BName : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EEE-N)/SEM-5/EEE-502/2012-13

2012
POWER SYSTEM-I

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives of the following : 10 × 1 = 10

   i) Ferranti effect on long overhead lines is experienced when it is

      a) lightly loaded

      b) on full load at unity p.f.

      c) fully loaded at 0·8 p.f. (lag)

      d) none of these.

ii) If the effect of earth is taken into account, then the capacitance of line to ground

a) decreases b) increases

c) remains unaltered d) becomes infinite.

iii) The insulation resistance of a single core cable is 160 MΩ/km. The insulation resistance of 4 km length is

a) 80 MΩ b) 40 MΩ

c) 120 MΩ d) 320 MΩ.

iv) The string efficiency of a string of suspension insulator is dependent on

a) size of the insulator

b) no. of discs in the sting

c) size of tower

d) none of these.

v) Transmission lines are transposed to

a) reduce Ferranti effect

b) reduce skin effect

c) reduce transmission line losses

d) reduce interference with communication lines.

vi) ACSR stands for

a) All Copper Standard Reinforced

b) Aluminium Conductor Steel Reinforced

c) Aluminium Copper Steel Reinforced

d) All Copper Steel Reinforced Conductor.

vii) The values of A, B, C and D constants for a short transmission line are respectively

a) 2, 0, and 1 b) 0, 1, 1 and 1

c) 1, 2, 0 and 1 d) 1, 1, 2 and 0.

viii) If we increase the length of transmission, line the charging current

a) decreases b) increases

c) remains same d) not affected.

ix) Disruptive corona begins in smooth cylindrical conductors in air at NTP if the electrical field intensity at the conductor surface goes to

a) 21·1 kV/cm (R.M.S) b) 21·1 kV/cm(Peak)

c) 21·1 kV/cm (Average) d) 21·1 kV/m(R.M.S).

x) The charging current in the transmission line

a) lags the voltage by 90°

b) leads the voltage by 45°

c) leads the voltage by 90°

d) leads the voltage by 180°.

GROUP – B

(Short Answer Type Questions)

Write short notes on any *three* of the following. 3 × 5 = 15

2. a) Show that maximum stress in a single core cables is $\frac{2V}{d\ln\left(\frac{D}{d}\right)}$ where V is the operating voltage d is the inner diameter of the conductor and D is the inner diameter of the sheath.

   b) Determine the ratio of maximum stress to minimum stress. 3 + 2

3. Find the expression of capacitance of single phase overhead transmission line with effect of earth into consideration. 5

4. Write down the advantages and disadvantages of corona. 5

5. A conductor is composed of seven identical copper strands, each having a radius r. Find the self GMD of the conductor. 5

6. What are the essential requirements of tariff ? Explain block rate tariff and maximum demand tariff in brief. 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Define string Efficiency.

   b) State the methods of improving string efficiency.

   c) Derive an expression of the voltage across each insulator of a 3-insulator string considering its self capacitance and capacitance to ground.

   d) In a 33 kV overhead line there are three units in the string of insulator. If the capacitance between each insulator pin and earth is 11% of self capacitance of each insulator, find the distribution of voltage over 3 insulators and string efficiency. 2 + 3 + 5 + 5

8. a) A 3 phase 50 Hz 150 km long overhead line has the following has the constants : Resistance/phase/km = 0·15 ohm, Inductance/phase/km = 1·2 mH, capacitance/phase/km = 0·0096 μF. The line supplies a load of 30 MW at 0·9 power factor lagging at a line to line voltage of 132 kV at the receiving end. Using nominal-Π method, determine :

      (i) Sending end power factor

      (ii) Sending end current

      (iii) Sending end voltage

      Also draw the necessary phasor diagram.

   b) Deduce an expression for sag in overhead lines when supports are at unequal levels. 11 + 4

9. a) What is Corona ? What is critical disruptive voltage ?

   b) In a three phase line the conductors with radius of 20 mm each, are arranged in the form of an equilateral triangle. Assuming fair weather conditions, air density factor of 0·95 and irregularity factor of 0·96. Find the minimum spacing between the conductors if the disruptive critical voltage is not to exceed 230 kV between lines. Breakdown strength of air = 30 kV/cm (Peak).

   c) How to reduce Corona effect ? (2 + 2) + 8 + 3

10. a) *A* 275 kV single-phase overhead line having line constants $A = 0{\cdot}85 \angle 5^\circ\ \Omega$ and $B = 200 \angle 75^\circ\ \Omega$

   Calculate :

   (i) the power factor at unity power factor that can be received if the voltage profile at each end is to be maintained at 275 kV

   (ii) The rating of compensation equipment that would be required if the load is 150 MW at unity power factor with the same voltage profile as in part (i)

b) Explain why the conductor ohmic resistance increases and insulation resistance decreases with the rise in temperature of a cable ?

c) Determine the most economical conductor size in a cable. 7 + 5 +3

11. Write short notes on any *three* of the following : 3 × 5

a) Kelvin's law

b) Dielectric loss and loss angle

c) Power circle diagram

d) Ferranti Effect.