POSTAL Book Package 2023

Electrical Engineering

Objective Practice Sets

Power Systems

Contents

MADE EASY Publications

1 CHAPTER Performance of Transmission Lines, Line Parameters & Corona

MCQ and NAT Questions

Q.1 Use of bundled conductor increases,
(a) GMR
(b) GMD
(c) Potential gradient
(d) Radius of conductor

Q.2 ACSR conductor have
(a) all conductors made of aluminium
(b) outer conductors made of aluminium
(c) inner conductor made of aluminium
(d) core made of aluminium

Q.3 Regulation of a short transmission line is given by
(a) $\frac{|V_S|-|V_R|}{|V_R|}\times 100\%$ (b) $\frac{|V_R|-|V_S|}{|V_R^2|}\times 100\%$
(c) $\frac{|V_S|-|V_R|}{|V_R^2|}\times 100\%$ (d) $\frac{|V_S|-|V_R|}{|V_S|}\times 100\%$

Q.4 If the p.f. of load decrease, the line losses,
(a) increase (b) decrease
(c) remain same (d) none

Q.5 In a transmission line sag depends upon
(a) conductor material
(b) tension in conductor
(c) weight per unit length of conductor
(d) all the above

Q.6 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) data insufficient for decision

Q.7 The good effect of corona on overhead lines is to
(a) increase the line carrying capacity due to conducting ionised air envelop around the conductor.
(b) increase the power factor due to corona loss.
(c) reduce the radio interference from the conductor.
(d) reduce the steepness of surge fronts.

Q.8 A 3-phase transmission line has its conductors at the corners of an equilateral triangle with side 3 m. The diameter of each conductor is 1.63 cm. The inductance of the line per phase per km is
(a) 1.232 mH (b) 1.182 mH
(c) 1.093 mH (d) 1.043 mH

Q.9 The capacitance of an overhead transmission line increases with
1. increase in mutual geometrical mean distance.
2. increase in height of conductors above ground.

Select the correct answer from the following:
(a) Both 1 and 2 are true
(b) Both 1 and 2 are false
(c) Only 1 is true
(d) Only 2 is true

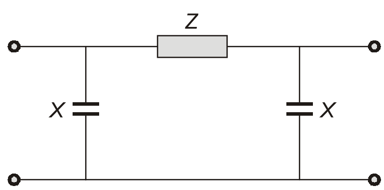
Q.10 Which one of the following equations is correct for a reciprocal network?
(a) $-AB + CD = -1$ (b) $AD + CB = 1$
(c) $AB - CD = -1$ (d) $-AD + BC = -1$
Where A, B, C and D are generalized circuit constants.

Q.11 Which one of the following statement is correct? Corona loss increases with
(a) decrease in conductor size and increase in supply frequency.
(b) increase in both conductor size and supply frequency.
(c) decrease in both conductor size and supply frequency.
(d) increase in conductor size and decrease in supply frequency.

Transformer : 15 MVA, 6.6 kV delta/33 kV star, $X_1 = X_2 = X_0 = 6\%$
Line reactance : $X_1 = X_2 = 2\ \Omega$ and $X_0 = 6\ \Omega$
If a SLG fault occurs on bus bar B, then the fault current is _______ p.u.

Q.65 For a 300 km long transmission line, the shunt admittance is (0.0 + j4.0) mho/km and series impedance is (0.0 + j0.5) Ω/km. The magnitude of the series impedance (in Ω) of the equivalent π-model of the transmission line is ______ Ω.

Q.66 The nominal-π circuit of transmission line is shown in the figure.



The characteristics impedance Z_C = 400 Ω and impedance is $Z = 100\angle 80\ \Omega$. The value of reactance X will be _______ Ω.

Q.67 The A, B, C, D parameters of a 220 kV line are: $A = D = 0.96\angle 1°$, $B = 130\angle 73°$, $C = 0.001\angle 90°$. If the sending end voltage of the line for a given load is 240 kV, then voltage regulation of the line in percentage will be ______.

Q.68 A surge of 50 kV magnitude travels along a lossless cable towards its junction with two identical lossless overhead transmission lines, the reactance and capacitance of the cable are 0.4 mH and 0.5 μF per km. The inductance and capacitance of the overhood transmission lines are 1 mH and 0.02 μF per km, the magnitude of the voltage at the junction due to surge is _____V

Q.69 A transmission line has an electrical line length of 8°. If the velocity of propagation is 2.99×10^8 m/s then, for 60 Hz system the length of the line in km will be ______.

Q.70 An 11 kV, 3-ϕ line has resistance of 1 Ω and reactance of 4 Ω per phase. The efficiency of the line when supplying the load of 4 MW at 0.85 lagging power factor. (in percentage) will be ____.

Multiple Select Questions (MSQ)

Q.71 The correct statement(s) regarding various conditions for regulation in transmission line is:
(a) Zero regulation occurs at $\phi_R = \tan^{-1}(R/X_L)$ at lagging pf.
(b) Maximum regulation occurs at
$$\phi_R = \tan^{-1}\left(\frac{X_L}{R}\right) \text{ at lagging pf.}$$
(c) Zero regulation and maximum regulation coincides at θ = 45°
(d) If resistance and reactance found to be equal, then load will be 0.707 lagging pf for zero regulation.

Q.72 An 11 kV, 3-ϕ short line has resistance of 1.5 Ω and reactance of 4 Ω. If the total load of 5 MVA at 0.8 lagging pf is supplied at 11 kV, then
(a) Load current will be 262.43 A.
(b) Sending end line voltage magnitude will be 12.636 kV.
(c) Line losses per phase in the line will be 309.91 kW.
(d) Percentage regulation will be 14.87%.

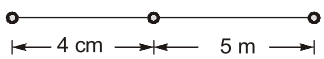
Q.73 Regarding the corona affect in transmission line, the which of below given statement(s) is/are NOT correct?
(a) ozone is produced by corona and may cause corrosion.
(b) Corona effect can be reduced by reducing conductor size.
(c) Visual critical voltage is the minimum phase-neutral voltage at which corona occurs.
(d) Critical disruptive voltage is the voltage always greater than visual critical voltage.

Q.74 A 3 phase transmission line has the three conductors each having a radius of 1.5 cm. The correct option is/are:
(a) GMR when conductors are symmetrically spaced having spacing of between them 10 cm is 1.5576 cm.
(b) GMD when conductors are symmetrically spaced having spacing of between them 10 cm is 12.6 cm.

(c) GMR when conductors are horizontally spaced having spacing of 10 cm between them is 1.5576 cm.

(d) GMD when conductors are horizontally spaced having spacing of 10 cm between them is 10 cm.

Q.75 A 3 phase, 50 Hz, 33 kV overhead line conductors are placed in a configuration as shown below. The conductor diameter is 1.5 cm. If the line length is 100 km, then



(a) capacitance per phase is 0.52 μF.

(b) capacitance per phase is 0.84 μF.

(c) charging current per phase is 12.1 A.

(d) charging current per phase is 5.028 A.

Q.76 A overhead 3 phase line delivers 10 MW at 33 kV at 0.6 pf (lagging). If the resistance and reactance of each conductor is 3 Ω and 5 Ω respectively, then

(a) sending end line voltage is 20.74 kV

(b) percentage regulation is 4.61%.

(c) transmission efficiency is about 93%.

(d) line current is 291.6 A.

Q.77 For the following configurations, of bundled conductors (D_S = GMR, of individual conductors) The correct option is

(a) For P : $(\text{GMR})_{\text{eq.}} = 1.09\sqrt[4]{D_S \times d^3}$

(b) For Q : $(\text{GMR})_{\text{eq.}} = \sqrt[3]{D_S \times d^2}$

(c) For R : $(\text{GMR})_{\text{eq.}} = \sqrt[4]{(D_S \times d)^2}$

(d) For : P : $(\text{GMR})_{\text{eq.}} = \sqrt[4]{(D_S \times d \times d)^3}$

■■■■

Answers — Performance of Transmission Lines, Line Parameters & Corona

1. (a)	2. (b)	3. (a)	4. (a)	5. (d)	6. (c)	7. (d)	8. (a)
9. (b)	10. (d)	11. (a)	12. (b)	13. (b)	14. (c)	15. (a)	16. (b)
17. (c)	18. (c)	19. (b)	20. (d)	21. (d)	22. (b)	23. (22.9)	24. (c)
25. (d)	26. (b)	27. (b)	28. (c)	29. (c)	30. (b)	31. (c)	32. (b)
33. (a)	34. (d)	35. (d)	36. (c)	37. (c)	38. (b)	39. (c)	40. (a)
41. (b)	42. (d)	43. (d)	44. (d)	45. (d)	46. (c)	47. (a)	48. (a)
49. (d)	50. (c)	51. (a)	52. (c)	53. (c)	54. (6.35)	55. (4000)	56. (191)
57. (296)	58. (0.80)	59. (–0.33)	60. (22.22)	61. (1.028)	62. (22)	63. (14)	64. (0)
65. (145.51)	66. (800)	67. (13.63)	68. (79.81)	69. (110.71)	70. (95.62)	71. (b,c)	72. (a,b,d)
73. (b,c,d)	74. (a,c)	75. (b,d)	76. (c,d)	77. (c,d)			

Explanations — Performance of Transmission Lines, Line Parameters & Corona

1. (a)

With the use of bundle conductors self GMD or GMR is increased which reduces the inductance of line.

2. (b)

ACSR is Aluminium conductor steel reinforced. In this the outer conductors made of aluminium.

3. (a)

$$\text{Voltage regulation } (V_R) = \frac{\left|\frac{V_S}{A}\right| - |V_R|}{|V_R|} \times 100\%$$

As for short line ⇒ $A = 1$

$$\therefore \quad (V_R) = \frac{|V_S| - |V_R|}{|V_R|} \times 100\%$$

4. (a)

$\because \quad P = VI\cos\phi$

$$I = \frac{P}{V\cos\phi}$$

For constant power and voltage, $I \propto \dfrac{1}{\cos\phi}$

$\therefore$ If p.f.↓ then I↑ and power loss↑.

$\because$ Power loss $(P_L) = I^2R$

5. (d)

$$\text{Sag} = \frac{Wl^2}{8T}$$

where,

$W \rightarrow$ weight of conductor per unit length

$l \rightarrow$ span length

$T \rightarrow$ tension in conductor (depends on the conductor material)

6. (c)

Criteria to be full filled for

Short line $\Rightarrow l \cdot f < 4000$

Medium line $\Rightarrow 4000 < l \cdot f < 10000$

Long line $\Rightarrow l \cdot f > 10000$

7. (d)

Corona, is helpful in one respect, namely, it reduces the effect of surges and acts as a relief valve for them. This is so because the surges are partially dissipated as corona.

8. (a)

Radius of the conductor,

$$r = \frac{1.63}{2} = 0.815 \text{ cm}$$

$$r' = 0.7788 \times r$$

$$= 0.7788 \times 0.815 \text{ cm}$$

$$= 0.634 \text{ cm}$$

$$r' = 0.634 \times 10^{-2} \text{ m}$$

$$L = 2\times10^{-7} ln\left(\frac{D}{r'}\right) \text{H/meter/phase}$$

$$= 2\times10^{-7} ln\left(\frac{3}{0.634\times10^{-2}}\right)$$

$$= 12.32 \times 10^{-7} \text{ H/phase/meter}$$

$$= 1.232 \text{ mH/phase/km}$$

9. (b)

Capacitance of TL including earth field,

$$C = \frac{\pi\varepsilon_0\varepsilon_r}{\ln\left(\dfrac{d}{r\sqrt{1+\dfrac{d^2}{4h^2}}}\right)}$$

From the above relationship,

- capacitance decreases with increase in mutual geometrical mean distance.
- capacitance decreases with increase in height of conductors above ground.

10. (d)

A transmission line can be represented by a linear, passive and bilateral network. By virtue of reciprocity, the generalized constants are related to each other by following equation: $AD - BC = 1$.

11. (a)

Corona loss,

$$P = 2.41\times10^{-5}\frac{(f+25)}{8}\sqrt{\frac{r}{d}}(V_P - V_0)^2$$

So, corona loss increases with frequency but V_0 is approximately directly proportional to conductor size. Therefore, as the conductor size increases, corona loss decreases.

12. (b)

$$\text{SIL} = \frac{(kV_L)^2}{Z_0} \text{ MW}$$

For single-circuit line,

$$Z_0 = 400\ \Omega/\text{phase}$$

$$\therefore \quad \text{SIL} = \frac{400\times400}{400} = 400 \text{ MW}$$

13. (b)

$$R = \frac{\rho l}{a} \propto \frac{1d}{a}$$

$$V_{01} = al \propto a$$

$$\Rightarrow \quad V_{01} \propto \frac{1}{R}$$

$$I_1^2R_1 = I_2^2R_2$$

$$\frac{I_1^2}{I_2^2} = \frac{R_2}{R_1}$$

$$\frac{I_1^2}{I_2^2} = \frac{V_{01}}{V_{02}} \quad \ldots(i)$$