國立臺灣科技大學 107 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)

1. Three loads are connected in parallel across a 11.8 kV three-phase supply.
   - Load 1: Inductive load, 110 kW and 630 kVar.
   - Load 2: Capacitive load, 200 kW at 0.8 power factor.
   - Load 3: Resistive load of 50 kW.

   (a) Find the total complex power, power factor, and the supply current. **(6%)**

   (b) A Y-connected capacitor bank is connected in parallel with the loads. Find the total kVar and the capacitance per phase in μF to improve the overall power factor to 0.8 lagging. What is the new line current? **(9%)**

2. A three-phase, 60-Hz, untransposed transmission line runs in parallel with a telephone line for 20 km. The power line carries a balanced three-phase rms current of $I_a = 240\angle 0^\circ$ A, $I_b = 240\angle -120^\circ$ A and $I_c = 240\angle -240^\circ$ A. The line configuration is as shown in Figure 1 where the d and e are the pair of telephone line. Assume zero current flows in the ungrounded telephone wires. Find the magnitude of the voltage induced in the telephone line. **(10%)**

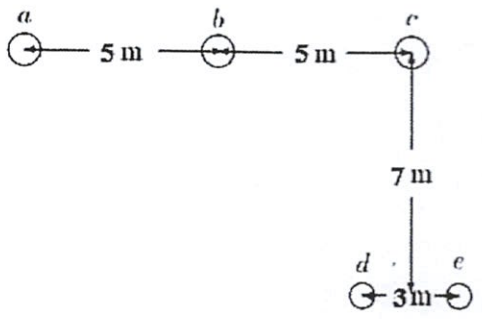

Figure 1

3. A 60-kVA, 4800/2400-V single-phase transformer gave the following test results:
   1. Rated voltage is applied to the low voltage winding and the high voltage winding is open-circuited. Under this condition, the current into the low voltage winding is 2.2A and the power taken from the 2400V source is 3500W.
   2. A reduced voltage of 1250V is applied to the high voltage winding and the low voltage winding is short-circuited. Under this condition, the current flowing into the high voltage winding is 12.5A and the power taken from the 1250V source is 4200W.

   (a)Determine parameters of the equivalent circuit referred to the high voltage side. **(12%)**

   (b)Determine voltage regulation and efficiency when transformer is operating at full-load, 0.8 power factor lagging, and a terminal voltage of 2400V. **(6%)**

   (c) What is the load kVA for maximum efficiency and the maximum efficiency at 0.8 power factor? **(4%)**

   (d) Determine the efficiency when transformer is operating at half load, 0.6 power factor lagging, and a terminal voltage of 2400V. **(3%)**

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4. The sending-end and receiving-end voltages of a transmission line at a 100 MW load are equal at 115 kV. The per-phase line impedance is 4+j7 Ω.
Calculate the maximum steady-state power that can be transmitted over the line. **(15%)**

5. An interconnected generator-reactor system is shown in Figure 2. The base values for the given percent reactances are the ratings of the individual pieces of equipment. A three-phase short-circuit occurs at point F. Determine the fault current if the busbar line-to-line voltage is 11 kV. **(15%)**

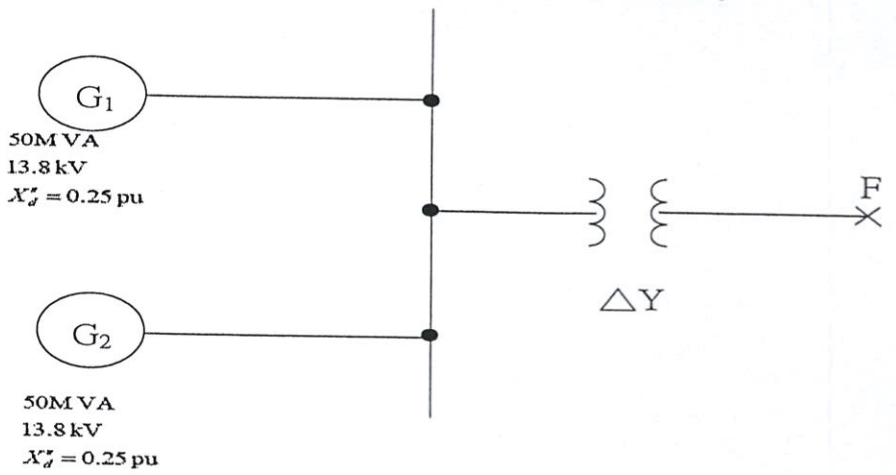

Figure 2

6. Consider a system without generator limits (see Figure 3). Assume that
The incremental cost for P_{G1}: $IC_1 = 0.006P_{G1} + 3.8$ \$/MWh
The incremental cost for P_{G2}: $IC_2 = 0.007P_{G2} + 4.1$ \$/MWh
The total line loss: $P_L = 0.001(P_{G2} - 50)^2$ MW
Find the optimal generation for each plant and the power loss in the transmission link. [Hint: If the initial value for P_{G1} is set to 200 MW, only a few iterations are required for convergence.] **(20%)**

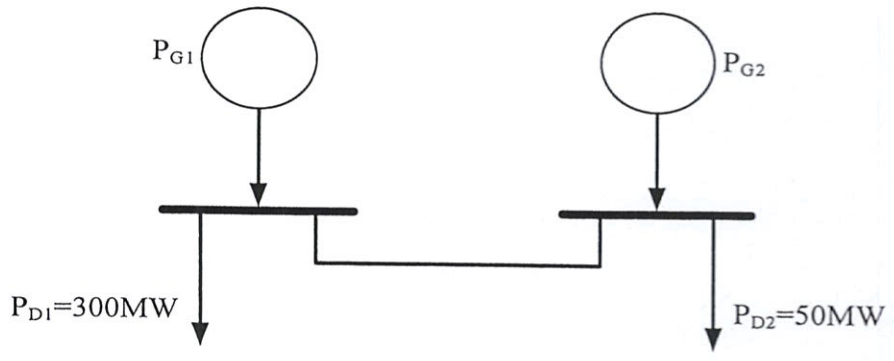

Figure 3