

CS/B.Tech/EE/Odd/Sem-5th/EE-502/2014-15

**EE-502**

**POWER SYSTEM-I**

Time Allotted: 3 Hours

Full Marks: 70

*The questions are of equal value.  
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. Answer all questions. 10×1 = 10
  - (i) A string insulator has 4 units. The voltage across the bottom most unit is 30% of the total voltage. Its string efficiency is  
(A) 30% (B) 60% (C) 75% (D) 83.33%
  - (ii) The capacitance between any two conductors of a 3-core cable with sheath earthed is 3  $\mu\text{F}$ . The capacitance per phase will be  
(A) 1.5  $\mu\text{F}$  (B) 6  $\mu\text{F}$  (C) 1  $\mu\text{F}$  (D) none of these
  - (iii) Grading ring is used to equalize the potential distribution across the units of the suspension insulator because it  
(A) forms capacitances which will help to cancel the charging current from link pins.  
(B) forms capacitances with link pins to cancel the charging current from link pins.  
(C) increases the capacitances of lower insulator units.  
(D) decreases the capacitances of upper insulator units.
  - (iv) The insulation resistance of a single core cable is 160  $\text{M}\Omega/\text{km}$ . The insulation resistance for 4 km length is  
(A) 80  $\text{M}\Omega$  (B) 40  $\text{M}\Omega$  (C) 120  $\text{M}\Omega$  (D) 320  $\text{M}\Omega$

5008

1

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CS/B.Tech/EE/Odd/Sem-5th/EE-502/2014-15

- (v) The presence of ground causes the line capacitance to  
(A) increase by about 12% (B) decrease by about 12%  
(C) increase by about 0.2% (D) none of these
- (vi) The current drawn by the line owing to corona loss is  
(A) non-sinusoidal (B) sinusoidal (C) dc (D) square
- (vii) In terms of constants A,B,C and D for short transmission lines, which of the following relation(s) is/are valid?  
(A)  $A = D = 1$  (B)  $C = 0$  (C)  $B = Z$  (D) all of these
- (viii) Constant power locus of a transmission line at a particular sending end and receiving end voltage is  
(A) a straight line (B) a circle (C) a parabola (D) an ellipse
- (ix) Bundle conductors are used to  
(A) reduce inductance of the line  
(B) reduce both inductance and capacitance  
(C) reduce corona loss  
(D) reduce corona loss and line inductance
- (x) The diameter of each strand is 'd', then the diameter of n-layer stranded conductor will be  
(A)  $(2n+1)d$  (B)  $3(n+1)d$  (C)  $(2n-1)d$  (D)  $3(n-1)d$

**GROUP B**  
**(Short Answer Type Questions)**

- Answer any three questions. 3×5
2. String efficiency for a d.c system is 100%. Discuss. Can string efficiency in an ac system be 100%?
  3. A 220 kV three phase transmission line with conductors radius 1.3 cm is built so that corona takes place if the line voltage exceeds 260 kV (rms). Find the spacing between conductors.

5008

2

CS/B.Tech/EE/Odd/Sem-5th/EE-502/2014-15

4. Give reasons for unequal potential distribution over a string of suspension insulators. Why are suspension insulators preferred for high voltage power transmission?
5. Derive the expression for critical disruptive voltage of corona.
6. What is surge impedance? What do you mean by surge impedance loading?

**GROUP C**  
(Long Answer Type Questions)

Answer any *three* questions.

3 × 15 = 45

7. (a) A single core cable has an inner diameter of 6 cm and a core diameter of 2 cm. Its paper dielectric has a working dielectric stress of 60 kV/cm. Calculate the maximum permissible line voltage when such cables are used on a three phase power system. 5
- (b) Find the most economical value of the diameter of single core cable to be used on 66 kV three phase system. Find also the overall diameter of the insulation if the maximum permissible stress is not to exceed 5 kV/mm. 5
- (c) What is insulation resistance of a single core cable? Prove that the insulation resistance is inversely proportional to the length of the cable. 5
8. (a) What is meant by transposition? Why is it done? 4
- (b) Derive the expression of the inductance of a 3 phase transposition line. 6
- (c) Determine the inductance of a 3 phase line operating at 50 Hz and the conductors are arranged in a horizontal plane with spacing such that  $D_{31} = 4$  m,  $D_{12} = D_{23} = 2$  m. The conductors are transposed and have a diameter of 2.5 cm. 5
9. (a) Discuss in brief various methods of controlling reactive power at load end to keep consumers terminal voltage fixed. 6
- (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. 5
- (c) Explain Ferranti effect. 4

CS/B.Tech/EE/Odd/Sem-5th/EE-502/2014-15

10. (a) Explain skin effect. On which factors does the skin effect depend? What do you mean by 24/7ACSR conductor? 2+1
- (b) Derive the expression for capacitance for single phase overhead line considering the effect of earth. Hence deduce the capacitance without considering the effect of earth. 4
- (c) A 500 kV line has a bundling arrangement of two conductors per phase as shown in Figure-1.

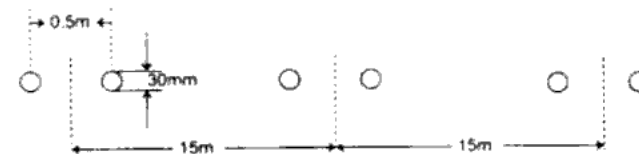


Figure-1

Compute the reactance per phase of this line at 50 Hz. Each conductor carries 50% of the phase current. Assume full transposition

11. (a) What is a stringing chart? How it can be prepared? What is its use?
- (b) A transmission line has a span of 150 m between level supports. The conductor has a cross section area of  $2 \text{ cm}^2$ . The tension in the conductor is 2000 kg. If the specific gravity of the conductor material is  $9.9 \text{ gm/cm}^3$  and wind pressure is  $1.5 \text{ kg/m}$  length, calculate the sag. What is vertical sag?
12. Write short notes on any *three* of the following:
  - (a) Capacitance grading of underground cable.
  - (b) Choice of voltage for transmission line.
  - (c) Earthing transformer.
  - (d) Proximity effect.
  - (e) Discuss the effect of wind and ice on sag.