國立臺灣科技大學
113學年度碩士班招生
試題

系所組別：0710電機工程系碩士班甲組

科　　目：電力系統

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(總分為 100 分；所有試題務必於答案卷內頁依序作答，否則不予計分)

1. **(10%)** Two branches having impedances equal to $j0.25$ per-unit are coupled through mutual impedance $Z_M = j0.15$ per-unit, as shown in Fig. 1. Please form the bus admittance matrix $\mathbf{Y}_{BUS}$.

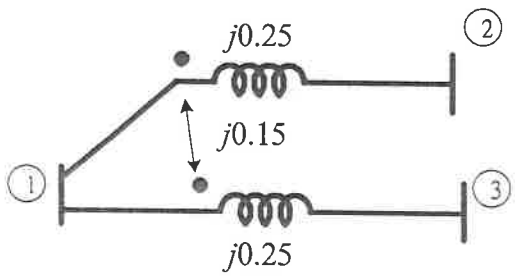

Fig. 1. Single-line diagram for Problem 1.

2. **(20%)** The bus admittance matrix of a network component is shown as Equation (1), where y_t is the per-unit leakage admittance. α and β are tappings on the primary and secondary sides of a transformer. Derive the coupling-free equivalent circuit model of this network component.

$$Y_{BUS} = \begin{bmatrix} \frac{y_t}{\alpha^2} & -\frac{y_t}{\alpha\beta} \\ -\frac{y_t}{\alpha\beta} & \frac{y_t}{\beta^2} \end{bmatrix} \quad (1)$$

3. **(20%)** Suppose that the P-Q load is known at each of the nine buses of a small power system and that synchronous generators are connected to buses ①, ②, ⑤, and ⑦. For a power-flow study, identify the ΔP and ΔQ mismatches and the state variables associated with each bus. Choose bus ① as the slack bus.

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4. **(20%)** The one-line diagram of a simple power system is shown in Fig. 2. The positive- and zero-sequence reactances of the lines and transformers in per unit on a 100-MVA is tabulated below. The $\Delta - Y$ transformer between buses 3 and 5 is grounded through a reactor of reactance 0.10 per unit.

Line and Transformer Data

Bus No.	Bus No.	X_1, pu	X_0, pu
1	4	0.225	0.400
2	4	0.035	0.035
3	5	0.042	0.042
4	6	0.125	0.250
5	6	0.175	0.350

The generator's positive- and zero sequences reactances including the reactance of grounding neutrals on a 200-MVA base is tabulated below.

Generator transient impedance, pu

Gen. No.	X_1, pu	X_0, pu	X_n, pu
1	0.32	0.16	0.00
2	0.24	0.12	0.08
3	0.24	0.12	0.00

Resistances, shunt reactances, and loads are neglected, and all negative-sequence reactances are assumed equal to positive- sequence.

(1) (6%) Construct the positive, negative and zero sequence networks circuit model on a 100-MVA base.

(2) (6%) Determine the short circuit capacity at bus 6.

(3) (8%) Determine the fault current for a line-to-ground fault occurs at bus 6 with a fault impedance $Z_f = j0.1$ per unit.

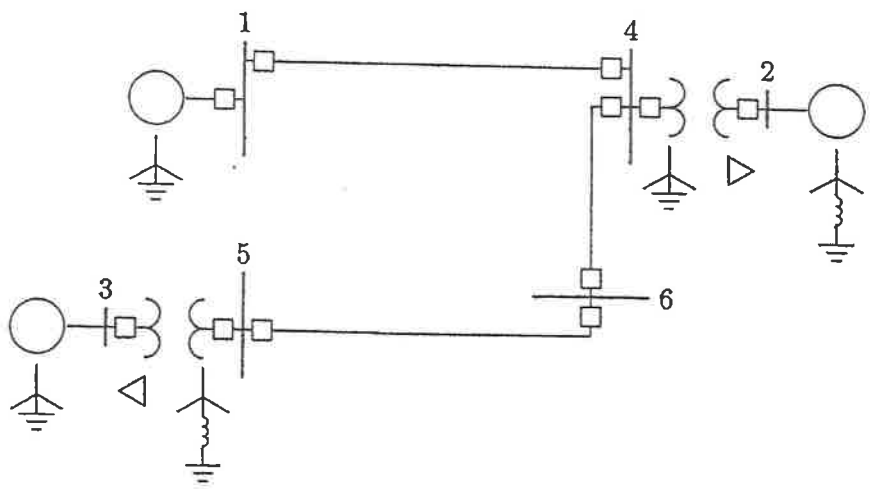

Fig. 2. One-line diagram for Problem 4.

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5. **(15%)** Two thermal plants of a power system are committed to supply load demand. The fuel-cost functions in \$/h for these two thermal plants are given by

$C_1 = 320 + 6.0P_1 + 0.003P_1^2$ $C_2 = 200 + 6.2P_2 + 0.002P_2^2$

where plant generations P_1 and P_2 are in MW, and subject to following limitations.

$50 \le P_1 \le 200$ $50 \le P_2 \le 450$

The system transmission losses in MW can be formed by

$P_L = 1.25 \times 10^{-4} \cdot P_1^2 + 0.625 \times 10^{-4} \cdot P_2^2$

Determine the optimal scheduling of generation P_1 and P_2 for the following conditions.

(1) (10%) Generation limits and transmission losses are neglected; load demand is of 550 MW.

(2) (5%) Load demand is of 550MW with transmission losses neglected. But take generation limits into consideration.

6. **(15%)** Two generating units for 300 MW and 400 MW have governor speed regulation of 6.0 and 6.4 percent, respectively, from no-load to full-load, respectively. They are operating in parallel and share a load of 600 MW. Assuming free governor action, determine the load shared by each unit.