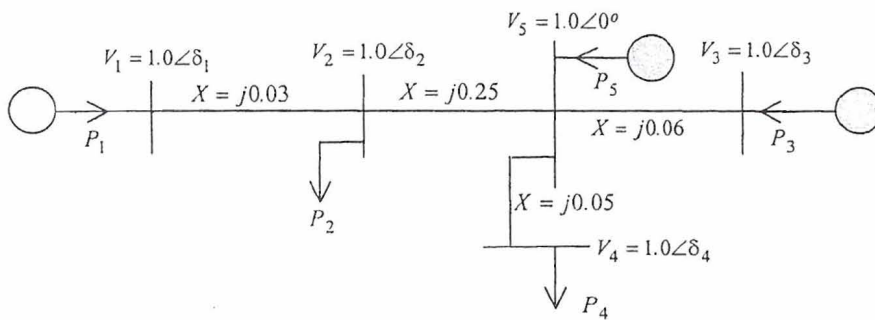


# 國立清華大學 命題紙

95 學年度 電機領域聯合招生 系(所) \_\_\_\_\_ 組碩士班入學考試

科目 電力系統 科目代碼 9905 共 3 頁第 1 頁 \*請在【答案卷卡】內作答

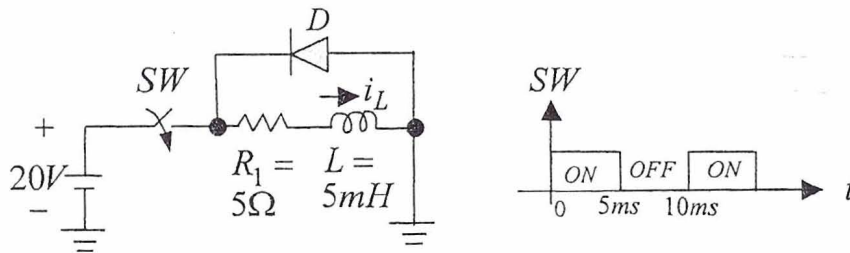
1. Given the following five-bus power system (with 100MVA base):
  - (a) Find the power flow equations.
  - (b) Calculate  $P_5$ .
  - (c) Calculate the power flow from bus 2 to bus 5 if  $\delta_2$  is known. (20%)



$$P_1 = 100MW, P_2 = 120MW, P_3 = 150MW, P_4 = 200MW$$

2. (a) Explain the operating limits on synchronous generators of large scale power systems.
- (b) A lossless synchronous generator with internal EMF  $E\angle\delta$  and  $X_d = 1.1pu$  is connected to an infinite bus with  $V = 1.0\angle 0^\circ$ . The following operating limits are to be observed:  $E_{max} = 1.8pu, P_{min} = 0.1pu, S_{max} = 1.0pu, \delta_{max} = 58^\circ$ . Plot the constraint curves of the generator on the  $PQ$  plane. (10%)

3. (1) The switch  $SW$  is turned on and off periodically as shown, find the expressions of inductor current  $i_L$  during  $ON$  and  $OFF$  periods.
- (2) Draw the current paths during  $ON$  and  $OFF$  periods.
- (3) Describe the purpose of diode  $D$ .
- (4) If the forward voltage of diode is  $1.0V$ , give the voltage across the switch when the switch is  $OFF$ . (15%)

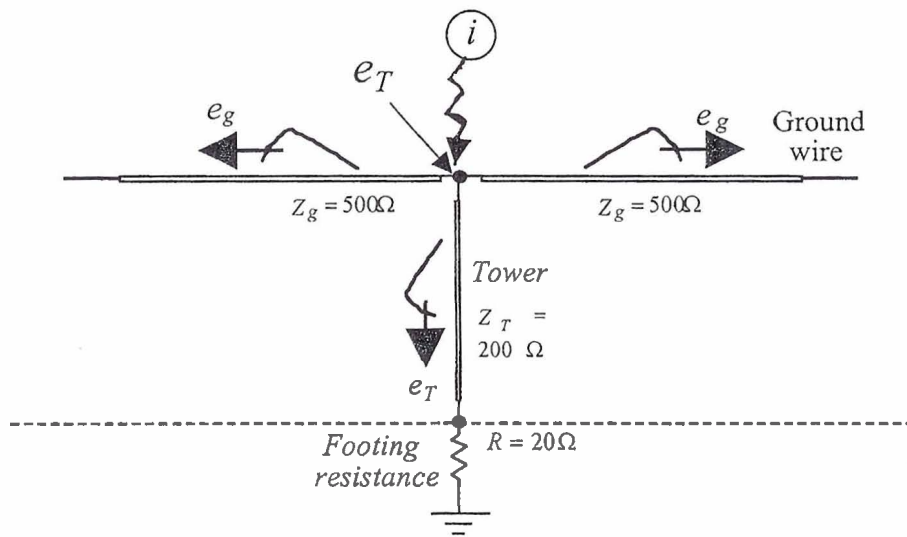


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4. (1) A transmission line is hit by the lightning current at its top, and the established voltage surge is traveled down toward the ground. If the surge resistance of the tower is  $Z_T = 200 \Omega$  and the ground footing resistance is  $R = 20 \Omega$ , find the reflective coefficient.
- (2) A single phase transmission line having line parameters per unit length  $R', L', C', G'$ , give its characteristic impedance and surge impedance, and also describe their difference. (10%)



5. The percentage differential relay and the overvoltage relay are to be applied to the protection of generator windings. (15%)
- (a) Sketch the developed three-phase or single-phase wiring diagram (which depicts the CT or PT connections) for both the percentage differential and the overvoltage relays.
- (b) Why is the overvoltage relay needed? Give the reason (You are requested to express in one sentence).
6. What are the underlying assumptions for applying the equal area method for transient stability analysis? Answer by giving two sentences each for stating on assumption. (5%)

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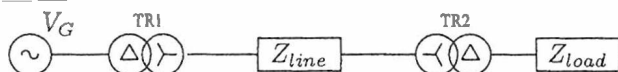
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科目 電力系統 科目代碼 9905 共 3 頁第 3 頁 \*請在【答案卷卡】內作答

7. Consider a three-phase system of the given one-line diagram. The three phase transformer name plate ratings are as follows:

- (15%)
- Transformer TR1: 5 MVA, 13.2 $\Delta$  - 132Y kV, leakage inductance of 10%.
  - Transformer TR2: 10 MVA, 138Y - 69 $\Delta$  kV, leakage reactance of 8%.

The generator voltage  $V_G$  is 13.2 kV(line-to-line), the transmission line impedance  $Z_{line} = 10 + j100 \Omega$ , and the load impedance  $Z_{load} = 300 \Omega$ . Use the per-unit analysis technique, find the actual values of the generator current, the transmission line current, the load current, and the load voltage.



8. A single-phase converter is as given. The AC input voltage  $v_s = V \sin(\omega t)$ , and the thyristors  $T_1$  and  $T_2$  are triggered with a delay angle of  $\alpha$ . Assuming the load current  $I_0$  is constant.

- (10%)
- (a) Sketch the waveforms of output voltage  $v_o$  and input current  $i_s$ .
  - (b) Calculate the average value of  $v_o$ .
  - (c) Calculate the power factor of this converter.

