國立臺灣科技大學101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）每題之子題平均配分

1. Please briefly answer the following questions. (18%)

(a) Compared a two-winding transformer with a same rating autotransformer, based on electrical point of view what are the major benefits by using an autotransformer than a two-winding transformer ?

(b) Please simply plot the V-I characteristics in Figure P1b(a) to explain the model of an induction motor in running state and starting state as shown in Figure P1b(b).

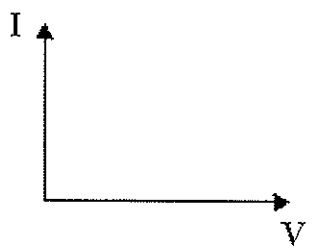

Figure P1b(a)

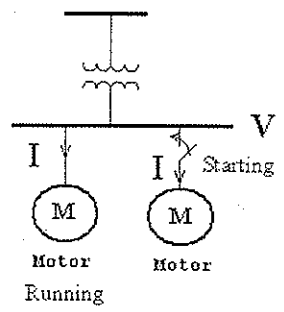

Figure P1b(b)

(c) Figure P1c(a) shows a Y-connected generator supplying balanced Y-connected loads through a 3Φ line. A 1Φ circuit is presented for per-phase analysis as Fig. P1c(b). Please explain why the neutral wire impedance in Figure P1c(a) do not be considered in Figure P1c(b).

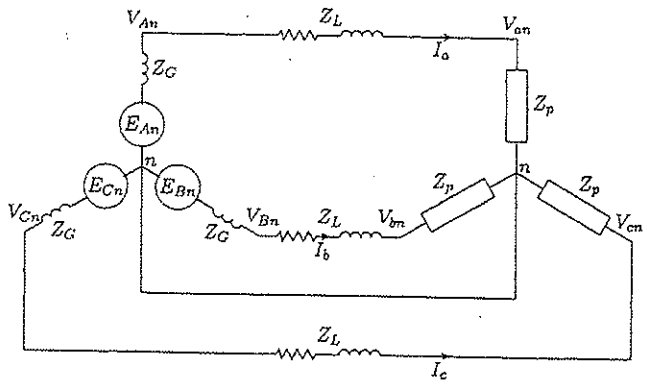

Figure P1c(a)

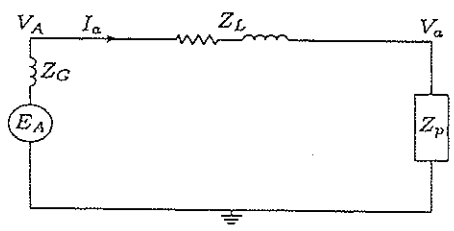

Figure P1c(b)

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2. The three-phase power and line-line ratings of the electric power system shown in Figure P2 are given below. (20%)

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	190/20 kV	X=10%
Line:		200 kV	Z=120 + j200 Ω

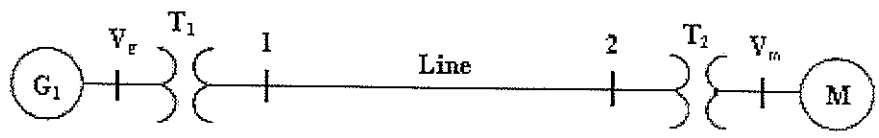

Figure P2

(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.

3. Suppose that the bus admittance matrix of the system in Figure P3 is $[Y]$ as shown, where bus 1 is slack bus, bus 2 is P-V bus, and bus 3 to bus 5 are P-Q bus. (12%)

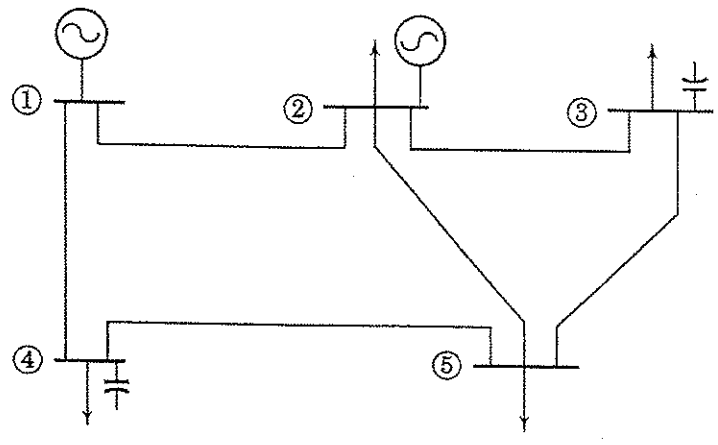

Figure P3

$$[Y]=\begin{bmatrix} 5-j25 & -2.5+j15 & 0 & -2.5+j10 & 0 \\ -2.5+j10 & 7.5-j60 & 1+j25 & 0 & -5+j20 \\ 0 & 1+j25 & 4-j41 & 0 & -4+j16 \\ -2.5+j10 & 0 & 0 & 6.5-j28 & -4+j18 \\ 0 & -5+j20 & -4+j16 & -4+j18 & 13-j54 \end{bmatrix}$$

To apply the decoupled power-flow method to the system,

(a) Find the corresponding bus susceptance matrix **[B']** for evaluation of $[\triangle\delta]$

(b) Find the corresponding bus susceptance matrix **[B"]** for evaluation of $[\triangle V]$

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4. Please briefly answer the following questions. (15%)
   (a) Explain the meaning of the optimal power flow.
   (b) Write different types of unbalanced faults.
   (c) Explain the meaning of the steady-state stability and the transient stability.

5. The one-line diagram of a simple power system is shown in Figure P5. The neutral of each generator is grounded through a current-limiting reactor of 0.25/3 per unit on a 100-MVA base. The system data expressed in per unit on a common 100-MVA base is tabulated below. The generators are running on no-load at their rated voltage and rated frequency with their emfs in phase. Determine the fault current for the following faults. (20%)
   (a) A balanced three-phase fault at bus 3 through a fault impedance $Z_f = j0.1$ per unit.
   (b) A single line-to-ground fault at bus 3 through a fault impedance $Z_f = j0.1$ per unit.

Item	Base MVA	Voltage Rating	X^1	X^2	X^0
G_1	100	20 kV	0.2	0.2	0.05
G_2	100	20 kV	0.2	0.2	0.05
T_1	100	20/220 kV	0.1	0.1	0.10
T_2	100	20/220 kV	0.1	0.1	0.10
L_{12}	100	20 kV	0.3	0.3	0.39
L_{13}	100	20 kV	0.3	0.3	0.39
L_{23}	100	20 kV	0.3	0.3	0.39

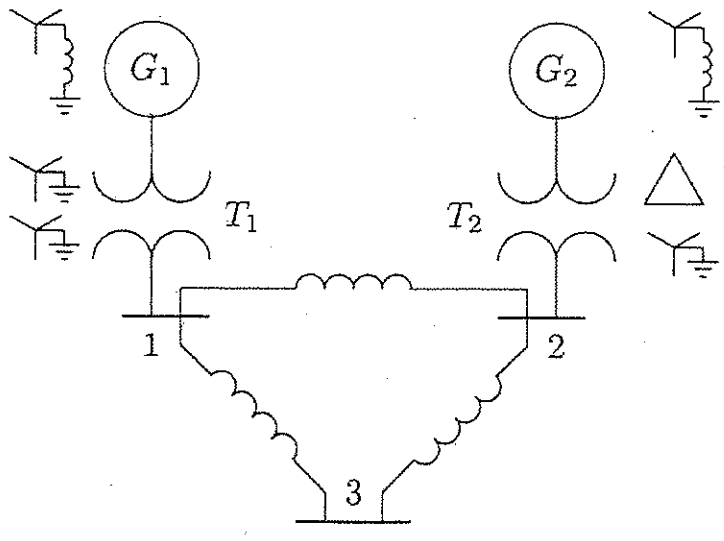

Figure P5

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6. A 60-Hz synchronous generator has a transient reactance of 0.2 per unit and an inertia constant of 6 MJ/MVA. The generator is connected to an infinite bus through a transformer and a double circuit transmission line, as shown in Figure P6. 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 0.8 per unit to bus bar 1. Voltage magnitude at bus 1 is 1.1 per unit. The infinite bus voltage $V = 1.0\angle 0^\circ$ per unit. Determine the generator excitation voltage and obtain the swing equation. (15%)

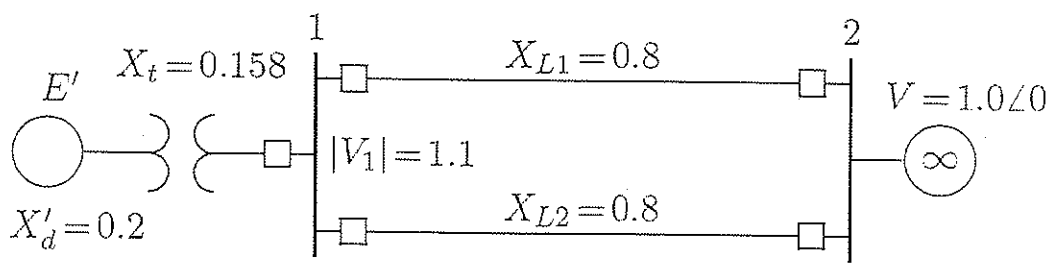

Figure P6