

CS/B.Tech(PWE)/SEM-6/PWE-604/2012

2012

POWER TRANSMISSION AND DISTRIBUTION

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 for the following :

10x1 = 10

i) In a long transmission line under no-load condition

a) the receiving end voltage is less than the sending
end voltage

b) the sending end voltage is less than the receiving
end voltage

c) the sending end voltage is equal to the receiving
end voltage

d) none of these.

ii) For stable operation of interconnected system, the
passive element that can be used as the
interconnecting element is

a) Reactor

b) Resistor

c) Capacitor

d) Resistor and capacitor.

iii) If the insulation resistance of a cable of length 10 km is
1 mega ohm its insulation resistance for 50 km length
will be

a) 1 mega ohm

- b) 5 mega ohm
 - c) 0.2 mega ohm
 - d) none of these.
- iv) Series capacitors can be used in distribution lines
- a) to provide reactive power compensation
 - b) to reduce the receiving end voltage under light load conditions
 - c) to reduce voltage drop
 - d) to reduce line losses.
- v) In a cable of conductor diameter ' d ' and overall diameter with dielectric ' D ', the maximum dielectric stress
- a) occurs at conductor surface and is proportional to ' d '
 - b) occurs at conductor surface and is proportional to $1/d$
 - c) occurs at the middle of the dielectric and is proportional to $1/D$
 - d) occurs at the outer surface of the dielectric and is proportional to D
 - e) None of these.
- vi) Ferranti effect on long overhead line is experienced when it is
- a) lightly loaded
 - b) on full load at any unity p.f.
 - c) on full load at 0.8 p.f. load
 - d) on any load.
- vii) The insulating material most commonly used for power cables is
- a) PVC b) paper
 - c) rubber d) none of these.

- viii) String efficiency can be improved by
- a) using long cross-arm
 - b) grading the insulator
 - c) using a guard ring
 - d) all of these.
- ix) A bus bar is rated by
- a) current only
 - b) current and voltage
 - c) current, voltage and frequency
 - d) none of these.
- x) A string insulator has 4 units. The voltage across the bottom-most units is 33.33% of the total voltage. Its string efficiency is
- a) 25% b) 33.33%
 - c) 66.67% d) 75%.

GROUP – B

(Short Answer Type Questions)

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

2. a) What are the main components of a transmission line ?
Write one line about each of them.
- b) What makes aluminium a suitable conductor material ?
3. a) What are the properties required for good insulators ?
b) Classify the different types of insulators.
c) Draw and explain briefly a pin insulator.
4. Write short notes on the following :
- a) Skin effect
 - b) Murray loop test.
5. a) What are the main equipment in a transformer substation ?
b) Explain the working of an SF₆ circuit breaker and enumerate its advantages.

6. a) What is transposition ? How can the unequal voltages in three phases be eliminated by transposition ?
- b) The three conductors of a 3-phase line are arranged at the corners of a triangle of sides 2 m, 2.5 m and 4.5 m. Calculate the inductance per km of the line when the conductors are regularly transposed. The diameter of each conductor is 1.24 cm.

GROUP – C

(Long Answer Type Questions)

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

7. a) A string of 4 insulators has a self capacitance equal to 10 times the pin to earth capacitance. Find
- the voltage distribution across various units expressed as a % of total voltage across the string
 - string efficiency.
- b) i) Define string efficiency.
- What are the methods of improving string efficiency ?
- c) An overhead transmission line conductor having a parabolic configuration weights 1.925 kg/m. The area of cross-section of the conductor is 2.2 cm^2 and the ultimate strength is 8000 kg/cm^2 . The supports are 600 m apart having 15 m difference of levels. Calculate the sag from the taller of the two supports which must be allowed so that the factor of safety shall be 5. Assume that ice load is 1 kg/m, there is on wind pressure.
8. a) Define corona.
- What are the factors affecting corona ?
 - What are the methods of reducing corona ?
 - A 3-phase 220 kV 50 Hz transmission line consists of

1.5 cm radius conductor spaced 2 m apart in equilateral triangle formation. If the temperature is 40°C and atm pressure is 76 cm, calculate the corona loss per km of the line. Take $m_0 = 0.85$.

9. a) What is the effect of load p.f. on regulation and efficiency of a transmission line ?

b) An overhead 3-phase transmission line delivers 5000 kW at 22 kV at 0.8 p.f. lagging. The resistance and reactance of each conductor is 4 and 6 respectively. Determine the

i) sending end voltage

ii) percentage regulation

iii) transmission efficiency.

c) Draw the circuit of a medium transmission line in nominal T configuration. Derive expressions for sending end voltage and sending end current. Also draw the phasor diagram for such a circuit.

10. a) What are the desirable properties for selecting insulating materials for cables ?

b) Derive an expression for finding insulation resistance of a single core cable.

c) What do you mean by grading of cables ? Explain the capacitance grading method.

d) A single core has a conductor diameter of 1 cm and internal sheath diameter of 1.8 cm. If impregnated paper of relative permittivity 4 is used as insulation, calculate the capacitance for 1 km length of the cable.

11. a) What are the types of unsymmetrical faults which occur in a power system ?

b) The current in a 3-phase unbalanced systems are :

$$I_R = (12 + j6) A, I_Y = (12 - j12) A \text{ and}$$

$I_B = (-15 - j10) A$. The phase sequence is RYB.

Calculate the zero, positive and negative sequence components of the currents.

c) Classify the transmission line on the basis of length and power transmission capacity.

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