POSTAL
BOOK PACKAGE
2024

CONTENTS

ELECTRICAL ENGINEERING

Objective Practice Sets

Power Systems

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.

Q.12 What is the approximate value of the surge impedance loading of a 400 kV, 3-phase 50 Hz overhead single circuit transmission line?
(a) 230 MW (b) 400 MW
(c) 1000 MW (d) 1600 MW

Q.13 If a fixed amount of power is to be transmitted over certain length with fixed power loss, it can be said that volume of conductor is
(a) Inversely proportional to magnitude of the voltage and that of power factor of the load
(b) Inversely proportional to square of the voltage and square of power factor of the load
(c) Proportional to square of voltage and that of power factor of the load
(d) Proportional to magnitude of the voltage only

Q.14 A 10 km long lossless transmission line has a reactance of 0.3 Ω/km and negligible shunt capacitance.

The value of $\begin{bmatrix} A & B \\ C & D \end{bmatrix}$ is

(a) $\begin{bmatrix} 1 & 0 \\ j3 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ j0.3 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & j3 \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} j3 & 0 \\ 1 & 1 \end{bmatrix}$

Q.15 The skin effect in a transmission line is affected by
(a) the resistivity of the transmission line
(b) the current magnitude in the transmission line
(c) the length of the transmission line
(d) the voltage applied across the transmission line

Q.16 When bundle of conductors are used in place of single conductors the effective inductance and capacitance will, respectively
(a) Increase and decrease
(b) Decrease and increase
(c) Decrease and remain unaffected
(d) Increase and remain unaffected

Q.17 Consider the following statements regarding corona:
1. It causes radio interference.
2. It attenuates lightning surges.
3. It causes power loss.
4. It is more prevalent in the middle conductor of a transmission line employing flat conductor configuration.

Which of the above statements are correct?
(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 1, 2, 3 and 4 (d) 3 and 4 only

Q.18 The transmission efficiency increases with
(a) decrease in pf and increase in voltage level
(b) decrease in pf and decrease in voltage level
(c) increase in pf and increase in voltage level
(d) increase in pf and decrease in voltage level

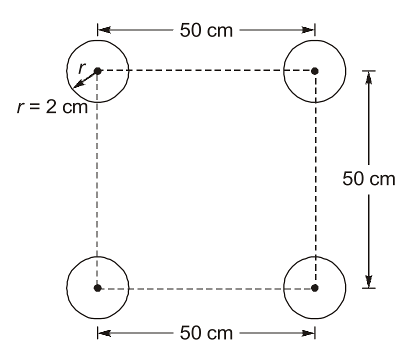
Q.19 A short line with reactance of 20 Ω and negligible resistance operates with a sending end voltage of 132 kV and a receiving end voltage of 126 kV. The maximum power that can be transmitted with this voltage profile is
(a) 400 MW (b) 832 MW
(c) 1000 MW (d) 132 MW

Q.20 The surge impedance of a 100 km line is 390 Ω. If the line is extended to 200 km, the value of surge impedance is
(a) 195 Ω
(b) 780 Ω
(c) depends on operating frequency
(d) 390 Ω

Q.21 Proximity effect depends upon
(a) size of the conductor
(b) resistivity of material
(c) permeability of the material
(d) all of the above

Q.22 In a short line, maximum power transfer occurs when δ is (here θ is angle of impedance of the line and δ = power angle):
(a) $> \theta$ (b) $= \theta$
(c) $< \theta$ (d) $= 90$

Q.23 A composite conductor consists of 4 conductors of radius 2 cm each. The conductors are arranged as shown below. The geometric mean radius GMR (in cm) for the given arrangement is ______ .



Q.24 For equilateral spacing of conductors of an untransposed 3-phase line, we have
(a) balanced receiving end voltage and no communication interference.
(b) unbalanced receiving end voltage and no communication interference.
(c) balanced receiving end voltage and communication interference.
(d) unbalanced receiving end voltage and communication interference.

Q.25 The time taken for a square wave to travel a 600 km long overhead transmission line is
(a) 6 sec (b) 1 sec
(c) 0.02 sec (d) 0.002 sec

Q.26 Match the items given in **List-I (Methods)** and those in **List-II (Line constants)** and select your answer to these questions using the codes given below the lists:

List-I
A. Simple series impedance method
B. End condenser method
C. Nominal-T method
D. Nominal-π method

List-II
1. $A = D = \left(1+\frac{YZ}{2}\right)$

$B = Z$ and $C = Y\left(1+\frac{YZ}{4}\right)$

2. $A = D = \left(1+\frac{YZ}{2}\right)$

$B = Z\left(1+\frac{YZ}{4}\right)$ and $C = Y$

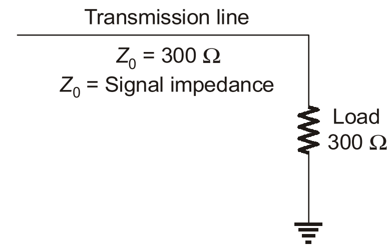
3. $A = D = 1$; $B = Z$ and $C = 0$
4. $A = (1 + YZ)$; $B = Z$; $C = Y$; $D = 1$

Codes:

	A	B	C	D
(a)	1	2	3	4
(b)	3	4	2	1
(c)	2	3	4	1
(d)	4	1	3	2

Q.27 A cable has the following characteristics.
$L = 0.201$ μH/m and $C = 196.2$ pF/m
The velocity of wave propagation through the cable is
(a) 32 m/s (b) 159.24 m/μs
(c) 0.0312 m/s (d) 159.24 m/s

Q.28 Reflection coefficient for the transmission line shown in the given figure, is



(a) +1 (b) –1
(c) 0 (d) 0.5

Q.29 A travelling wave 400/1/50 means crest value of
(a) 400 V with rise time of 1/50 s
(b) 400 kV with rise time 1 s and fall time 50 s
(c) 400 kV with rise time 1 μs with fall time 50 μs
(d) 400 MV with rise time 1 μs and fall time 50 μs

Q.30 The *ABCD* constants of a 3-phase transmission line are:

$$A = D = 0.8\angle 1^\circ$$
$$B = 170\angle 85^\circ\ \Omega$$
$$C = 0.002\angle 90.4^\circ \text{ mho}$$

The sending end voltage is 400 kV. The receiving end voltage under no-load condition is
(a) 400 kV (b) 500 kV
(c) 320 kV (d) 417 kV

Q.31 **Assertion (A):** In the modelling of medium and long transmission lines the nominal-π and *T* circuits are not equivalent to each other.
Reason (R): A star-delta transformation can be used to derive the one circuit from the other.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.32 The component inductance due to the internal flux-linkage of a non-magnetic straight solid circular conductor per metre length has a constant value, and is independent of the conductor-diameter, because
(a) all the internal flux due to a current remains concentrated on the peripheral region of the conductor.

(b) the internal magnetic flux-density along the radial distance from the centre of the conductor increases proportionately to the current enclosed.
(c) the entire current is assumed to flow along the conductor-axis and the internal flux is distributed uniformly and concentrically.
(d) the current in the conductor is assumed to be uniformly distributed throughout the conductor cross-section.

Q.33 A 100 km long transmission line is loaded at 110 kV. If the loss of line is 15 MW and the load is 150 MVA, the resistance of the line is
(a) 8.06 ohms per phase
(b) 0.806 ohm per phase
(c) 0.0806 ohm per phase
(d) 80.6 ohms per phase

Q.34 D_s is the GMR of each subconductor of a four subconductor bundle conductor and d is the bundle spacing. What is the GMR of the equivalent single conductor?
(a) $1.09\sqrt{D_s \times d^3}$
(b) $1.09\sqrt{D_s^3 \times d^3}$
(c) $1.09\sqrt[4]{D_s^3 \times d^3}$
(d) $1.09\sqrt[4]{D_s \times d^3}$

Q.35 For a fixed receiving end and sending end voltage in a transmission system, what is the locus of the constant power?
(a) A straight line
(b) An ellipse
(c) A parabola
(d) A circle

Q.36 The corona loss on a particular system at 50 Hz is 1 kW/km per phase. What is the corona loss at 60 Hz in kW/km per phase?
(a) 0.83
(b) 1.0
(c) 1.13
(d) 1.2

Q.37 Consider the following statements:
1. Equivalent-T circuit of a long line is preferred to equivalent-π circuit.
2. The nature of reactive power compensation is different for peak load and off-peak load conditions.
3. Ferranti effect is significant only on medium and long lines.

Which of these statements are correct?
(a) 1 and 2
(b) 1 and 3
(c) 2 and 3
(d) 1, 2 and 3

Q.38 The propagation constant of a transmission line is $0.15 \times 10^{-3} + j1.5 \times 10^{-3}$.
The wavelength of the travelling wave is
(a) $\frac{1.5\times10^{-3}}{2\pi}$m
(b) $\frac{2\pi}{1.5\times10^{-3}}$m
(c) $\frac{1.5\times10^{-3}}{\pi}$m
(d) $\frac{\pi}{1.5\times10^{-3}}$m

Q.39 To equalize the sending and receiving end voltages, impedance is connected at the receiving end of a transmission line having the following *ABCD* parameters:
$A = D = 0.9\angle0°$ $B = 200\angle90°\ \Omega$
The impedance so connected would be
(a) $1000\angle0°\ \Omega$
(b) $1000\angle90°\ \Omega$
(c) $2000\angle90°\ \Omega$
(d) $2000\angle0°\ \Omega$

Q.40 A 50 Ω distortionless transmission line has a capacitance of 10^{-10} F/m. What is the inductance per metre?
(a) 0.25 μH
(b) 500 μH
(c) 5000 μH
(d) 50 μH

Q.41 A single-phase, two wire transmission line, 15 km long, is made up of round conductors, each 0.8 cm radius, separated from each other by 40 cm. The equivalent diameter of a fictitious hollow, thin-walled conductor having the same inductance as the original line is given by
(a) 1.557 cm
(b) 1.246 cm
(c) 1.6 cm
(d) 0.623 cm

Q.42 The resistance and reactance of a short line are equal. At zero regulation the load will be
(a) upf
(b) zpf
(c) 0.707 lag
(d) 0.707 lead

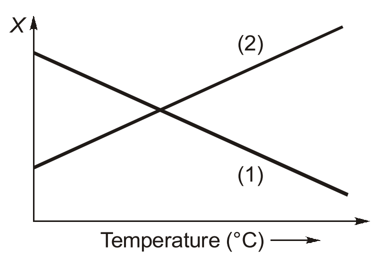
Q.43 A single-phase transmission line of impedance $j0.8$ ohm supplies a resistive load of 500 A at 300 V. The sending end power factor is
(a) unity
(b) 0.8 lagging
(c) 0.8 leading
(d) 0.6 lagging

Q.44 A rectangular voltage wave is impressed on a loss-free overhead line, with the far end of the line being open-circuited. On reaching the end of this line
(a) both the current and the voltage waves are reflected with positive sign.
(b) both the current and the voltage waves are reflected with negative sign.

(c) the current wave is reflected back with positive sign, but the voltage wave with negative sign.
(d) the current wave is reflected back with negative sign, but the voltage wave with positive sign.

Q.45 The breakdown strength of air at STP is 21 kV/cm. Its breakdown strength at 30°C and 72 cm of the *Hg* will be
(a) 21.25 kV/cm (b) 20.2 kV/cm
(c) 23 kV (d) 19.5 kV/cm

Q.46 Consider the plot of an unknown parameter (X) of the transmission line vs temperature in °C as shown below.



If the unknown parameter is taken as Sag and tension of the transmission line respectively then, the resulting variation of "Sag vs temperature" and "tension vs temperature" will be respectively represented by the straight line (s)
(a) 1 and 2 (b) 1 only
(c) 2 and 1 (d) 2 only

Q.47 The Sag for a span of 350 m, if the ultimate tensile strength of conductor is 5000 kg, factor of safety 2 and weight of conductor is 0.550 kg/m is
(a) 3.37 m (b) 6.12 m
(c) 1.2 m (d) 10.8 m

Q.48 **Assertion (A):** Corona reduces the effects of transients produced by lightning and other causes.
Reason (R): Charges induced on the line by lightning or other causes are partially dissipated as a corona loss.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not a correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Q.49 Match the items given in **List-I** and those in **List-II** and select your answer to these questions using the codes given below the lists:

List-I
A. Skin effect
B. Proximity effect
C. Ferranti effect
D. Corona
E. Surge impedance

List-II
1. Increase in resistance but decrease in self inductance.
2. Increase in ac resistance.
3. Causes power loss in the line.
4. Owing to voltage drop across line inductance due to flow of a charging current.
5. Square root of ratio of line impedance and shunt admittance.

Codes:

	A	B	C	D	E
(a)	1	2	3	4	5
(b)	5	4	1	2	3
(c)	3	2	5	4	1
(d)	2	1	4	3	5

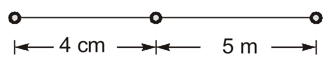
Q.50 Consider the following statements:
The calculation performed using short line approximate model instead of nominal-Π model for a medium length transmission line delivering lagging load at a given receiving end voltage always results in higher:
1. Sending end current
2. Sending end power
3. Regulation
4. Efficiency

Which of these statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1, 2 and 3 (d) 1, 3 and 4

Q.51 **Statement (I):** The power distribution system are 3-phase 4-wire circuits.
Statement (II): A neutral wire is necessary to supply single-phase loads of domestic and marginal commercial consumers.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).

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

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

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

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

■■■■

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)

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

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

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

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

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

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

$$P = V_1 I_1 \cos\phi_1 = V_2 I_2 \cos\phi_2$$

$$\frac{I_1}{I_2} = \frac{V_2 \cos\phi_2}{V_1 \cos\phi_1} \quad ...(ii)$$

Equation (*ii*) in equation (*i*),

$$\frac{(V_2 \cos\phi_2)^2}{(V_1 \cos\phi_1)^2} = \frac{\text{Vol}_1}{\text{Vol}_2}$$

Volume of the conductor $\propto \dfrac{1}{(V\cos\phi)^2}$

14. (c)

This is short transmission line

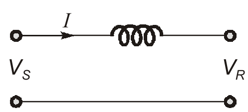
Z = j0.3 Ω/km

For 10 km, $Z = j3\ \Omega$

In this, $A = D = 1$

$B = Z = j3\ \Omega$

$C = 0$



$$\text{So,} \quad \begin{bmatrix} A & B \\ C & D \end{bmatrix} = \begin{bmatrix} 1 & j3 \\ 0 & 1 \end{bmatrix}$$

15. (a)

$$\because \quad \text{Skin depth}(\delta) = \frac{1}{\sqrt{\pi f \mu_0 \mu_r \sigma}} \propto \frac{1}{(\text{skin effect})}$$

$$\because \quad \sigma = \frac{1}{\rho}$$

Therefore skin effect is affected by resistivity of conductor.

16. (b)

For bundled conductors:

$$L_{ph} = 2\times 10^{-7} \ln\left(\frac{D_m}{D_s}\right)$$

$$C_{ph} = \frac{2\pi \in_0 \in_r}{\ln\left(\dfrac{D_m}{D_s}\right)}$$

By using bundled conductor D_s is increased, so L_{ph} is decreased and C_{ph} is increased.

17. (c)

- Corona increases radio interference indirectly.
- If corona is initiated by lightning surge then the stepness of the surge passing through the line is reduces.
- Power loss will occurs due to corona.
- It is more prevalent in the middle conductor in flat line configuration.

18. (c)

The losses occuring in a transmission line is

$$\text{loss} \propto \frac{1}{(V\cos\phi)^2}$$

As pf is improved and voltage is increased, losses reduces and hence, efficiency of transmission increases.

19. (b)

Maximum power transmitted is

$$P_{max} = \frac{V_S \cdot V_R}{X}$$

$$= \frac{132\times 126}{20} = 831.6\text{ MW} \approx 832\text{ MW}$$

20. (d)

Surge impedance is independent of length of the line.

21. (d)

Like skin effect, proximity effect depends on the conductor size, frequency of the supply, resistivity and relative permeability of the material.

22. (b)

For a short transmission line, receiving end power is given by,

$$P_R = \frac{|V_S||V_R|}{|Z|}\cos(\theta_s - \delta) - \frac{|V_R|^2}{|Z|}\cos\theta_s$$

For max power transfer,

$$\frac{dP_R}{d\delta} = 0 = \sin(\theta_s - s) = 0$$

$$\delta = \theta_s$$

23. Sol.

$$\text{GMR} = \left[\left((0.7788\times 2)\times 50\times 50\times 50\sqrt{2}\right)^4\right]^{1/16}$$

$$= 22.9\text{ cm}$$

24. (c)

As the line is not transposed therefore, there will be communication interference.

25. (d)

$$\text{Required time,} \quad t = \frac{600\times 10^3}{3\times 10^8} = 0.002\text{ sec}$$

26. (b)

For simple series impedance method,

$$T = \begin{bmatrix} 1 & z \\ 0 & 1 \end{bmatrix}$$

For end conductor method,

$$T = \begin{bmatrix} 1+yz & z \\ y & 1 \end{bmatrix}$$

For nominal-*T* method,

$$T = \begin{bmatrix} \left(1+\frac{yz}{2}\right) & z\left(1+\frac{yz}{4}\right) \\ y & \left(1+\frac{yz}{2}\right) \end{bmatrix}$$

For nominal π-method,

$$T = \begin{bmatrix} \left(1+\frac{yz}{2}\right) & z \\ 4\left(1+\frac{yz}{4}\right) & \left(1+\frac{yz}{2}\right) \end{bmatrix}$$

27. (b)

Velocity of propagation,

$$V = \frac{1}{\sqrt{LC}}$$

$$V = \frac{1}{\sqrt{0.201\times10^{-6}\times196.2\times10^{-12}}}$$

$$= 159.24 \times 10^6 \text{ m/s} = 159.24 \text{ m/}\mu\text{s}$$

28. (c)

$$\text{Reflection coefficient} = \frac{Z_L - Z_0}{Z_L + Z_0}$$

$$= \frac{300-300}{300+300} = 0$$

29. (c)

Surge of 400 kV rise in 1 μs and fall in 50 μs.

30. (b)

$$\because \quad \begin{bmatrix} V_s \\ I_s \end{bmatrix} = \begin{bmatrix} A & B \\ C & D \end{bmatrix}\begin{bmatrix} V_R \\ I_R \end{bmatrix}$$

For no-load $\Rightarrow I_R = 0$

$$\therefore \quad V_s = AV_R$$

$$V_R = \frac{V_s}{A}$$

$$V_R = \frac{400 \text{ kV}}{0.8\angle 1^\circ}$$

$$\Rightarrow \quad |V_R| = 500 \text{ kV}$$

31. (c)

Nominal-π and *T* circuits are not equivalent to each other, so Y-Δ transformation can not be used to drive the one circuit from the other.

32. (b)

L_{int} of conductor remain constant and independent of size or radius of conductor, because the flux link or flux density is increasing in proportion to the current from center to the surface.

33. (a)

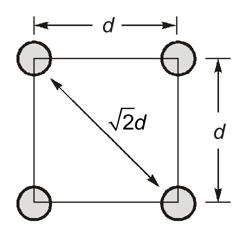
100 km long line is a short transmission line so, $Z = R + jX$; and assuming single phase line,

$$P_{loss} = I_L^2 R = 15 \times 10^6$$

$$15 \times 10^6 = \left(\frac{150 \times 10^6}{110 \times 10^3}\right)^2 \times R$$

$$\Rightarrow \quad R = 8.06\ \Omega/\text{Phase}$$

34. (d)



$\because r' = D_s$

$$\therefore \quad \text{GMR} = [(D_s \times d \times d \times \sqrt{2}d)^4]^{1/16}$$

$$= (D_s \times \sqrt{2} \times d^3)^{1/4}$$

$$= 1.09\sqrt[4]{D_s \times d^3}$$

35. (d)

Refer receiving-end power circle diagram. Since the locus of the operating point is a circle with radius $\frac{V_sV_r}{B}$ for fixed values of V_s and V_r, the diagram so obtained is called the power-circle diagram.

36. (c)

Use Peek's formula, $P \propto (f + 25)$

$$\therefore \quad \frac{P_2}{1} = \frac{60+25}{50+25}$$

$$\Rightarrow \quad P_2 = 1.13 \text{ kW/km/Phase}$$

37. (c)

Result from equivalent T and equivalent π are same but from practical point of view equivalent π is preferred because of number of equation as no need to create a new bus hence (1) is not correct.

38. (b)

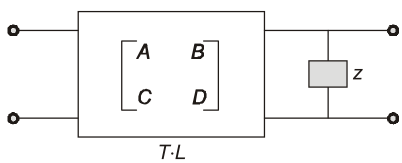
Given: $\gamma = 0.15 \times 10^{-3} + j1.5 \times 10^{-3}$

$\therefore \quad \gamma = \alpha + j\beta$

wavelength,

$$\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{1.5 \times 10^{-3}} \text{m}$$

39. (c)



$$\text{Equivalent T-parameter} = \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} 1 & 0 \\ 1/2 & 1 \end{bmatrix}$$

$$A_{eq} = A + \frac{\beta}{z} = 0.9\angle 0 + \frac{200\angle 90°}{z}$$

For $\quad |V_S| = |V_R|$

$$A_{eq} = 1 = 0.9\angle 0 + \frac{200\angle 90°}{z}$$

$\Rightarrow \quad z = 2000\angle 90°\ \Omega$

40. (a)

Given that characteristic impedance of distortion less line

$$Z_0 = \sqrt{\frac{L}{C}} = 50\ \Omega$$

$$L = ? \quad C = 10^{-10} \text{ F/m}$$

$$\therefore \quad Z_0 = \sqrt{\frac{L}{10^{-10}}} = 50$$

$$L = 2500 \times 10^{-10} \text{ H/m}$$

$$L = 0.25\ \mu\text{H/m}$$

41. (b)

The fictitious conductor is one whose radius is r' and whose diameter is therefore,

$$2r' = 2r\,e^{-1/4} = 2 \times 0.8 \times 0.7788$$
$$= 1.24608 \text{ cm}$$
$$\approx 1.246 \text{ cm}$$

42. (d)

Zero regulation of a transmission line occurs at a leading power factor when $\phi = \theta$.

Since, $\quad R = X$

Therefore, $\quad \tan\theta = \frac{X}{R} = 1$

or $\quad \theta = 45°$

$\therefore$ At zero regulation, $\phi = 45°$

Hence, $\cos\phi = \cos 45° = 0.707$ leading

43. (d)

Given, $I_R = 500\angle 0°$ A, $V_R = 300\angle 0°$ V

We know that,

$$V_s = AV_R + BI_R$$
$$= 300\angle 0° + (j0.8)(500\angle 0°)$$
$$= (300 + j400) \text{ volt}$$
$$= 500\angle \tan^{-1}\frac{4}{3} \text{ volt}$$
$$= 500\angle\phi \text{ volt}$$

Here, $\quad \tan\phi = \frac{4}{3}$

$\therefore \quad \cos\phi = \frac{3}{5} = 0.6$

Also, $\quad I_s = 500\angle 0°$ A

and $\quad V_s = 500\angle\phi$

Hence, V_s leads I_s

Therefore, sending end pf = 0.6 lagging

44. (d)

As the far-end (receiving end) is open-circuited therefore, reflection coefficient of voltage, $\rho_V = +1$ and reflection coefficient of current, $\rho_I = -1$.

Hence, reflected current wave will have negative sign whereas the reflected voltage wave will have positive sign.

45. (d)

The breakdown strength of air at any temperature (t) and pressure (b) is given by:

$$\gamma' = 21\delta = 21 \times \left(\frac{3.92b}{273 + t}\right)$$

$$= 21 \times \left(\frac{3.92 \times 72}{273 + 30}\right) \text{ kV/cm}$$

$$= 21 \times 0.93 = 19.5 \text{ kV/cm}$$