

6

Power Distribution

6.1 - Power Cables



Multiple Choice Questions

Q.1 A one kilometer long 11 kV 3-core three-phase metal sheathed cable gave the following test results:

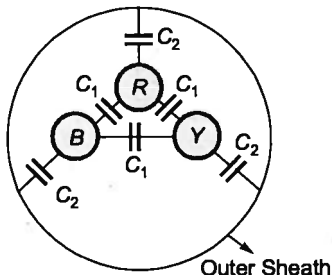
1. Capacitance between 2 conductors joined to sheath and the third conductor: $0.6 \mu\text{F}$
2. Capacitance between all the three conductors bunched together and sheath: $0.96 \mu\text{F}$

Effective capacitance of each core to neutral is

- (a) $0.12 \mu\text{F}$ (b) $0.74 \mu\text{F}$
(c) $0.16 \mu\text{F}$ (d) $0.32 \mu\text{F}$

[IAS-1996]

Q.2 Consider a three-core, three-phase, 50 Hz, 11 kV cable whose conductors are denoted as R, Y and B in the figure. The inter-phase capacitance (C_1) between each pair of conductors is $0.2 \mu\text{F}$ and the capacitance between each line conductor and the sheath is $0.4 \mu\text{F}$. The per-phase charging current is



- (a) 2.0 A (b) 2.4 A
(c) 2.7 A (d) 3.5 A

[GATE-2010]

Q.3 A cable has the following characteristics $L = 0.201 \mu\text{H/m}$ and $C = 196.2 \text{ pF/m}$. the velocity of wave propagation through cable is

- (a) 32 m/s (b) 159.24 m/s
(c) 0.0312 m/s (d) 159.24 m/ μs

[GATE-1998]

Q.4 The undesirable property of an electrical insulating material is

- (a) high dielectric strength
(b) high relative permittivity
(c) high thermal conductivity
(d) high insulation resistivity

[GATE-2014]

Q.5 A 110 kV, three core coaxial, XLPE insulated power cable delivering power at 50 Hz, has a capacitance of 125 nF/km . If the dielectric loss tangent of XLPE is 2×10^{-4} , then dielectric power loss in this cable in W/km is

- (a) 5.0 (b) 31.7
(c) 37.8 (d) 189.0

[GATE-2004]



Numerical Data Type Questions

Q.6 The insulation resistance of a 20 km long underground cable is $8 \text{ M}\Omega$. Other things being the same, the insulation resistance of a 10 km long cable will be ____ $\text{M}\Omega$.

[IAS-1997]

Q.7 The insulation resistance of a single core cable is $495 \text{ M}\Omega$ per km. If the core diameter is 2.5 cm and resistivity of insulation is $4.5 \times 10^{14} \Omega\text{-cm}$, the insulation thickness is ____ cm.

6.2 - Distribution System

Multiple Choice Questions

Q.8 Why is a ring main distribution system preferred to a radial system?

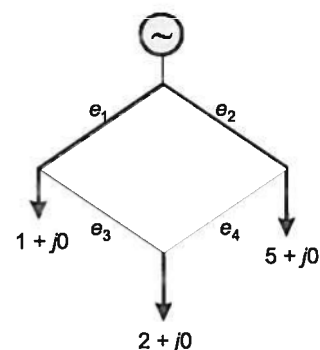
1. Voltage drop in the feeder is less
2. Power factor is higher
3. Supply is more reliable

Select the correct answer using the code given below:

- (a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

[ESE-2007]

Q.9 Single line diagram of a 4-bus single source distribution system is shown below. Branches e_1 , e_2 , e_3 and e_4 have equal impedances. The load current values indicated in the figure are in per unit.

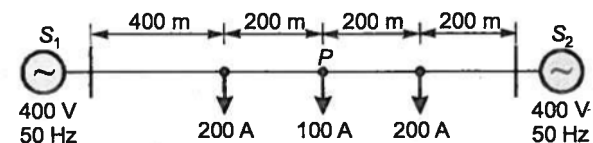


Distribution company's policy requires radial system operation with minimum loss. This can be achieved by opening of the branch

- (a) e_1 (b) e_2
(c) e_3 (d) e_4

[GATE-2008]

Q.10 A distribution feeder of 1 km length having resistance, but negligible reactance, is fed from both the ends by 400 V, 50 Hz balanced sources. Both voltage sources S_1 and S_2 are in phase. The feeder supplies concentrated loads of unity power factor as shown in figure.



The contributes of S_1 and S_2 in 100 A current supplied at location P respectively, are

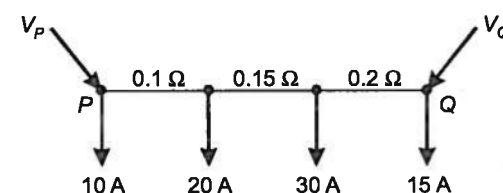
- (a) 75 A and 25 A (b) 50 A and 50 A
(c) 25 A and 75 A (d) 0 A and 100 A

[GATE-2014]



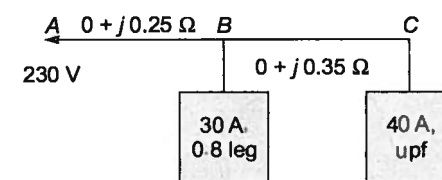
Numerical Data Type Questions

Q.11 A D.C. distribution system is shown in figure, with load currents as marked. The two ends of the feeder are fed by voltage sources such that $V_P - V_Q = 3$ V. The value of the voltage V_P for a minimum voltage of 220 V at any point along the feeder is ____ V.



[GATE-2003]

Q.12 A single-phase AC distributor supplies two single-phase loads as shown in figure. The voltage drop from A to C is ____ V.



Try Yourself

T1. A single core cable 5 km long has an insulation resistance of $0.4 \text{ M}\Omega$. The core diameter is 20 mm and the diameter of the cable over the insulation is 50 mm. The resistivity of the insulating material is

- (a) $0.45 \text{ G}\Omega\text{-m}$ (b) $1.12 \text{ G}\Omega\text{-m}$
(c) $0.97 \text{ G}\Omega\text{-m}$ (d) $1.37 \text{ G}\Omega\text{-m}$

[Ans: (d)]

T2. A single phase ring distributor ABC is fed at A. The loads at B and C are 20 A at 0.8 pf lagging and 15 A at 0.6 pf lagging respectively, both expressed with reference to voltage at A. The total impedance of the section AB, BC and CA are $(1 + j1)$, $(1 + j2)$ and $(1 + j3)$ ohm's respectively. The current in section BC, I_{BC} is

- (a) $(2.6 + j1.5)\text{A}$ (b) $(2.4 + j3.2)\text{A}$
(c) $(2.6 - j1.5)\text{A}$ (d) $(2.4 - j3.2)\text{A}$

[Ans: (c)]

T3. A single core cable for use on 11 kV, 50 Hz system has conductor area 0.645 cm^2 and the internal diameter of sheath is 2.18 cm. The maximum electric stress in the cable is

- (a) 2.1 MV/m (b) 2.7 MV/m
(c) 3.2 MV/m (d) 3.6 MV/m

[Ans: (b)]

T4. The KVA taken by a 10 km long, 3-phase, 3-core, cable, if the capacitance measured between any two cores is $0.3 \mu\text{F/Km}$ when it is connected to 10 KV, 50 Hz bus-bar is

- (a) 142.6 KVAR (b) 188.5 KVAR
(c) 194.2 KVAR (d) 201.6 KVAR

[Ans: (b)]

T5. Determine the insulation resistance of a single core cable of length 5 km and having conductor radius 12.5 mm, insulation thickness 9 mm and specific resistance of insulation of $8 \times 10^{12} \Omega\text{-m}$.

- (a) 108 $\text{M}\Omega$ (b) 112 $\text{M}\Omega$
(c) 120 $\text{M}\Omega$ (d) 138 $\text{M}\Omega$

T6. A 11 kV, 3-phase, 50 Hz under ground line, 7 km long uses three single core cables. Each cable has a core diameter 2.5 c.m. and the radial thickness of insulation is 1 c.m. The relative permittivity of the dielectric is 3.5. The maximum electrostatic stress is ____ MV/m.

T7. A single phase ring distributor ABC is fed at A. The loads at B and C are 30 A at 0.8 p.f lagging and 20 A at 0.6 p.f lagging respectively both expressed with reference to voltage at A. The impedances of the section AB, BC and CA are $(1.5 + j1.5)$, $(2 + j2.5)$ and $(2 + j3)$ ohms respectively. The current in section BC is

- (a) $1.14 \angle 80.9^\circ \text{ A}$ (b) $1.12 \angle 80.9^\circ \text{ A}$
(c) $1.21 \angle -80.9^\circ \text{ A}$ (d) $1.15 \angle -80.9^\circ \text{ A}$

