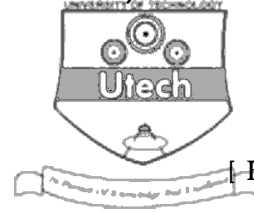




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ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
POWER SYSTEMS – I
SEMESTER – 6



[Full Marks : 70

Time : 3 Hours]

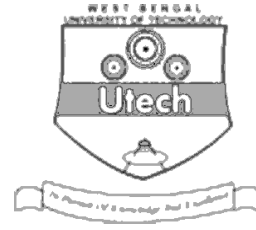
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10
- i) ACSR stands for
- a) All Copper Standard Reinforced
- b) Aluminium Conductor Steel Reinforced
- c) Aluminium Copper Steel Reinforced
- d) All Copper Steel Reinforced Conductor. ■
- ii) The charging current in the transmission line
- a) lags the voltage by 90° b) lead the voltage by 45°
- c) lead the voltage by 90° d) lead the voltage by 180°. ■
- iii) Farranti effect on long overhead line is experienced when it is
- a) lightly loaded b) on full load at u.p.f.
- c) on full load at 0.8 p.f. lad d) in all these cases. ■
- iv) The highest voltage in India is
- a) 400 kV b) 230 kV
- c) 220 kV d) 132 kV. ■

v) The most common type of 3-phase fault is

- a) double line to ground (unsymmetrical)
- b) line to line fault (unsymmetrical)
- c) single line to ground (unsymmetrical)
- d) symmetrical fault.



vi) The positive, negative and zero sequences of a solidly grounded system under steady state condition always follow the relation

- a) $Z_1 > Z_2 > Z_0$
- b) $Z_1 < Z_2 < Z_0$
- c) $Z_0 < Z_1 < Z_2$
- d) none of these.

vii) The impedance value of a generator is 0.2 p.u. on a base value of 11 kV, 50 MVA. The impedance value for a base value of 22 kV, 150 MVA is

- a) 0.15 p.u.
- b) 0.20 p.u.
- c) 0.30 p.u.
- d) 2.40 p.u.
- e) none of these.

viii) The positive sequence component of voltage at the point of fault is zero when it is a/an

- a) 3-phase fault
- b) L-L fault
- c) L-L-G fault
- d) L-G fault.

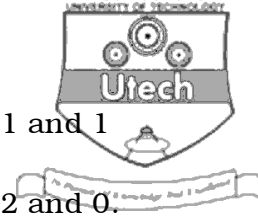
ix) The values of A , B , C and D constants for a short transmission line are respectively

a) 2, 0, 1 and 1

b) 0, 1, 1 and 1

c) 1, 2, 0 and 1

d) 1, 1, 2 and 0.



x) For a 500 Hz frequency excitation, a 50 km long power line will be modelled as

a) short line

b) medium line

c) long line

d) none of these.

xi) The insulating material commonly used for power cable is

a) paper

b) rubber

c) XLPE

d) none of these.

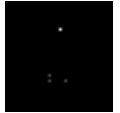
GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following questions.

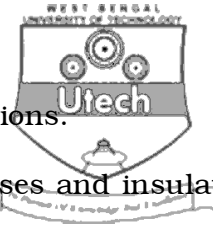
3 × 5 = 15

2. a) Define grounding.
b) Explain skin effect and proximity effect.
3. Why do we use CT in the relay circuit ? Explain why CT secondary should not be operated without a burden.
4. a) What is the function of a metal sheath in a cable ?
b) What is the use of a jacket of a cable ?
5. Derive an expression for fault current for single line to ground fault by symmetrical components method.
6. Derive an expression of the voltage across each insulator of a 3-insulator string considering its self capacitance and capacitance to ground.



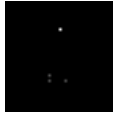
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions.

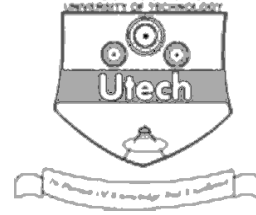
3 × 15 = 45

7. a) Explain why the conductor ohmic resistance increases and insulation resistance decreases with the rise in temperature of a cable ?
- b) A single core lead sheathed cable has a conductor of 1 cm diameter and uses two layers of insulating materials having relative permittivity of 3.0 and 2.5 (outer) respectively. If the allowable maximum stress for the inner layer is 100 k V/cm (peak) and that for the outer layer is 45 k V/cm (peak), calculate the thickness of each layer of insulation. The system voltage is 63.5 kV. 5 + 10
8. a) What are dampers used in high voltage line ?
- b) What is sag template ?
- c) What is corona ? Explain measures to reduce corona.
- d) A 3-phase 220 kV, 50 Hz transmission line has conductors spaced 5.5 m at the corners of an equilateral triangle. Calculate the corona inception voltage of each conductor which has a radius of 1.2 cm with surface irregularity factor of 0.92. Weather conditions : temperature 40° C and pressure 752 mm of Hg. 2 + 2 + 5 + 6
9. a) A 3-phase, 50 Hz, 100 km long overhead transmission line has the following constants :
- Resistance/km/phase = 0.1 Ω, inductive reactance/km/phase = 0.2 Ω, capacitive susceptance/km/phase = 0.04 × 10⁻⁴ siemens.
- Determine :
- The sending end current
 - Sending end voltage
 - Sending end power factor
 - Transmission efficiency when supplying a balanced load of 10 MW at 66 kV, p.f. 0.8 lagging. Use nominal *T* method. Draw the phasor diagram.



- b) Deduce an approx. expression for sag in overhead lines when supports are at unequal levels. 12 + 3

10. Write short notes on any *three* of the following :



3 × 5

- a) Ferranti effect
b) Medium line nominal π method
c) Skin effect
d) Earth fault protection of alternator.

11. A 3-phase overhead line having line constants $A = 0.9 \angle 1^\circ \Omega$ and $B = 143 \angle 84.5^\circ \Omega$, is operated at constant sending end and receiving end voltages of 240 kV and 220 kV respectively.

- a) Find output rating of the synchronous phase modifier at the receiving end if the line supplies a load of 100 MVA at 0.8 power factor lagging. What is the power angle ?
b) What is the maximum power that can be received at the receiving end ? How much reactive power will be available at the load end under this condition ? What will be the line efficiency ?

END