國立台灣科技大學九十九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. Three zones of a single-phase circuit are identified in Fig. 1. The zones are connected by transformers T_1 and T_2, whose ratings are also shown. Using base values of 30 kVA and 240 volts in zone 1, transformer winding resistances and shunt admittance branches are neglected.
   (a) Draw the per-unit circuit. **(5%)**
   (b) Calculate the load current both in per-unit and in amperes. **(10%)**

$Z_{load} = 0.8 + j0.1\Omega$

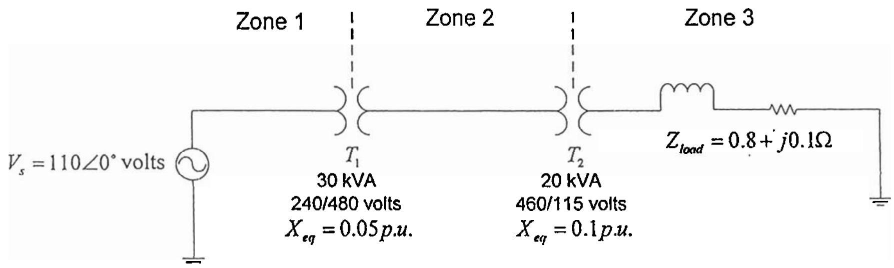

Fig. 1 Circuit for Problem 1.

2. A three-phase untransposed transmission line and a telephone line are supported on the same towers as shown in Fig. 2. The power line carries a 60-Hz balanced current of 200 A per phase. The telephone line is located directly below phase b. Assuming balanced three-phase currents in the power line, find the voltage per kilometer induced in the telephone line. **(15%)**

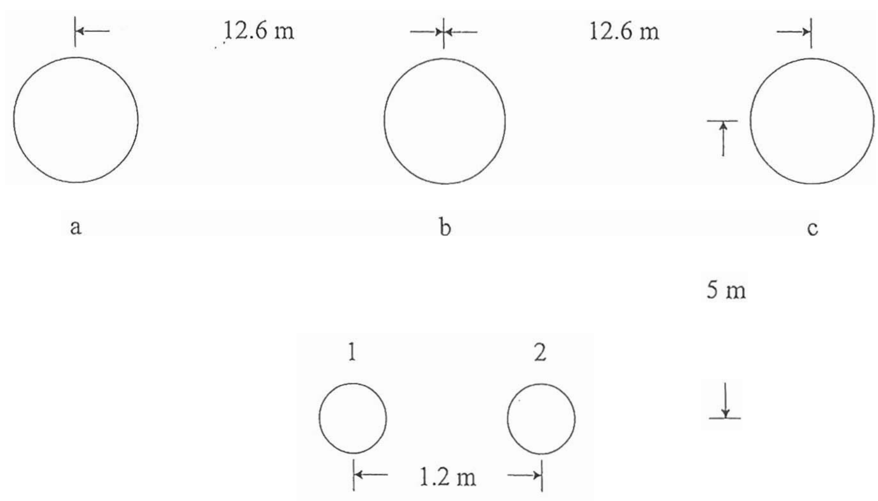

Fig. 2 Circuit for Problem 2.

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3. A 240-kV, three-phase transmission line has a per phase series impedance of $z = 0.1 + j0.35\,\Omega$ per Km and a per phase shunt admittance of $y = j2.7\times10^{-6}$ siemens per km. The line is 100 km long. Using the nominal π model, determine

(a) the transmission line ABCD constants. **(5%)**

(b) the sending end voltage and current, voltage regulation, the sending end power and the transmission efficiency when the line delivers 100 MVA, 0.9 lagging power factor at 220 kV. **(15%)**

4. A power system network is shown in Fig. 3. The generators at buses 1 and 2 are represented by their equivalent current sources with their reactances in per unit on a 100 MVA base. The lines are represented by π model where series reactances and shunt reactances are also expressed in per unit on a 100 MVA base. The loads at buses 3 and 4 are expressed in MW and Mvar.

(a) Assuming a voltage magnitude of 1.0 per unit at buses 3 and 4, convert the loads to per unit impedances. (4%)

(b) Convert network impedances to admittances and obtain the bus admittance matrix by inspection. (6%)

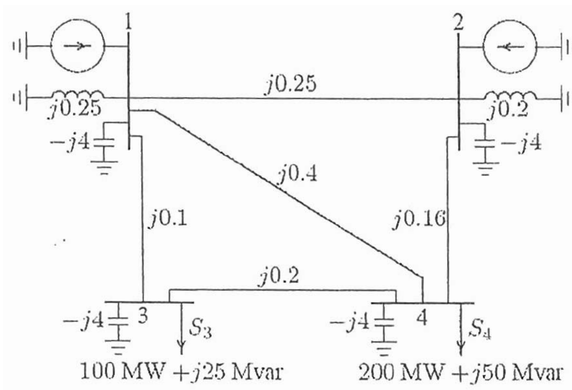

Fig. 3 Circuit for Problem 4.

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5. In the two-bus system shown in Fig. 4, bus 1 is a slack bus with $V_1 = 1.0\angle 0°$ pu. A load of 0.5+j1.0 is taken from bus 2. The line impedance is $z_{12} = j0.5$ pu.

   (a) Using Gauss-Seidel method, obtain the voltage magnitude and phase angle of bus 2. Start with an initial estimate of $|V_2|^{(0)} = 1.0$ pu and $\delta_2^{(0)} = 0°$. Perform two iterations. **(15%)**

   (b) If after several iterations voltage at bus 2 converges to $V_2 = 0.933056 - j0.249925$ pu, determine S_1. **(5%)**

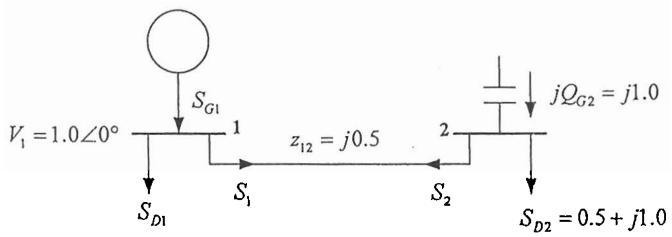

Fig. 4 Circuit for Problem 5.

6. Two 11 kV, 20 MVA, three-phase, star connected generators operate in parallel as shown in Fig. 5; the positive, negative and zero sequence reactances of each being, respectively, $j0.18, j0.15, j0.10$ pu. The star point of one of the generators is isolated and that of the other is earthed through a 2.0 ohm resistor. A single line-to-ground fault occurs at the terminals of one of the generators. Estimate

   (a) the fault current I_a (in *pu*), and **(15%)**

   (b) the current (in *kA*) in grounding resistor. **(5%)**

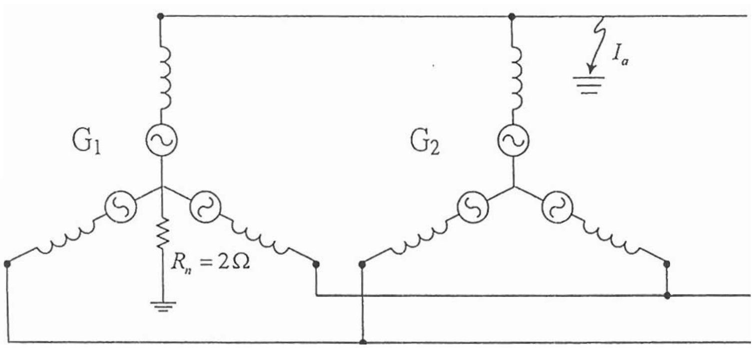

Fig. 5 Circuit for Problem 6.