國立臺灣科技大學 110 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. **(15%)** Define the following keywords.

(a) Load factor. **(3%)**

(b) Load shedding. **(3%)**

(c) Annual plant factor. **(3%)**

(d) Automatic meter reading. (AMR) **(3%)**

(e) Transformer load management. (TLM) **(3%)**

2. **(15%)** A 735 kV three-phase transposed line is composed of four ACSR 954,000 cmil, 45/7 Rail conductors per phase with horizontal conductor configuration as shown in Fig. 1. The conductors have a diameter of 2.959 cm and a GMR of 1.173 cm. Bundle spacing is 18 inch.

(a) Find the inductance (mH/km) per phase per kilometer of the line. **(7%)**

(b) Find the capacitance (μF/km) per phase per kilometer of the line. **(8%)**

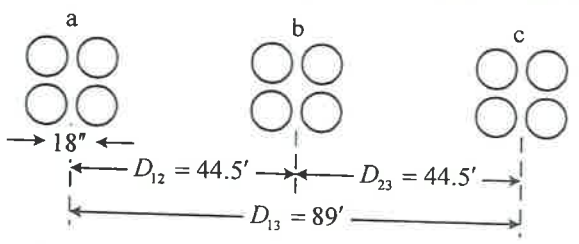

Fig. 1. Conductor layout for Problem 2.

3. **(20%)** A power system network is shown in Fig. 2.

(a) Determine the bus admittance matrix without mutual coupling between elements. **(5%)**

(b) Determine the bus admittance matrix with mutual coupling between elements. **(15%)**

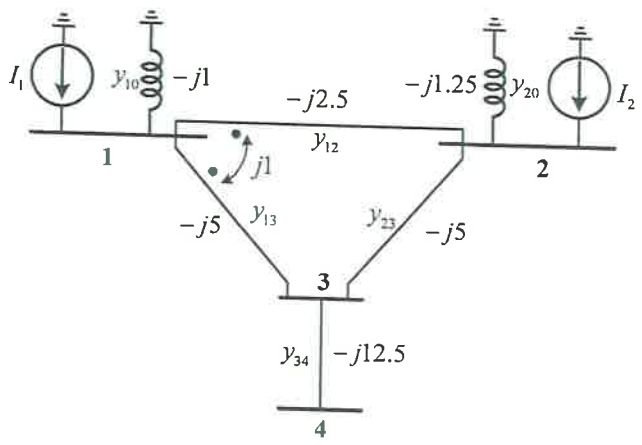

Fig. 2. Per-unit admittance diagram for Problem 3.

4. **(15%)** The incremental costs of units in $/MWh for three thermal plants are given by

$$IC_1 = 0.008P_1 + 8.0$$

$$IC_2 = 0.004P_2 + 6.0$$

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$$IC_3 = 0.005P_3 + 7.5$$

where P_1, P_2, and P_3 are in MW. The total load is 1200 MW with the following generator limits.

$$122 < P_1 < 400$$
$$80 < P_2 < 550$$
$$250 < P_3 < 600$$

(a) Neglecting line losses, determine the optimal economic scheduling of generation. **(9%)**

(b) The real power loss with generation expressed in per unit on a 100-MVA base is given by $P_{L(pu)} = 0.02P_{1(pu)} + 0.05P_{2(pu)} + 0.01P_{3(pu)}$, determine the power loss in the transmission lines. **(6%)**

5. **(15%)** A 60-Hz synchronous generator having inertia constant H= 5 MJ/MVA and a direct axis transient reactance $X'_d = 0.36$ per unit is connected to infinite bus through a purely reactive circuit as shown in Fig. 3. Reactance are marked on the diagram on a common system base. The generator is delivering real power $P_e = 0.8$ per unit to the infinite bus at a voltage of $V = 1$ per unit. Voltage magnitude at bus 1 is 1.2 per unit. A temporary three-phase fault occurs at the sending end of the line at point F through a fault impedance of $\mathrm{Z_f} = \mathrm{j0.2}$ per unit. When the fault is cleared, both lines are intact.

(a) Determine the bus voltages and line currents during fault. **(6%)**

(b) Determine the critical clearing time. **(9%)**

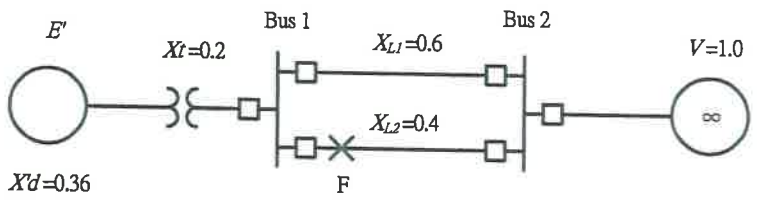

Fig. 3. The one-line diagram for Problem 5.

6. **(20%)** A single area consists of two generating units, rated at 500 and 800 MVA, with speed regulation of 6 percent and 5 percent on their respective ratings. The units are operating in parallel, sharing 900 MW. Unit 1 supplies 300 MW and unit 2 supplies 600 MW at 1.0 per unit (60 Hz) frequency. The load is increased by 100 MW.

(a) Assume there is no frequency-dependent load. Find the steady-state frequency deviation and the new generation on each unit. **(10%)**

(b) The load varies 0. 67 percent for every 1 percent change in frequency. Find the steady-state frequency deviation and the new generation on each unit. **(5%)**

(c) Explain the operating principles of Frequency Control and Voltage Control in power system. **(5%)**

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