國立臺灣科技大學
八十九學年度碩士班招生考試試題

系所組別： 電機工程系甲組
科　目： 電力工程

1. A salient-pole synchronous motor has the direct- and quadrature- synchronous reactance respectively represented as X_d and X_q. The applied voltage is of rated value. The field excitation of the motor is zero.
   (a) What percentage of its rated output will the machine deliver without loss of synchronism if X_d=0.85 pu and X_q=0.6 pu? **(10 %)**
   (b) Compute the per-unit armature current for this operating condition. **(10 %)**

2. The following test data were taken on a 7.5hp, 4-pole, 208V, 60Hz, design class A, Y-connected induction motor having a rated current of 28A.
   Dc test: V_{DC}=13.6V, I_{DC}=28A
   No-load test: V_{no}=208V, I_{no}=8.17A, f=60Hz, P_{noin}=420W
   Locked-rotor test: V_{Lo}=25V, I_{Lo}=27.9A, f_{Lo}=15Hz, P_{Loin}=920W
   Find the slip at pullout torque? **(20%)**

3. A 3-phase induction motor has the rotor leakage reactance per phase at standstill of X_2, and the rotor resistance per phase of R_2. Please derive the condition such that the motor has a maximum starting torque. **(10%)**

4. The one-line diagram of a four-bus power system is as shown in Figure 1. Reactances are given in per unit on a common MVA base. Transformers T_1 and T_2 have tap settings of 0.8:1, and 1.25:1 respectively. Obtain the bus admittance matrix. **(10%)**

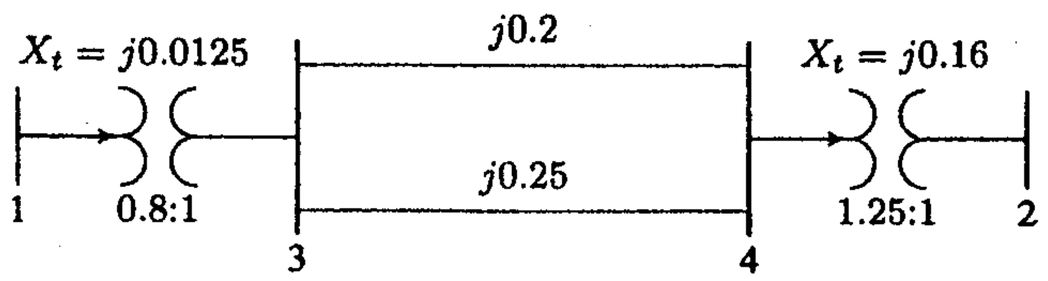

Figure 1

5. A three-phase unbalanced source with the following phase-to-neutral voltages

$$\mathbf{V}^{abc} = \begin{bmatrix} 300\angle -120^\circ \\ 200\angle 90^\circ \\ 100\angle -30^\circ \end{bmatrix}$$

is applied to the circuit in Figure 2. The load series impedance per phase is Z_s = 10 + j40 and the mutual impedance between phases is Z_m = j5. The load and source neutrals are solidly grounded. Determine
   (a) The load sequence impedance matrix. **(4%)**
   (b) The symmetrical components of voltage. **(4%)**
   (c) The symmetrical components of current. **(4%)**
   (d) The load phase currents. **(4%)**
   (e) The complex power delivered to the load. **(4%)**

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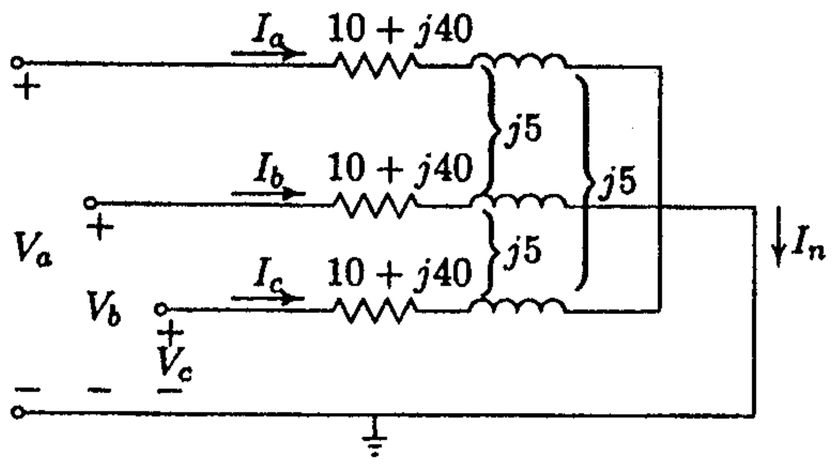

Figure 2

6. A 60-Hz synchronous generator has a transient reactance of 0.2 per unit and an inertia constant of 5.66 MJ/MVA The generator is connected to an infinite bus through a transformer and a double circuit transmission line, as shown in Figure 3. Resistances are neglected and reactances are expressed on a common MVA base and are marked on the diagram. The generator is delivering a real power of 0.77 per unit to bus bar 1. Voltage magnitude at bus 1 is 1.1. The infinite bus voltage V=1.0∠0° per unit. Determine the generator excitation voltage and obtain the swing equation in terms of δ. **(20%)**

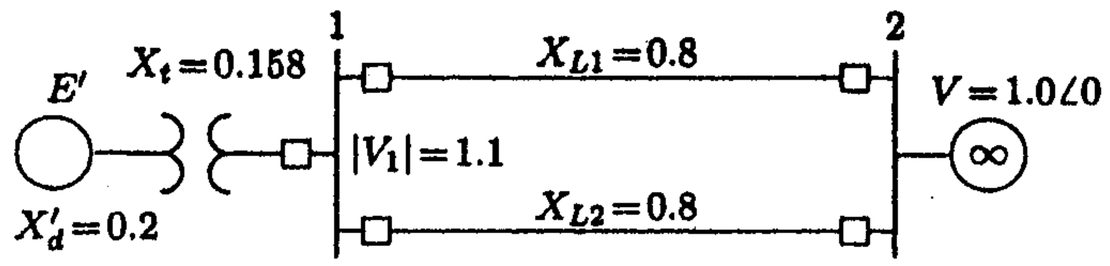

Figure 3