ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER - 2008

POWER SYSTEM - I

SEMESTER - 5

Time : 3 Hours] [Full Marks : 70

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) For power transmission over long distances the combination of voltage and current will be

a) high voltage, high current b) low voltage, high current

c) low voltage, low current d) high voltage, low current. ☐

ii) Tower footing resistance of a transmission tower should be

a) as high as possible b) as low as possible

c) moderately high d) moderately low. ☐

iii) Use of bundle conductors in EHV transmission system provides

a) increased line reactance b) decreased capacitance

c) reduced voltage gradient d) increased corona loss. ☐

iv) Paper insulated 3-ϕ belted cables are not used beyond 22 kV because

a) paper cannot withstand normal component of stress beyond 22 kV

b) paper can withstand tangential component of stress beyond 22 kV

c) paper cannot withstand tangential component of stress beyond 22 kV

d) none of these. ☐

v) At the dead end of a conductor or when there is a change in the direction of transmission line, the insulator used is

a) pin type b) support type

c) strain type d) shackle type. ☐

vi) Ferranti effect on long overhead line is experienced when it is

a) lightly loaded

b) on full-load at unity *p.f.*

c) on full-load at *p.f.* 0·8 lagging

d) on full-load at *p.f.* 0·8 leading. ☐

vii) Shifting of neutral may occur in

a) Grounded system b) Ungrounded system

c) Delta connected system d) Star connected system. ☐

viii) A string insulator has 4 units. The voltage across the bottom most unit is 30% of the total voltage. The string efficiency of the insulator is

a) 30% b) 60%

c) 75% d) 83·33%. ☐

ix) Stringing chart is useful

a) for 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 towers. ☐

x) The surge impedance of a 100 km long underground cable is 50 ohms. The surge impedance of a 40 km long similar cable would be

a) 20 ohms b) 50 ohms

c) 80 ohms d) 125 ohms. ☐

xi) The insulation resistance of a cable of length 10 km is 1 MΩ. Its resistance for 50 km length will be

a) 1 MΩ b) 5 MΩ

c) 0·2 MΩ d) 0·5 MΩ . ☐

xii) 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. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. What parameters guide determination of tariff of an electrical utility ? Explain.

3. Define string efficiency. State how with the help of guard rings string efficiency can be improved.

4. Discuss the effect of wind and ice on sag.

5. Explain what do you mean by 'Back flashover'.

6. Why ACSR conductors are preferred over copper conductors for overhead lines ? Why are the conductors of transmission lines stranded ?

GROUP – C

(Long Answer Type Questions)

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

7. a) Derive the expression for voltage and current distribution over a long transmission line in hyperbolic form and obtain the A, B, C, D parameters. 9

b) Derive the expression for the voltage regulation of a short transmission line for lagging power factor load. 6

8. a) Derive the expression for capacitance for a single phase over line considering the effect of earth. Hence deduce the capacitance without the effect of earth. 4 + 2

b) A certain 3-phase equilateral transmission line has a total corona loss of 53 kW at 106 kV and a loss of 98 kW at 111 kV. What is the disruptive critical voltage between lines ? What is coronal loss at 113 kV ? 4

c) Each conductor of a 3-phase overhead transmission line is suspended from a cross-arm of a steel tower by a string of 4 suspension insulators. The voltage across the second unit from top is 15 kV and across the third unit from top is 27 kV. Find the voltage between conductors and string efficiency. 5

9. a) A two wire *d.c.* distributor *AB* is fed from both ends. At feeding point *A*, the voltage is maintained at 235 V and at *B* at 240 V. The total length of the feeder is 300 metres and loads are tapped off as given below :

30 A at a distance of 75 m from *A*

55 A at a distance of 100 m from *A*

25 A at a distance of 150 m from *A*

25 A at a distance of 200 m from *A*

30 A at a distance of 250 m from *A* .

The resistance per km of one conductor is 0·3 Ω . Calculate

i) current in different sections of the conductor

ii) minimum potential and the location of minimum potential

iii) current supplied from both the feeding points *A* and *B*. 10

b) Derive the relation between the conductor radius and inside sheath radius of a single core cable so that the electric stress on the conductor surface is minimum. 5

10. a) Derive the expression for the inductance of a 3-phase line without considering the effect of transposition. What is the significance of the imaginary term in the expression for inductance ? Hence derive the expression for inductance for a completely transposed line. 9

b) 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. 1·3/- per kWh. Determine the energy consumption per year (365 days) and yearly bill. 6

11. a) The parameters of a 132 kV, 50 Hz, 3-phase transmission lines are

$R = 12{\cdot}84\ \Omega$, $L = 0{\cdot}162$ H, $C = 1{\cdot}014\ \mu F$

Calculate the line constants A, B, C and D for nominal π method. 8

b) A transmission line has a span of 275 m between level supports. The conductor has an effective diameter of 1·96 cm and weighs 0·865 kg/m. Its ultimate strength is 8060 kg. If the conductor has ice coating of radial thickness 1·27 cm and is subjected to a wind pressure of 3·9 gm/cm^2 of projected area, calculate sag for a safety factor of 2. Assume weight of 1 c.c. of ice is 0·91 gm. 7

END