1. (24) A Wye-connected load, with a-b-c phase sequence, has a line-to-neutral voltage magnitude of 120 volts. Assume the a-phase line-to-neutral voltage is reference. Identify the following phasors (magnitude and angle).

\[ V_{an} = 120 \angle 0^\circ \]

\[ V_{bn} = 120 \angle -120^\circ \]

\[ V_{cn} = 120 \angle -240^\circ \]

\[ V_{ab} = (\sqrt{3})(120) \angle 30^\circ \]

\[ V_{bc} = (\sqrt{3})(120) \angle -90^\circ \]

\[ V_{ca} = (\sqrt{3})(120) \angle -210^\circ \]

2. (24) A Delta-connected load, with a-b-c phase sequence, has a line current magnitude of 10 amperes. Assume the a-phase line current is reference. Identify the following phasors (magnitude and angle).

\[ I_a = 10 \angle 0^\circ \]

\[ I_b = 10 \angle -120^\circ \]

\[ I_c = 10 \angle -240^\circ \]

\[ I_{ab} = (10/\sqrt{3}) \angle 30^\circ \]

\[ I_{bc} = (10/\sqrt{3}) \angle -90^\circ \]

\[ I_{ca} = (10/\sqrt{3}) \angle -210^\circ \]

3. (28) A 3-phase line has an impedance of 0.4+j2.7 ohms/phase. The line feeds 2 balanced 3-phase loads that are connected in parallel. The first load is absorbing 560.1 kVA at 0.707 power factor lagging. The second load absorbs 132 kW at unity power factor. The line-to-neutral voltage at the load end of the line is 2200 volts. Determine the total real and reactive power loss in the line.

**Solution:**

The total complex power is

\[ S_{R(3p)} = 560.1(0.707 + j0.707) + 132 = 528 + j396 = 660 \angle 36.87^\circ \text{ kVA} \]

With the phase voltage \( V_2 \) as reference, i.e., \( V_2 = 2200/0^\circ \), the current in the line is

\[ I = \frac{S_{R(3p)}}{3V_2^*} = \frac{660,000 \angle -36.87^\circ}{3(2200 \angle 0^\circ)} = 100 \angle -36.87^\circ \text{ A} \]

The three-phase power loss in the line is

\[ S_{L(3p)} = 3R|I|^2 + j3X|I|^2 = 3(0.4)(100)^2 + j3(2.7)(100)^2 = 12 \text{ kW} + j81 \text{ kvar} \]

4. (24) Consider the two magnetic circuits illustrated below; the cores of each are ferromagnetic and are identically constructed. Both circuits have \( N_1 \) primary coils and \( N_2 \) secondary coils. For each question below, assume that identical voltage sources are applied to the primary terminals \( v_1 \).

i. Which magnetic circuit has the largest reluctance as seen by an applied magnetomotive force at the primary side? **Solution:** (b)

ii. Assume \( v_1 \) is a DC voltage. Is flux flowing in (a) larger, smaller, or equal to the flux flowing in (b)? **Solution:** Larger.

iii. Assume \( v_1 \) is an AC voltage. Which magnetic circuit sees an induced voltage \( v_2 \): (a), (b), both, or neither? **Solution:** both.