※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (15%) Three single-phase two-winding transformers, each rated 20kVA, 400/1000 V, with leakage reactance X_{eq}=0.1 per unit, are connected together to form a three-phase transformer. High voltage side is connected in Y and low voltage side is connected in Δ. Winding resistance and excitation current are neglected. A three-phase load connected at high voltage side absorbs 50kVA at 0.8 power factor lagging with phase voltage V_{AN} = 1000V∠0°. **Consider the phase shift** between Δ and Y, determine the followings:
   - A. phase a current I_a at low voltage side in per unit.
   - B. phase voltage V_{an} at the terminal of low voltage side in per unit.
   - C. magnitude of line-to-line voltage at low voltage side in real unit.

2. (15%) The zero-, positive-, negative-sequence bus impedance matrices for a three-bus three-phase power systems are shown as follows:

$$Z_{bus\,0} = j\begin{bmatrix} 0.1 & 0 & 0 \\ 0 & 0.2 & 0 \\ 0 & 0 & 0.1 \end{bmatrix} \text{ per unit}$$

$$Z_{bus\,1} = Z_{bus\,2} = j\begin{bmatrix} 0.12 & 0.08 & 0.04 \\ 0.08 & 0.12 & 0.06 \\ 0.04 & 0.06 & 0.08 \end{bmatrix} \text{ per unit}$$

   Assume the **prefault voltage is 1 per unit**, prefault current is neglected.
   Determine the followings:
   - A. per unit fault current at bus 2 if a three-phase bolted ground fault takes place at bus 2.
   - B. per unit sequence fault current at bus 2 if a single line-to-ground fault takes place from a phase to ground at bus 2.
   - C. Continue on section B, calculate per unit sequence voltage at bus 1.

3. (10%) A power system has two fossil-fueled units with the following operating cost functions.
   $C_1 = 10P_1+8\times10^{-3}P_1^2$, $C_2 = 8P_2+10\times10^{-3}P_2^2$ in \$/MWh
   where P_1 and P_2 are in megawatts. Each generating unit has the following output constraints
   $100\le P_1 \le 600$MW, $400\le P_2 \le 1000$MW.
   These two units are to support total load of 1300MW **on economic dispatch**.
   Determine the followings:
   - A. power output of each unit.
   - B. total operating cost.

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

4. Plot the topology of the ideal CCM DC-DC Buck-Boost converter (4%) and use the volt-second balance equation to derive its voltage conversion ratio (6%).

5. Plot the topology of the ideal CCM DC-DC SEPIC converter (4%) and use the volt-second balance equation to derive its voltage conversion ratio (6%).

6. Plot the topology of the ideal CCM DC-DC Cúk converter (4%) and use the volt-second balance equation to drive it voltage conversion ratio (6%).

7. Plot the topology of the ideal CCM DC-DC forward converter (4%) and use the volt-second balance equation to derive it voltage conversion ratio (6%).

8. Plot the equivalent circuit of the non-ideal transformer, containing one ideal transformer, two leakage inductors, one magnetizing inductor, one primary-to-secondary parasitic capacitor, and two equivalent series resistors. Then, derive its voltage conversion ratio from the primary side to the secondary side at no-load condition (10%).

9. Plot the topology of the ideal voltage step-down autotransformer (4%) and derive its voltage conversion ratio (6%).