國立台灣科技大學九十五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. Define the following: **(10%)**
   (a) IEC
   (b) Plant factor of a power plant
   (c) Surge impedance loading (SIL)
   (d) Slack bus
   (e) Transformer voltage regulation

2. The line-to-line voltages in an unbalanced three-phase supply are

   $V_{ab} = 600\angle 36.87°$ V, $V_{bc} = 800\angle 126.87°$ V, and $V_{ca} = 1000\angle -90°$ V. A

   grounded Y-connected load with a resistance of 37Ω per phase is connected to the supply. Determine **(20%)**
   (a) The symmetrical components of voltage
   (b) The phase voltages
   (c) The line currents

3. Two synchronous motors having subtransient reactances of 0.80 and 0.25 per unit, respectively, on a base of 480 V, 2000kVA are connected to a bus. This bus is connected by a line having a reactance of 0.023Ω to a bus of a power system, as shown in Figure 1. At the power-system bus the short-circuit megavoltamperes of the power system are 9.6 MVA for a nominal voltage of 480 V. When the voltage at the motor bus is 440 V, neglect load current and find the initial symmetrical rms current in kA for a bolted three-phase fault at the motor bus. **(20%)**

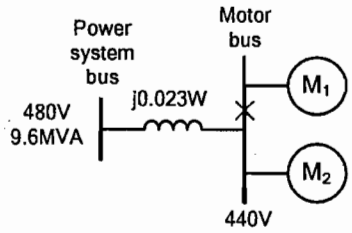

Figure 1　One-line diagram for Problem 3

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4. Please briefly explain the major purpose of the following analysis in power systems. **(10%)**
   (a) Power flow analysis
   (b) Short-circuit analysis
   (c) Economic dispatch analysis
   (d) Steady-state stability analysis
   (e) Transient stability analysis

5. The *ABCD* constants of a lossless three-phase, 500kV transmission line are $A = D = 0.86 + j0$ $B = 0 + j130.2$ $C = j0.02$ The line delivers 1000MVA at 0.8 lagging power factor at 500kV. To improve the line performance, series capacitors are installed at both ends in each phase of the transmission line. As a result of this, the compensated *ABCD* constants become **(20%)**

$$\begin{bmatrix} A' & B' \\ C' & D' \end{bmatrix} = \begin{bmatrix} 1 & -\frac{1}{2}jX_C \\ 0 & 1 \end{bmatrix} \begin{bmatrix} A & B \\ C & D \end{bmatrix} \begin{bmatrix} 1 & -\frac{1}{2}jX_C \\ 0 & 1 \end{bmatrix}$$

   where X_C is the total reactance of the series capacitor. If $X_C = 100\,\Omega$
   (a) Determine the compensated *ABCD* constants.
   (b) Determine the sending end quantities and the voltage regulation.

6. Figure 2 shows the one-line diagram of a simple three-bus power system with generation at buses 1 and 3. The voltage at bus 1 is $V_1 = 1.025\angle 0°$ pu. Voltage magnitude at bus 3 is fixed at 1.03pu with a real power generation of 300MW. A load consisting of 400MW and 200Mvar is taken from bus 2. Line impedances are marked in pu on a 100MVA base. For the purpose of hand calculations, line resistances and line charging susceptances are neglected. **(20%)**

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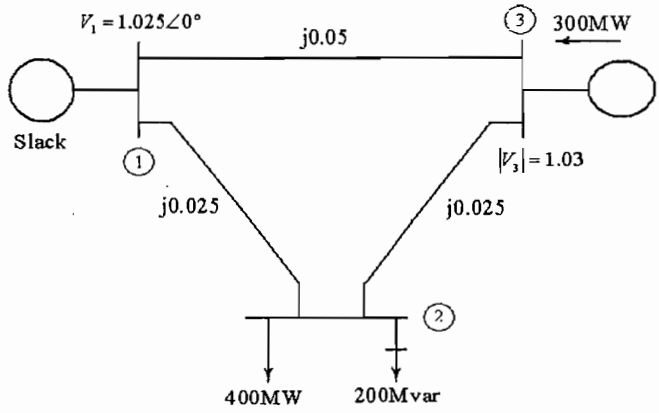

Figure 2 One-line diagram for Problem 6

(a) Determine the bus admittance matrix [Y_{bus}] in rectangular form?

(b) For the each bus *i=1, 2, 3* determine which variables V_i, P_i, Q_i, and δ_i are input data and which are unknowns(state variables) ?

(c) Using Gauss-Seidel method and initial estimates of $V_2^{(0)} = 1.0 + j0$ and $V_3^{(0)} = 1.03 + j0$ and keeping $|V_3| = 1.03$ pu, determine the phasor values of $V_2^{(1)}$ and $V_3^{(1)}$.