

6 + 6 = 12

7.   (a)   Explain the methods of improving string efficiency.

    (b)   A 3-phase transmission line is supported by a 3-unit suspension insulator string. The voltage across the line unit is 20 kV and that across the adjacent unit is 15 kV. Determine:
(i)   Ratio of ground to mutual capacitance
(ii) System line voltage
(iii) String efficiency.

5 + 7 = 12

Group – E

8.   (a)   Derive the expression of A,B,C,D parameters for Nominal-T network using Phasor diagram.

    (b)   A 220 kV, 3-phase, 150 km, 50 Hz transmission line delivers a load of 100 MW at 0.85 p.f. lagging. The line has per phase a total impedance of $Z=(40 + j\,125)$ ohms and a total shunt admittance $Y=j\,0.001$ mho. Using Nominal-T method determine
(i)   Sending end line voltage
(ii) Sending end line current
(iii) Sending end power factor
(iv) Transmission efficiency.

6 + 6 = 12

9.   (a)   A generating station has a connected load of 450 MW and a maximum demand of 250 MW. The units generated being 615×10^6 per annum. Calculate
(i) the demand factor and (ii) load factor.

(b)   A DC 2-wire distributor AB is 450 meters long and is fed at both ends at 250 V. The distributor is loaded as shown in Figure 2. The resistance of each conductor is 0.05 ohm per km. Find the point of minimum potential and its potential.
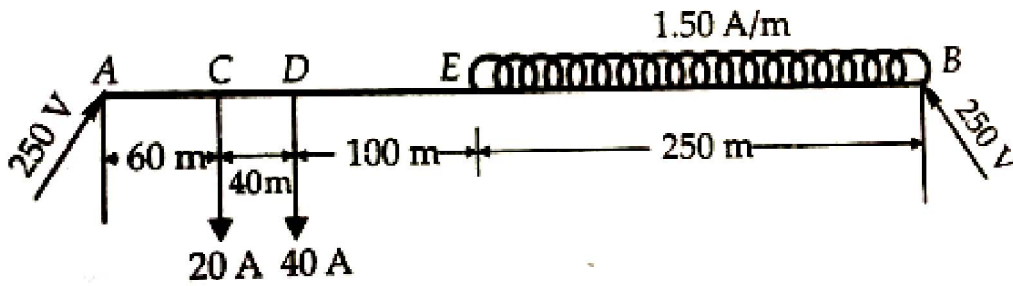

Figure 2

6 + 6 = 12

Department & Section	Submission Link
EE	https://classroom.google.com/c/MjQ4OTM2MTEzODU5/a/Mjc0MDQ0OTgzNjkx/details