104 年度助理管理師/助理工程師、助理事務員甄試試題答案

師級：「類別三：電機」

科目：電力系統

一、選擇題

題號	標準答案
1	A
2	C
3	D
4	A
5	D
6	C
7	B
8	A
9	B
10	A

二、申論題或計算題

1. Pavg =8、Peak =16、LF =50%

2.

$$I_{12} = \frac{500\angle 16.26^\circ - 585\angle 0^\circ}{0.7 + j2.4} = 42 + j56 = 70\angle 53.13^\circ \text{ A}$$

$$\begin{aligned} S_{12} = V_1 I_{12}^* = (500\angle 16.26^\circ)(70\angle -53.13^\circ) &= 35000\angle -36.87^\circ \\ &= 28000 - j21000 \text{ VA} \\ S_{21} = V_2 I_{21}^* = (585\angle 0^\circ)(-70\angle -53.13^\circ) &= 40950\angle -53.13^\circ \\ &= -24570 + j32760 \text{ VA} \end{aligned}$$

From the above results, since P_1 is positive and P_2 is negative, source 1 generates 28 kW, and source 2 receives 24.57 kW, and the real power loss is 3.43 kW. Similarly, since Q_1 is negative, source 1 receives 21 kvar and source 2 delivers 32.76 kvar. The reactive power loss in the line is 11.76 kvar.

3.

$$S_2 = 15.93 \text{ MW} - j33.4 \text{ Mvar} = 0.1593 - j0.334 \text{ pu}$$
$$S_3 = 77.00 \text{ MW} + j14.0 \text{ Mvar} = 0.7700 + j0.140 \text{ pu}$$
$$V_3 = \frac{400\angle 0^\circ}{400} = 1.0\angle 0^\circ \text{ pu}$$
$$I_3 = \frac{S_3^*}{V_3^*} = \frac{0.77 - j0.14}{1.0\angle 0^\circ} = 0.77 - j0.14 \text{ pu}$$
$$V_2 = 1.0\angle 0^\circ + (j0.4)(0.77 - j0.14) = 1.1\angle 16.26^\circ \text{ pu}$$

Therefore, the line-to-line voltage at bus 2 is

$$V_2 = (400)(1.1) = 440 \text{ kV}$$
$$I_2 = \frac{S_2^*}{V_2^*} = \frac{0.1593 + j0.334}{1.1\angle -16.26^\circ} = 0.054 + j0.332 \text{ pu}$$
$$I_{12} = (0.77 - j0.14) + (0.054 + j0.332) = 0.824 + j0.192 \text{ pu}$$
$$V_1 = 1.1\angle 16.26^\circ + (j0.5)(0.824 + j0.192) = 1.2\angle 36.87^\circ \text{ pu}$$

Therefore, the line-to-line voltage at bus 1 is

$$V_1 = (400)(1.2) = 480 \text{ kV}$$

4.

The load impedance in per unit is found from

$$Z = \frac{|V_{L-L}|^2}{S_L^*} \ \Omega \quad \& \quad Z_B = \frac{|V_B|^2}{S_B^*} \ \Omega \quad \text{or} \quad Z = \frac{|V_{pu}|^2}{S_{pu}^*} \text{ pu}$$

$$Z_3 = \frac{(1.0)^2}{1 - j0.25} = 0.9412 + j0.2353 \text{ pu}$$
$$Z_4 = \frac{(1.0)^2}{2 - j0.5} = 0.4706 + j0.11765 \text{ pu}$$

Converting all impedances to admittances results in the admittance diagram shown in Figure 48

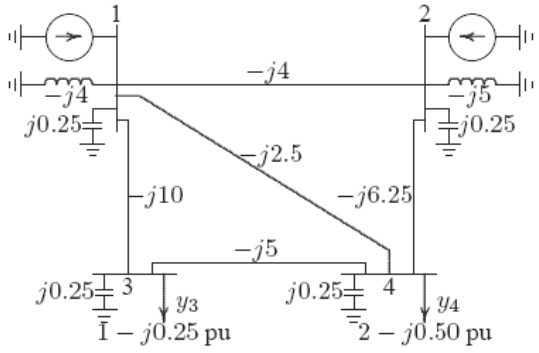

FIGURE 48

The self admittances are

$$Y_{11} = -j4 + j0.25 - j4 - j10 - j2.5 = -j20.25$$
$$Y_{22} = -j5 + j0.25 - j4 - j6.25 = -j15$$
$$Y_{33} = (1 - j0.25) + j0.25 - j10 - j5 = 1 - j15$$
$$Y_{44} = (2 - j0.5) + j0.25 - j2.5 - j6.25 - j5 = 2 - j14$$

Therefore, the bus admittance matrix is

$$Y_{bus} = \begin{bmatrix} -j20.25 & j4 & j10 & j2.5 \\ j4 & -j15 & 0 & j6.25 \\ j10 & 0 & 1 - j15 & j5 \\ j2.5 & j6.25 & j5 & 2 - j14 \end{bmatrix}$$