國立台灣科技大學九十六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100分

1. A wye-connected load is supplied from three-phase 220V mains. Each branch of the load is a resistor of 20 Ω. Using 220 V and 10 kVA bases calculate the per unit values of the current and power taken by the load. (10%)

2. Figure 1 shows the one-line diagram of a simple three-bus power system with generation at bus 1. The magnitude of voltage at bus 1 is adjusted to 1.05 per unit. The scheduled loads at buses 2 and 3 are as marked on the diagram. Line impedances are marked in per unit on a 100-MVA base and the line charging susceptances are neglected. Bus 1 is taken as the reference bus (slack bus). A solution is converged with an accuracy of 5×10^{-5} per unit in seven iterations as given below: (20%)

$$V_2 = 0.9800 - j0.0600 = 0.98183\angle -3.5035^\circ \text{ pu}$$

$$V_3 = 1.0000 - j0.0500 = 1.00125\angle -2.8624^\circ \text{ pu}$$

(a) Obtain the bus admittance matrix $\mathbf{Y}_{bus}$ for the system.
(b) Find the slack bus real and reactive power.
(c) Determine the line flow and line loss in the line connecting buses 1 and 2.

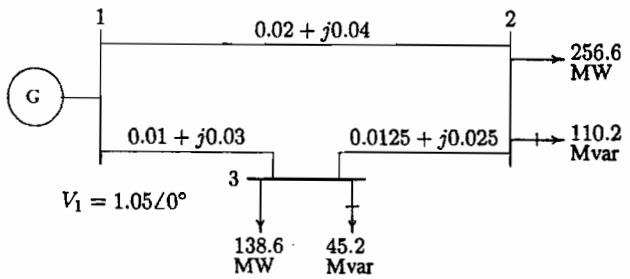

Figure 1 One-line diagram for Problem 2

國立台灣科技大學九十六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

3. The reactance data for the power system shown in Figure 2 in per unit on a common base is as follows: (20%)

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

where superscripts "(1)", "(2)" and "(0)" mean "positive-sequence", "negative-sequence" and "zero-sequence," respectively.

Obtain the Thévenin sequence impedances for the fault at bus 1 and compute the fault current in per unit for the following faults:

(a) A bolted three-phase fault at bus 1.

(b) A bolted single-line-to-ground at bus 1.

(c) A bolted line-to-line fault at bus 1.

(d) A bolted double-line-to-ground at bus 1.

Figure 2 One-line diagram for Problem 3

國立台灣科技大學九十六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

4 A three-phase transposed line is composed of one ACSR, 1,431,000-cmil, 47/7 Bobolink conductor per phase with flat horizontal spacing of 11 m as shown in Figure 3(a). The conductors have a diameter of 3.625 cm and a GMR of 1.439 cm. The line is to be replaced by a three-conductor bundle of ACSR, 477,000-cmil, 26/7 Hawk conductors having the same cross-sectional area of aluminum as the single-conductor line. The conductors have a diameter of 2.1793 cm and a GMR of 0.8839 cm. The new line will also have a flat horizontal configuration, but it is to be operated at a higher voltage and therefore the phase spacing is increased to 14 m as measured from the center of the bundles as shown in Figure 3(b). The spacing between the conductors in the bundle is 45 cm. Determine (20%)

(a) The percentage change in the inductance.

(b) The percentage change in the capacitance.

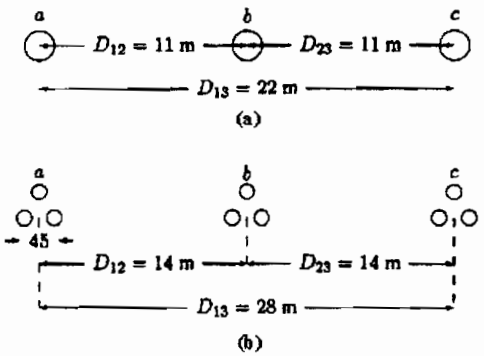

Figure 3. For problem 4

5 A 300 km long, three-phase 500 kV, 60 Hz transposed line. The line inductance is 0.97 mH/km per phase and its capacitance is 0.0115 μF/km per phase. Assume a lossless line. Determine he transmission line (10%)

(a) Surge impedance Z_C

(b) Phase constant β

(c) Line wavelength λ

(d) Velocity of propagation v

(e) Surge impedance loading *SIL*

國立台灣科技大學九十六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

6 The three-phase power and line-line ratings of the electric power system shown in Figure 4 are given below.

G1:	60 MVA	20 kV	X=9%
M:	43.2 MVA	18 kV	X=8%
T1:	50 MVA	20/200 kV	X=10%
T2:	50 MVA	200/20 kV	X=10%
Line:		200 kV	Z=120 + j200 Ω

(20%)

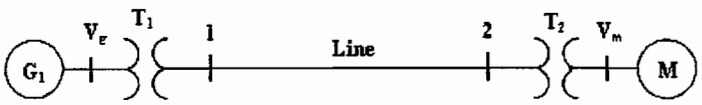

Figure 4. For problem 6

(a) Draw an impedance diagram showing all impedances in per-unit on a 100-MVA base. Choose 20 kV as the voltage base for generator.

(b) The motor is drawing 45 MVA, 0.8 power factor lagging at a line-to-line terminal voltage of 18 kV. Determine the terminal voltage and the internal emf of the generator in per-unit and in kV.