國立臺灣科技大學
九十二學年度碩士班招生考試試題

系所組別：電機工程系碩士班甲組
科　目：電力工程

「總分 100 分」

1. A three-phase Y-connected 220-V (line-to-line), 7.5-kW, 60-Hz, six-pole induction motor has the following parameter values in Ω/phase referred to the stator:
$R_1 = 0.294$, $R_2 = 0.144$, $X_1 = 0.503$, $X_2 = 0.209$, $X_m = 13.25$
The total friction, windage, and core losses may be assumed to be constant at 400 W, independent of load. For a slip of 2 percent, compute the stator current, shaft output torque, power factor and efficiency when the motor is operated at rated voltage and frequency. (20%)

2. The following data were obtained for a 50-kVA, 60-Hz, 2400: 240-V distribution transformer tested at 60 Hz:

| | Voltage, V | Current, A | Power, W |
|---|---|---|---|
| With high-voltage winding open-circuit | 240 | 5.41 | 186 |
| With low-voltage side short-circuit | 48 | 20.8 | 617 |

Determine the efficiency and the voltage regulation at full load, 0.80 power factor lagging. (15%)

3. A 60-Hz, three-phase synchronous motor is observed to have a terminal voltage of 460 V(line-to-line) and a terminal current of 120 A at a power factor of 0.95 lagging. The field-current under this operating condition is 47 A. The machine synchronous reactance is equal to 1.68 Ω. Assume the armature resistance to be negligible. Calculate the generated voltage $E_{af}$ (line-to-neutral), the magnitude of the field-to-armature mutual inductance, and the electrical power input to the motor. (15%)

4. In the two-bus system shown in Fig. 1, bus 1 is a slack bus with $V_1 = 1.0\angle 0^\circ$ pu. A load of 100 MW and 50 Mvar is taken form bus 2. The line impedance is $z_{12} = 0.12 + j0.16$ pu on a base of 100MVA.
(a) Determine the bus admittance matrix. (5%)
(b) Substituting for admittances, derive the expression for real and reactive power at bus 2. (5%)
(c) Using Newton-Raphson method, obtain the bus voltage magnitude and phase angle of bus 2. Start with an initial estimate of $|V_2|^{(0)} = 1.0$ pu and $\delta_2^{(0)} = 0^\circ$. Perform one iteration. (10%)

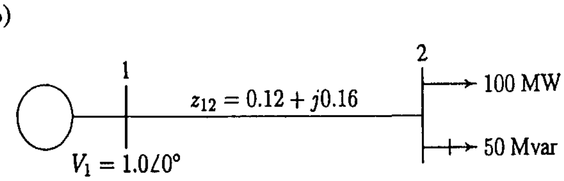


Fig. 1. One-line diagram for Problem 4.

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5. The one-line diagram of a simple power system is shown in Fig. 2. The neural of each generator is grounded through a current-limiting reactor of 0.25/3 per unit on a 100-MVA base. The system data expressed in per unit on a common 100-MVA base is tabulated below, where the superscripts 1, 2, and 0 are used to represent positive, negative, and zero-sequence quantities, respectively. The generators are running on no-load at their rated voltage and rated frequency with their emfs in phase.

(a) Find the positive-sequence, negative-sequence, and zero-sequence Thevenin equivalent networks viewed from bus 3 (the faulted bus). (10%)
(b) Determine the fault current for a single line-to-ground fault at bus 3 through a fault impedance $Z_f = j0.1$ per unit. (5%)
(c) Determine the fault current for a line-to-line fault at bus 3 through a fault impedance $Z_f = j0.1$ per unit. (5%)

| Item | Base MVA | Voltage Rating | $X^1$ | $X^2$ | $X^0$ |
|---|---|---|---|---|---|
| $G_1$ | 100 | 20 kV | 0.15 | 0.15 | 0.05 |
| $G_2$ | 100 | 20 kV | 0.15 | 0.15 | 0.05 |
| $T_1$ | 100 | 20/220 kV | 0.10 | 0.10 | 0.10 |
| $T_2$ | 100 | 20/220 kV | 0.10 | 0.10 | 0.10 |
| $L_{12}$ | 100 | 220 kV | 0.125 | 0.125 | 0.30 |
| $L_{13}$ | 100 | 220 kV | 0.15 | 0.15 | 0.35 |
| $L_{23}$ | 100 | 220 kV | 0.25 | 0.25 | 0.7125 |

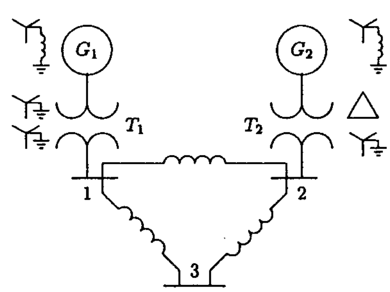


Fig. 2. One-line diagram for Problem 5.

6. The fuel-cost functions in $/h for three thermal plants are given by

$C_1 = 350 + 7.20P_1 + 0.0040P_1^2$

$C_2 = 500 + 7.30P_2 + 0.0025P_2^2$

$C_3 = 600 + 6.74P_3 + 0.0030P_3^2$

where $P_1$, $P_2$, and $P_3$ are in MW. Neglecting line losses and generator limits, determine the optimal scheduling of generation for $P_D = 450$ MW. (10%)