TSGENCO 2015 SOLUTIONS

1. (1)

2. (3)

For cables, insulation resistance $\propto \frac{1}{\text{length of the cable}}$

3. (C)

Lines greater than $\frac{\lambda}{20}$ are modeled as long lines.

For 500 Hz, length,

$$\lambda = \frac{3 \times 10^8}{500} = 600 \text{ kM}$$

$$\lambda = \frac{600}{20} = 30 \text{ kM}$$

∴ Given line length is greater than 30 kM

4. (B)

5. *

$P_c \propto (f + 25)$

P_c for 60 Hz $= 1 \times \frac{(60+25)}{(50+25)} = 1.133$ kW

6. (1)

The fault current in case of line to ground fault is given by

$I_{LG} = \frac{3E_t}{Z_1+Z_2+Z_0+3Z_n}$ also $I_{3-\emptyset} = \frac{E_f}{X_f}$

Given $I_{LG} = I_{3-\emptyset}$

∴ $\frac{3E_t}{Z_1+Z_2+Z_0+3Z_n} = \frac{E_f}{X_f}$

$2 x_y = x_2 + x_0 + 3x_n$

$2(0.1) = 0.1 + 0.05 + 3x_n$

$x_n = 0.0167$ p.u

7. (1)

Buses	Quantities specified
Load bus -	P, Q
Generator bus -	P, |V|
Slack bus -	|V|, δ

8. (1)

$P_{G_1} + P_{G_2} = 250$ MW -------- (i)

$25 + 0.2P_{G_2} = 32 + 0.2P_{G_2}$

$P_{G_1} + P_{G_2} = 35$ MW ---------- (ii)

Solving eq. (i) and (ii), we get

$P_1 = 140.25$ MW and $P_2 = 109.75$ MW

9. (B)

10. (A)

11. (C)

R cos φ + X sin φ = 0 ⇒ When φ = 45^o and negative, regulation will be zero.

12. (B)

13. (1)

14. (4)

PSM =

$$\frac{\text{Fault current}}{\text{CT ratio} \times \text{Relay operating current}} = \frac{2000}{80 \times 0.5 \times 5} = 10$$

15. (1)

16. (1)

17. (1)

18. (2)

19. (2)

20. (2)

21. (4)

22. (1)

23. (3)

$A[B + C(\overline{AB + AC})] = AB + AC(\overline{AB}.\overline{AC})$

$= AB + AC(\overline{A} + \overline{B}).(\overline{A} + \overline{C}) = AB + [AC\overline{A} + AC\overline{C}] = AB$

24. (4)

25. (4)

26. (2)

$\text{Load factor} = \frac{\text{Average demand}}{\text{Maximum demand}}$

$= \frac{6 \times 40 + 2 \times 50 + 2 \times 60 + 2 \times 50 + 2 \times 70 + 4 \times 80 + 2 \times 40}{80 \times 24}$

= 0.71

27. (1)

Annual energy generated = Load factor $\times$ Maximum demand $\times$ 8760

$= 0.7 \times 20 \times 10^3 \times 8760$

= 122.64 MWH

28. (4)

29. (2)

30. (1)

31. (3)

32. (1)

33. (3)

34. (2)

35. (3)

36. (1)

At resonance, the impedance offered by the series RLC circuit is minimum.

37. (4)

For series connection of two 2-port networks, Z parameters, For parallel connection, Y parameters and for cascade connection ABCD parameters are convenient to use.

38. (1)

The necessary and sufficient condition for a rational function T(s) to be a driving point impedance of an RC network is that all poles and zeros should simple and negative.

39. (4)

Since the sources are ideal, there would be no change in voltages across resistors even though all of them are doubled.

40. (3)

L = b - n + 1

41. (3)

Under steady state condition, inductor acts like short circuit and capacitor like open circuit. Hence there will be no current through and voltage drop across resistor and total voltage will appear across it.

42.

43. (B) & (C)

44. (B)

G(s)H(s) = $\frac{2(1+s)}{s^2}$

G(jω)H(jω) = $\frac{(j\omega_{pc}+1)^2}{(j\omega_{pc})^2}$

∠ G(jω)H(jω) = - 180^0 + $\text{Tan}^{-1}\omega_{pc}$

$\omega_{pc} = 0$

M = $|G(j\omega_{pc})H(j\omega_{pc})| = \frac{2\sqrt{1+\omega_{pc}^2}}{\omega_{pc}^2} = \infty$

Gain margin = $\frac{1}{M} = \frac{1}{\infty} = 0$

45. (B)

Let $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} e \\ f \end{bmatrix} u(t)$

$[B] = \begin{bmatrix} e \\ f \end{bmatrix}$, $[A\ B] = \begin{bmatrix} ae+bf \\ ce+df \end{bmatrix}$

Since $x_1(t) = x_2(t)$ and $\dot{x}_1(t) = \dot{x}_2(t)$

e = f and a + b = c + d

$$\therefore |Q_C| = |B \;\; AB| = \begin{vmatrix} e & ae+bf \\ f & ce+df \end{vmatrix} = 0$$

The system is uncontrollable.

46. (A)

T.F = C $[SI - A]^{-1}B + D$

47. (B)

Y(t) = $|G(j\omega)|\, A \sin\, (\omega t + \angle G(j\omega))$

48. (D)

49. (C)

Current through the voltmeter = $\dfrac{\text{half full scale reading}}{\text{seisitivity}}$

$$I_v = \frac{50}{100} = 0.5 \text{ mA}$$

50. (A)

T = N B I A = 100 × 200 × 10^{-3} × 50 × 10^{-3} × 10 × 10^{-3} × 20 × 10^{-3} = 200 μNm

51. (B)

E = at + $\frac{1}{2}$ b t^2

At 20^0 C, $194 \times 10^{-6} = 20a + \frac{1}{2} \times (20)^2 \times b$

At 100^0 C, $850 \times 10^{-6} = 100a + \frac{1}{2} \times (100)^2 \times b$

At 300^0 C, $1650 \times 10^{-6} = 300a + \frac{1}{2} \times (300)^2 \times b$

Solving for a & b and then substituting it in $T_n = -\frac{a}{b}$, we get (B)

52. (B)

$$I_{sh} = \frac{500 \times 10^{-3}}{0.02} = 25 \text{ mA}$$

53. (A)

54. (A)

55. (A)

56. (A) & (C)

57. (C)

58. (A) & (C)

59. (C)

Time delay = 4 × 50 ns = 200 ns

Maximum clock frequency, f = $\frac{1}{T} = \frac{1}{200\text{ns}} = 5\text{ MHz}$

60. (A)

LSB = $\frac{10.24 \times 1000}{1024} = 10\text{ mV}$

Temperature coefficient = $\frac{5 \times 1000}{25} = 200\text{ mV}/^0\text{C}$

61. (C)

62. (A)

Silicon is added to increase resistivity and steel is used to provide a low reluctance path for the magnetic flux.

63. (B)

64. (B)

$E_2 = 1.44\ N_2\ f\ B_{max}\ A \Rightarrow A = \frac{222}{1.44 \times 1000 \times 50 \times 0.1} = 0.01\text{ m}^2$

65. (A)

66. (A)

67. (A)

68. (B) & (C) & (D)

69. (A)

$$E_g = \frac{\emptyset ZN}{60} \times \frac{p}{A} = \frac{1 \times 100 \times 600 \times 4}{60 \times 4} = 1000\text{ V}$$

70. (B)

If N = 1440 rpm means that Ns $\approx$ 1500 rpm

$$N_s = \frac{120f}{p} \Rightarrow P = \frac{120 \times 50}{1500} = 4$$

71. (C)

If N = 1440 rpm, then obviously Ns = 1500 rpm

$$\text{slip}, S = \frac{1500 - 1440}{1500} = \frac{60}{1500} = 4\%$$

72. (B)

In an induction motor, T $\propto V^2$

$$\frac{T_2}{T_1} = \frac{{V_2}^2}{{V_1}^2} \Rightarrow T_2 = 100 \times \frac{200^2}{400^2} = 25 \text{ Nm}$$

73. (B)

The starting current drawn with star-delta starter is $\frac{1}{3}$ times that of current drawn by DOL starter.

74. (1)

75. (2)

76. (4)

Displacement factor, $\cos\alpha = \cos 30 = \frac{\sqrt{3}}{2}$

77. (4)

In 3-Ø controlled converter, $I_{T_{rms}} = \frac{I_{dc}}{\sqrt{3}}$

78. (4)

79. (2)

80. (4)

81. (2)

82. (3)

83. (1)

84. (3)

85. (2)

86. (4)

87. (3)

88. (1)

89. (1)

90. (3)

91. (1)

92. (3)

93. (4)

94. (3)

95. (1)

96. (4)

$2^{31} = (2^1 \times 2^1 \times 2^1) \times (2^1 \times 2^1 \times 2^1) \times$
$- - - - (2^1 \times 2^1 \times 2^1) \times 2^1$

In terms of 8 powers = $8^{10} \times 2$

When 8^{10} is divided by 7 gives remainder of 1 and 2 gives 2 only.

97. (1)

Let x = full bottle ink and y = quantity of ink that can fill one pen

$\therefore \left(\frac{2}{3}\right)x + 2y - 7y = \frac{1}{4}.x \Rightarrow x = 12.y$

One full bottle of ink can fill 12 pens

98. (4)

$a + b + c + d + e + f = 28 \times 7 = 196$

$a + b = 25, c + d + e = 49, g - f = 5$

Solving for g and f, g = 63

99. *

Given data is wrong

100. (1)