國立臺灣科技大學
九十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. The reactance data for the power system shown in Fig.1 in per unit on a common base is as follows. The superscripts 1, 2, 0 represent positive, negative, and zero-sequence quantities, respectively. Neglect prefault currents and assume that the prefault bus voltages are equal to 1.0 per unit.

Item	X^1	X^2	X^0
G_1	0.10	0.10	0.05
G_2	0.10	0.10	0.05
T_1	0.25	0.25	0.25
T_2	0.25	0.25	0.25
Line 1-2	0.30	0.30	0.50

Fig.1 Circuit for Problem 1.

(a) Draw the zero-, positive-, and negative-sequence impedance networks. 4%

(b) Compute the fault current in per unit for a bolted three-phase fault at bus 1. 4%

(c) Compute the fault current in per unit for a bolted single line-to-ground fault at bus 1. 4%

(d) Compute the fault current in per unit for a bolted line-to-line fault at bus 1. 4%

(e) Compute the fault current in per unit for a bolted double line-to-ground fault at bus 1. 4%

2. In the power system network shown in Fig.2, bus 1 is a slack bus with $V_1 = 1.0\angle 0^\circ$ per unit and bus 2 is a load bus with $S_2 = 280\ \text{MW} + j60\ \text{Mvar}$. The line impedance on a base of 100 MVA is $Z = 0.02 + j0.04$ per unit.

(a) Using Gauss-Seidel method, determine V_2. Using an initial estimate of $V_2^{(0)} = 1.0 + j0.0$ and perform two iterations. 10%

(b) If after several iterations voltage at bus 2 converges to $V_2 = 0.90 - j0.10$, determine S_1 and the real and reactive power loss in the line. 10%

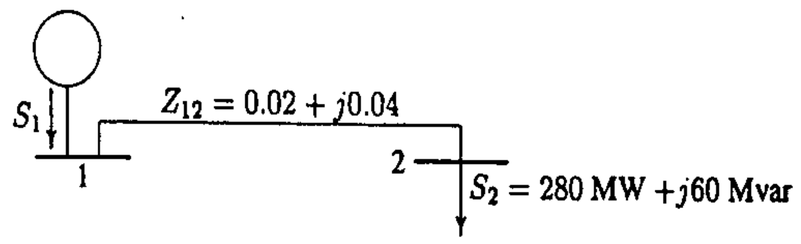

Fig.2 One-line diagram for Problem 2.

3. A three-phase, 60-Hz transposed transmission line has a flat horizontal configuration as shown in Fig.3. The line reactance is $0.486\,\Omega$/km. The conductor geometric mean radius is 2.0 cm. Determine the phase spacing D in meters. 10%

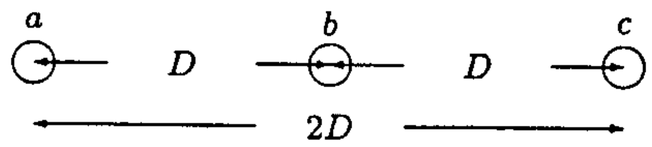

Fig.3 Conductor layout for Problem 3.

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4. A two-winding excited magnetic system has the inductances in henrys as follows: winding 1 self-inductance $L_{11}= (3 + \cos 2\theta) \times 10^{-3}$, winding 2 self-inductance $L_{22}= 30 + 10 \times \cos 2\theta$, and mutual inductance $L_{12}= 0.1\times \cos \theta$. The symbol θ represents the angle between the winding magnetic axes. If the current of winding 1 is of 2 A and the current of winding 2 is of 0.02 A, determine the developed torque $T(\theta)$? 10%

5. The rating of a dc shunt motor is 25 hp, 240 V, 860 rpm and with an efficiency of 89%. The motor has an armature resistance of 0.08 Ω. A four-step starter is utilized to limit the starting current of the motor to 150% of its rated current. Assume that all four steps of the starter have equal resistance values. During startup, the step resistor of starter is cut out when the current reduces to the rated value. If the field current is constant and negligible compared with rated armature current, determine
   (a) the step resistance value of the starter? 5%
   (b) at which speed in rpm the last step of starter resistor must be cut out? 5%

6. A 500 kVA, 60 Hz, 2300 V, Y-connected synchronous generator is tested with the obtained data as follows:
   DC resistance test: applied terminal dc voltage V_{dc}=8 V, I_{dc}=10 A
   Open-circuit test: field current I_f=25 A, terminal line-voltage V_{oc}=1408 V
   Short-circuit test: field current I_f=25 A, armature current I_{sc}=126 A
   Assume that the correction factor for the dc resistance to arrive at the effective ac resistance is of 1.25. Determine the voltage regulation at a full-load with 0.866 power factor lagging? 15%

7. A 3-phase, Y-connected induction motor has a nominal rating of 100 hp, a synchronous speed of 1800-rpm, a wind-age and friction losses of 1.2 kW, a stator iron losses of 2 kW and a stator resistance of 0.17 Ω per phase. The motor is connected to a voltage source with line voltage of 600 V. The total consumption power measured is of 70 kW. The line current is of 78 A, and the motor speed is of 1763 rpm. Determine
   (a) losses caused by rotor current? 5%
   (b) the efficiency? 5%
   (c) the internal torque developed at 1763 rpm? 5%

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