CS/B.TECH/EE/ODD SEM/SEM-5/EE-502/2016-17

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Paper Code : EE-502

# POWER SYSTEM - I

Time : 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 )

Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) The presence of earth in case of overhead lines

a) increases the capacitance

b) increases the inductance

c) decreases the capacitance

d) decreases the inductance.

ii) Use of bundle conductors in EHV transmission system provides

a) increased line reactance

b) decreased capacitance

c) reduced voltage gradient

d) increased corona loss.

iii) Transposition of transmission line is done to

a) reduce line loss

b) reduce skin effect

c) balance line voltage drop

d) reduce corona.

iv) The transmission efficiency of a line is

a) directly proportional to the load power factor

b) inversely proportional to the load power factor

c) does not depend on load power factor

d) proportional to the square of load power factor.

v) For a stranded conductor, the ratio of GMR to actual radius is

a) equal to 1

b) greater than 1

c) equal to 0·7788

d) less than 0·7788.

vi) The electric stress in a cable is maximum at

a) centre of conductors

b) interface of sheath and conductors

c) lead sheath

d) armour.

vii) The *A, B, C, D* parameters for short transmission line with a series impedance *z* are

a) *z*, 0, 1, 1

b) 0, *z*, 1, 1,

c) 1, *z*, 0, 1

d) 1, 1, *z*, 0.

viii) Load factor is defined as the ratio of

    a)    average demand to plant capacity

    b)    average load to maximum demand

    c)    maximum demand to connected load

    d)    average load to connected load.

ix) Nuclear power plant is invariably used as a/an

    a)    peak load point    b)    base load point

    c)    stand by plant    d)    emergency plant.

x) The a.c. resistance of a conductor is greater than its d.c. value due to

    a)    skin effect    b)    proximity effect

    c)    Ferranti effect    d)    both (a) and (b).

xi) 25% of the line of neutral voltage appears across the bottom-most unit in a string insulators with 5 identical discs. The string efficiency is

    a)    80%    b)    75%

    c)    50%    d)    25%.

xii) By increasing the sag on the transmission line, the tension

    a)    increases

    b)    decrease

    c)    not affected

    d)    may increase or decrease.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following.    $3 \times 5 = 15$

2.    A 3-phase, 50 Hz line consists of three conductors, each of diameter 21 mm. The spacing between the conductors are 3 m, 5 m & 3·6 m. Find the inductance & inductive reactances per phase per km of the line.

3.    For a single core lead sheathed cable derive the expressions for (i) maximum dielectric stress and (ii) capacitance.

4.    What is corona ? Explain the principle of corona formation. What is critical disruptive voltage ? What is air density factor ?    $1 + 2 + 1 + 1$

5.    A single core cable of conductor diameter 2 cm and lead sheath of diameter 5·3 cm is to be used on a 66 kV, 3-phase system. Two intersheaths of diameter 3·1 cm and 4·2 cm are introduced between the core and lead sheath. If the maximum stress in the layers is the same, find the voltages on the intersheaths.

6.    The towers of height 30 m and 90 m respectively support a transmission line conductor at water crossing. The horizontal distance between the towers is 500 m. If the tension in the conductor is 1600 kg, find the minimum clearance of the conductor and water and clearance mid-way between the supports. Weight of the conductor is 1·5 kg/m. Bases of the towers can be considered to be at water level.

## GROUP – C
### ( Long Answer Type Questions )

Answer any *three* of the following.   $3 \times 15 = 45$

7.  a)  Discuss in brief various methods of controlling reactive power at load end to keep consumers' terminal voltage fixed.

b)  A 3-phase line having an impedance of ( 5 + J20 ) ohm per phase delivers a load of 30 MW at a *p.f.* of 0·8 lagging and voltage 33 kV. Determine the capacity of the phase modifier required to install at the receiving end if the voltage at the sending end is to be maintained at 33 kV.

c)  Explain Ferranti effect.           6 + 5 + 4

8.  a)  What are the methods of equalizing potential distribution over a string of insulator ?

b)  In a string of three insulator unit, the self-capacitance of each unit is $C$, from each connector to ground is $C/3$ and from each connector to line is $C/5$. Calculate the voltage across each unit as a percentage of total voltage.

c)  Name the different types of insulators. What is string efficiency ?           6 + 5 + 4

9.  a)  What is availability based tariff ?

b)  What is two part tariff ? Explain how it is determined.

c)  The daily load of an industrial corner is as follows :

100 kW for 9 hours

125 kW for 6 hours

50 kW for 7 hours

5 kW for 2 hours.

The tariff rate is Rs. 800 per kW of maximum demand per year plus Rs. 2·50 per kWh. Determine consumption per year & yearly bill.           3 + 5 + 7

10. a)  Derive the expression of capacitance of a single phase line considering the effect of earth. Hence deduce the capacitance without the effect of earth.

b)  A 3-phase, 400 kV, 50 Hz, 350 km overhead transmission line has flat horizontal spacing with three identical conductors. The conductors have an outside diameter of 3·28 cm with 12 m between adjacent conductors.

Determine the capacitive reactance to neutral in ohms/m/ph and the capacitive reactance for the line in ohms/ph.

c)  Why is surge impedance of overhead line more than underground cable ?           8 + 5 + 2

11. Draw the layout diagram of a Hydel power plant. Give detailed working principle of the Hydel power plant.           8 + 7

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12. a)  Point out the difference between the nominal $\pi$ equivalent and equivalent $\pi$ circuit model of a transmission line.

   b)  Find $A$, $B$, $C$, $D$ constants for nominal $\pi$ circuit of a medium transmission line. Also derive the expression for sending end voltage & current.

   c)  A 3-phase, 132 kV, 50 Hz transmission line has resistance, reactance and capacitance of $0.1\ \Omega$, $5.0\ \Omega$ and $0.01\ \mu F$ per km. Determine the series and shunt parameter and draw the nominal $\pi$ circuit model of the line.                2 + 8 + 5