國立臺灣科技大學
九十一學年度碩士班招生考試試題

系所組別：電機工程系甲組
科　目：電力工程

※總分100分

1. The bus impedance matrix for the network shown in Figure 1 is given by

$$Z_{bus} = j\begin{bmatrix} 0.300 & 0.200 & 0.275 \\ 0.200 & 0.400 & 0.250 \\ 0.275 & 0.250 & 0.419 \end{bmatrix}$$

There is a line outage and the line from bus 1 to 2 is removed. Using the method of building algorithm determine the new bus impedance matrix. (15%)

2. The zero-, positive-,and negative-sequence bus impedance matrices for a three-bus power system are

$$Z^0_{bus} = j\begin{bmatrix} 0.20 & 0.05 & 0.12 \\ 0.05 & 0.10 & 0.08 \\ 0.12 & 0.08 & 0.30 \end{bmatrix} pu, Z^1_{bus} = Z^2_{bus} = j\begin{bmatrix} 0.16 & 0.10 & 0.15 \\ 0.10 & 0.20 & 0.12 \\ 0.15 & 0.12 & 0.25 \end{bmatrix} pu$$

Determine the per unit fault current and the per unit fault bus voltages during fault for

(a) A bolted three-phase fault at bus 3, (5%)

(b) A single-line-to-ground fault with R=0.05 pu arcing resistance at bus 3. (10%)

3. Figure 2 shows the one-line diagram of a simple three-bus power system with generation at bus 1. The voltage at bus 1 is $V_1 = 1.0\angle 0°$ per unit. The scheduled loads on buses 2 and 3 are marked on the diagram. Line impedances are marked in per unit on a 100-MVA base. For the purpose of hand calculations, line resistances and line charging susceptances are neglected.

Using Gauss-Sedial method and initial estimates of $V_2^{(0)} = 1.0 + j0$ and $V_3^{(0)} = 1.0 + j0$, determine V_2 and V_3. Perform two iterations. (20%)

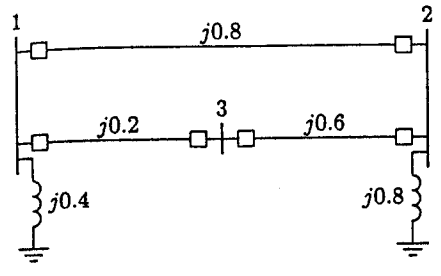

Figure 1

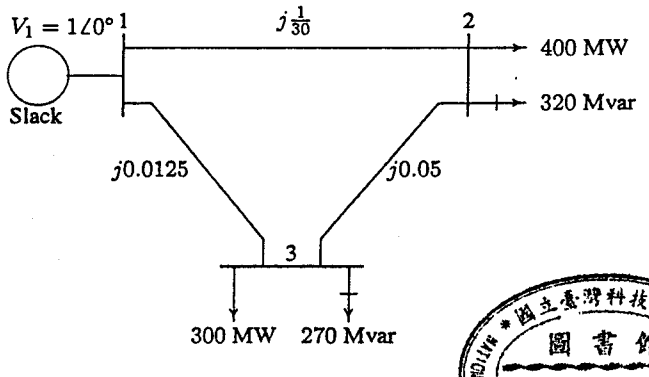

Figure 2

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4. A four-pole, 220-V, three-phase, 60-Hz, Y-connected induction motor has the following parameters in the equivalent model referred to the stator side:

stator winding resistance=0.4Ω, stator winding reactance=0.35Ω
rotor winding resistance=0.14Ω, rotor winding reactance=0.35Ω
magnetization reactance=16Ω

Please calculate the input current at the instant of starting. Also if the motor works at 1746 rpm, calculate the input active power. (20%)

5. Describe the requirements and conditions where the two-axis (d-q) model should be used to describe the dynamic and transient behavior responses of a synchronous machine. (10%)

6. For a Scott transformer with the diagram in Figure 3, the primary side turn numbers are given by $N_{AO} = \sqrt{3}\,N_{BO} = \sqrt{3}\,N_{OC}$, and the turn numbers of the secondary windings are equal. If a set of balanced positive sequence three-phase voltages are given to the primary side, please draw the phasor diagram and explain the relationship among the input and output voltages. With input instantaneous voltages $e_{AB}(t) = \sqrt{2}(120)\cos(\varpi t + 120^\circ)$ V, $e_{BC}(t) = \sqrt{2}(120)\cos(\varpi t)$ V, $e_{CA}(t) = \sqrt{2}(120)\cos(\varpi t - 120^\circ)$ V, and N_{AO} =140 turns, please find the turn numbers of the secondary side if the output phase voltage magnitudes are 150 V and also give the instantaneous voltages of the secondary side. (20 %)

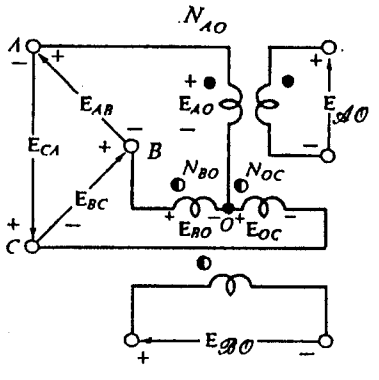

Figure 3