國立台灣科技大學九十八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

（總分爲 100 分）

1. The one-line diagram of a power system is shown in Fig. 1. Some of system component ratings are given as follows.
   G_1: A synchronous generator, 60-MVA, 20-kV, X=9%.
   T_1: A three-phase transformer, 50-MVA, 20/161-kV, X=10%.
   T_2: A three-phase transformer, 55-MVA , 161/20-kV, X = 9%.
   Line: A series impedance of $Z = 120 + j200\Omega$ per phase.
   Load: 20-MVA, 0.8 power factor lagging at 150-kV.
   Selecting 100-MVA, 20-kV as the base for generator G_1 side, determine the per-unit value of
   (a) the reactance of generator G_1. **(5%)**
   (b) the impedance of line. **(5%)**
   (c) the impedance of load. **(5%)**

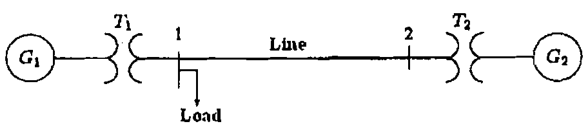

Fig. 1 Circuit for Problem 1.

2. A three-phase, 60-Hz un-transposed transmission line runs in parallel with a ungrounded telephone line (d,e) for 20-km as shown in Fig. 2. The power line carriers a balanced three-phase current of $I_a = 320\angle 0°$ A、$I_b = 320\angle -120°$ A、$I_c = 320\angle -240°$ A. Assuming that there is no current flowing in telephone line, determine the induced peak voltage. **(10%)**

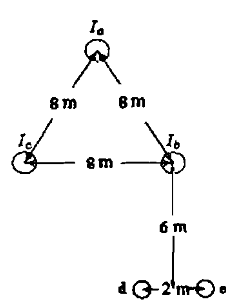

Fig. 2 Circuit for Problem 2.

3. A three-phase, 60-Hz, 345-kV transmission line is 320-km long. The series impedance is j0.49-Ω/km per phase and shunt capacitance is 8.9357×10^{-9}-F/km per phase. The receiving end load is 200-MVA, unity power factor at 345-kV. Determine
   (a) the line velocity of propagation.**(5%)**
   (b) the sending end line-to-line voltage magnitude. **(5%)**
   (c) the voltage regulation. **(5%)**
   (d) the line-to-line voltage magnitude at mid-point of the line. **(5%)**
   (e) the line current magnitude at mid-point of the line. **(5%)**

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4. Fig. 3 shows the one-line diagram of a simple three-bus power system with generation at buses 1 and 2. The voltage at bus 1 is $V_1 = 1.0\angle 0°$ per unit. Voltage magnitude at bus 2 is fixed at 1.05 pu with a real power generation of 400 MW. A load consisting of 500 MW and 400 Mvar is taken from bus 3. Line admittances are marked in per unit on a 100 MVA base. For the purpose of hand calculations, line resistances and line charging susceptances are neglected.
   (a) Find $\mathbf{Y}_{Bus}$. **(5%)**
   (b) Identify the independent variables for power flow analysis for this system. **(5%)**
   (c) Using *Gauss-Seidel method*, start with the initial estimates of $V_2^{(0)} = 1.05 + j0$ and $V_3^{(0)} = 1.0 + j0$, and keeping $|V_2| = 1.05$ pu, determine the phasor values of V_2 and V_3. Perform the first iteration. **(10%)**

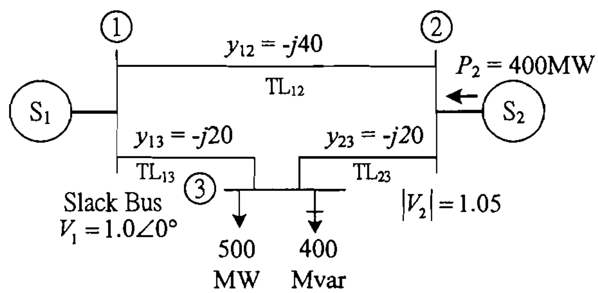

Fig. 3 Circuit for Problem 4.

5. The three-bus circuit of Fig. 4 has per-unit reactances as marked.

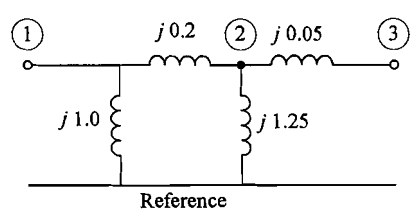

Fig.4 Circuit for Problem 5. Values shown are reactances in per unit.

The symmetrical $\mathbf{Y}_{Bus}$ for the circuit has triangular factors

$$\mathbf{L} = \begin{bmatrix} -j6.0 & 0 & 0 \\ j5.0 & -j21.633333 & 0 \\ 0 & j20.0 & -j1.510038 \end{bmatrix} \quad \mathbf{U} = \begin{bmatrix} 1 & -0.833333 & 0 \\ 0 & 1 & -0.924499 \\ 0 & 0 & 1 \end{bmatrix}$$

(a) Use **L** and **U** to calculate the Thévenin impedance Z_{22} looking into the circuit of Fig. 4 between bus ② and reference. **(8%)**
(b) Check your answer by inspection of Fig. 4. **(2%)**

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6. Given the one-line diagram of Fig. 5 with a line-to-line short-circuit at bus ⑤ on phases b and c. All per phase impedances has been referred to a common-base MVA. Assume all the prefault bus voltages are equal to $1.0\angle 0°$ pu. Find the phasor values of three-phase fault currents and bus voltages during fault, all at the fault location. **(20%)**

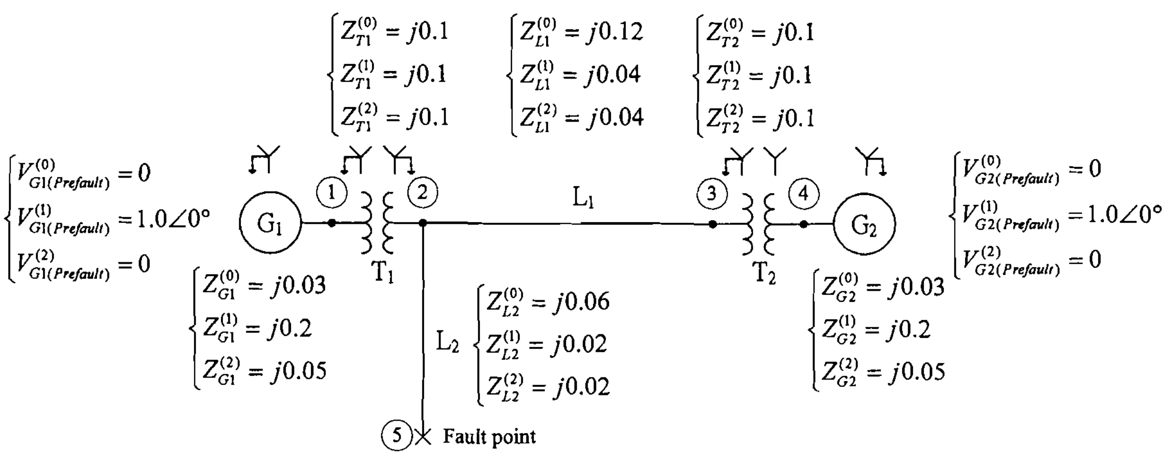

Fig. 5　Circuit for Problem 6.