國立臺灣科技大學
九十三學年度碩士班考試試題

系所組別：電機工程系甲組
科　　目：電力系統

〔總分 100 分〕

1. A 150-kVA 2400/240-V single-phase power transformer has the parameters as shown in Figure 1. **(15%)**
   (a) Determine the equivalent circuit referred to the high-voltage side.
   (b) Find the primary voltage and voltage regulation when transformer is operating at full load 0.8 power factor lagging and 240 V.
   (c) Find the primary voltage and voltage regulation when the transformer is operating at full load 0.8 power factor leading.

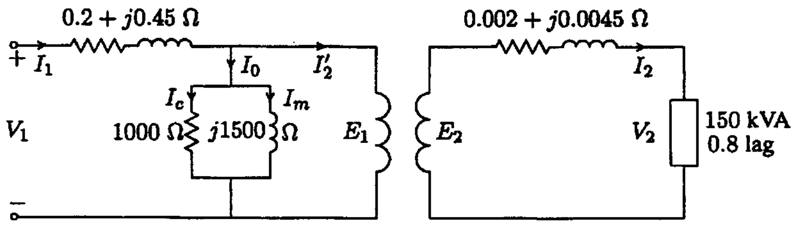

Figure 1 For Problem 1

2. A 50-MVA, 30-kV, three-phase, 60-Hz synchronous generator has a synchronous reactance of 9 Ω per phase and a negligible resistance. The generator is delivering rated power at a 0.8 power factor lagging at the rated terminal voltage to an infinite bus. **(20 %)**
   (a) Determine the excitation voltage per phase E and the power angle δ.
   (b) If the generator is operating at the excitation voltage of part (a), what is the steady-state maximum power the machine can deliver before losing synchronism? Also, find the armature current corresponding to this maximum power.
   (c) If the generator is delivering 40MW at a terminal voltage of 30 kV. Compute the power angle, armature current and the power factor when the field current is adjusted for the excitation that the excitation voltage is decreased to 80 percent of the value found in part (a).

3. A 230-kV, three-phase transmission line has a per phase series impedance of $z = 0.05+j0.45$ Ω/km and a per phase shunt admittance of $y = j3.4\times10^{-6}$ siemens per km. The line is 80 km long. Using the nominal π model, determine
   (a) The transmission line ABCD constants.
   (b) Find the sending end voltage and current, the voltage regulation and the sending end power when the line delivers 200 MVA, 0.8 lagging power factor at 220 kV. **(15 %)**

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4. Figure 2 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 $V_1 = 1.0\angle 0°$ pu. 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. Using fast decoupled algorithm, 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 only one iteration. **(25%)**

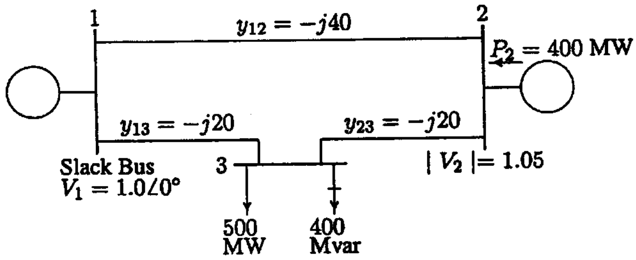

Figure 2 For Problem 4

5. A generator supplies a motor through a Y-Δ transformer. The generator is connected to the Y side of the transformer. A fault occurs between the motor terminals and the transformer. The symmetrical components of the subtransient current in the motor flowing toward the fault are **(25%)**

$I_a^{(0)} = -j3.0$ pu

$I_a^{(1)} = -0.8 - j2.6$ pu

$I_a^{(2)} = -j2.0$ pu

From the transformer toward the fault

$I_a^{(0)} = 0$ pu

$I_a^{(1)} = 0.8 - j0.4$ pu

$I_a^{(2)} = -j1.0$ pu

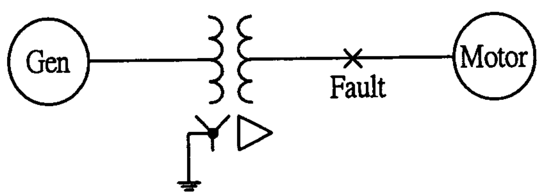

Figure 3 For Problem 5

Assume $X_d'' = X_1 = X_2$ for both the motor and the generator.

(a) Describe the type of fault.

(b) Find the prefault current, if any, in line a.

(c) Calculate the subtransient fault current in per unit.

(d) Calculate the subtransient current in each phase of the generator in per unit. Assume that the generator is on the high-voltage side of the transformer.