國立臺灣科技大學 108 學年度碩士班招生試題

系所組別：電機工程系碩士班甲組

科　　目：電力系統

(總分為 100 分)

1. There is a two-bus system shown in Figure 1, bus 1 is a slack bus with $V_1 = 1.0\angle 0°$ pu. A load of 120MW and 60 Mvar is taken from bus 2. The line admittance is $y_{12} = 8\angle -75°$ pu on a base of 100 MVA. The expression for real and reactive power at bus 2 is given by

$$P_2 = 8|V_2||V_1|\cos(105° - \delta_2 + \delta_1) + 8|V_2|^2\cos(-75°)$$

$$Q_2 = -8|V_2||V_1|\sin(105° - \delta_2 + \delta_1) - 8|V_2|^2\sin(-75°)$$

Using Newton-Raphson method, obtain the voltage magnitude and phase angle in degrees of bus 2. Perform one iteration and start with an initial estimate of $|V_2|^{(0)} = 1.0$ pu and $|\delta_2|^{(0)} = 0°$. **(20%)**

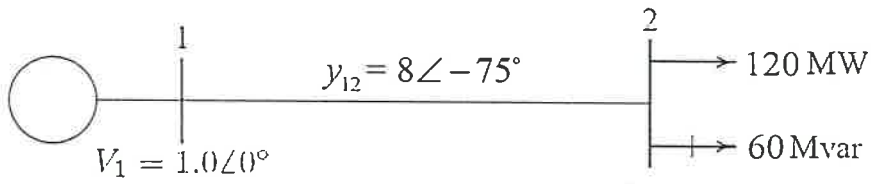

Figure 1 One line diagram for problem 1

2. A two-winding transformer rated at 12-kVA, 150/100-V, 60-HZ has a core loss of 220 W and a full-load copper loss of 460 W.

(a) The above transformer is to be connected as an auto transformer to supply a load at 150 V from 250 V source. Please draw the auto transformer connection diagram. **(4%)** And what kVA load can be supplied without exceeding the current rating of the windings? (For this part assume an ideal transformer.) **(3%)**

(b) Find the efficiency with the kVA loading of part (a) and 0.85 power factor. **(3%)**

3. A three-phase, 161-kV, 60-Hz transposed line is composed of two ACSR 1,033,500, 45/7 Ortolan conductors per phase with flat horizontal spacing of 10 m. The conductors have a diameter of 3.25 cm and a *GMR* of 1.55 cm. The bundle spacing is 40 cm. The resistance of each conductor in the bundle is 0.062 Ω per km and the line conductance is negligible. The line is 220 km long. Using the nominal π model, determine the ABCD constant of the line. **(20%)**

4. Derive the sequence network circuit model for the unbalanced three-phase fault at bus p as shown in Figure 2. **(20%)**

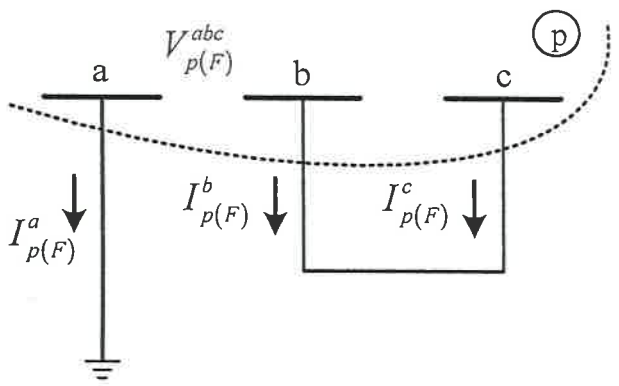

Figure 2 Faulted circuit diagram for Problem 4

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

$$C_1 = 500 + 5.3P_1 + 0.004P_1^2$$
$$C_2 = 400 + 5.5P_2 + 0.006P_2^2$$
$$C_3 = 200 + 5.8P_3 + 0.009P_3^2$$

where P_1, P_2 and P_3 are in MW. The total load, P_D, is 975MW with the following generator limits (in MW).

$$200 \le P_1 \le 450$$
$$150 \le P_2 \le 350$$
$$100 \le P_3 \le 225$$

(a) Find the optimal dispatch **(10%)**

(b) Find the total cost in $/h **(10%)**

6. Explain the major purposes of the following analysis in power systems.

(a) Power flow analysis **(2%)**

(b) Short circuit analysis **(2%)**

(c) Economic dispatch analysis **(2%)**

(d) Steady-state stability analysis **(2%)**

(e) Transient stability analysis **(2%)**