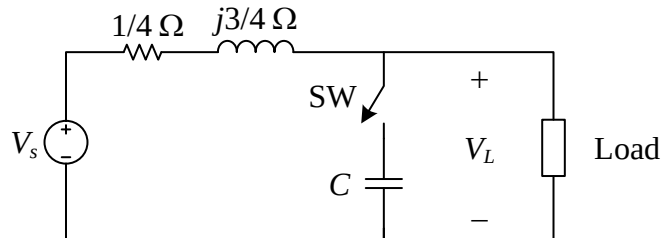


HOMEWORK V

Question 1) Consider the circuit below.



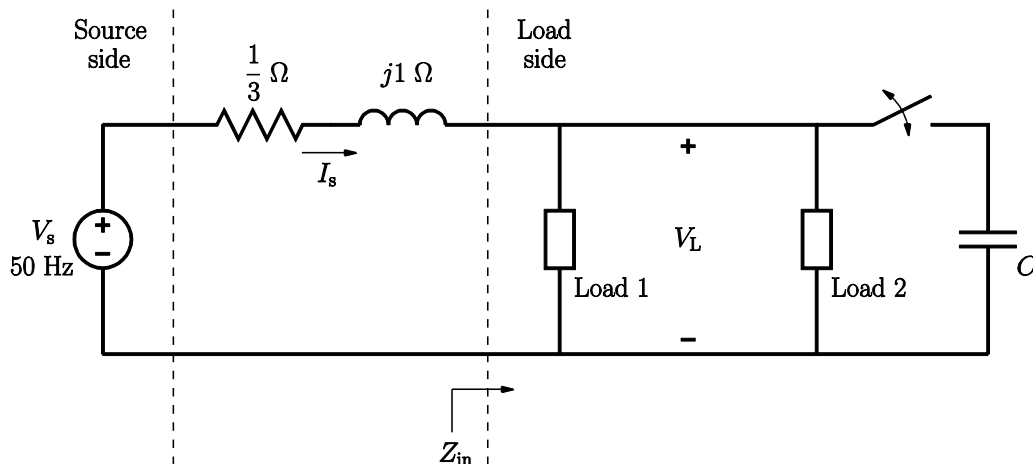
Load: $6\sqrt{5}$ VA at $1/\sqrt{5}$ pf lagging.

- a) The switch SW is open:
The reactive power supplied by the source is 24 VAR.
Find the real power supplied by the source, $V_{s,\text{eff}}$, and $V_{L,\text{eff}}$.
- b) The switch SW is closed. $V_{L,\text{eff}}$ is as in the above part:
The real power supplied by the source decreases by 30 %.
Find the susceptance of the capacitor and $V_{s,\text{eff}}$.

Answer a) $P_s = 10$ W, $V_{s,\text{eff}} = 6.5$ V, $V_{L,\text{eff}} = 1.5\sqrt{5}$ V.

b) $B_C = 4/5$ mho, $V_{s,\text{eff}} = \sqrt{85}/2$ V or $B_C = 4/3$ mho, $V_{s,\text{eff}} = 3.5$ V.

Question 2) Consider the circuit below.



Load 1: Real power 1600 W; power factor 0.8 lagging.

Load 2: Reactive power 600 VAR; inductive.

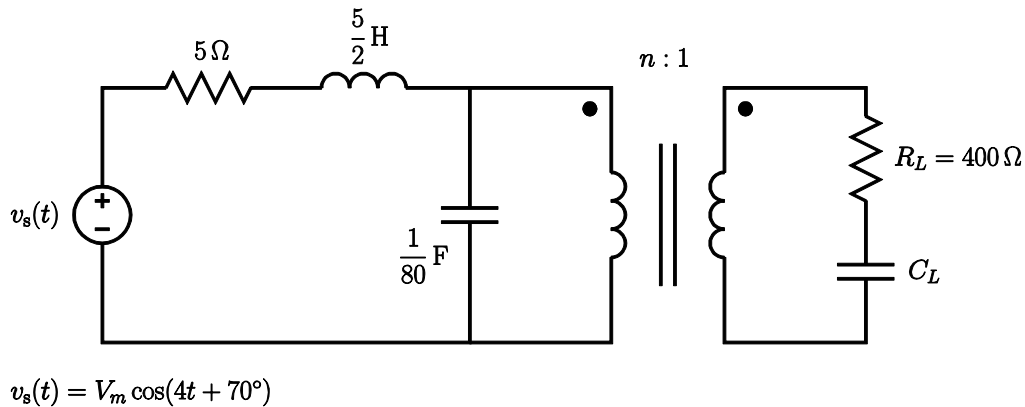
- a) Let the switch be open, $I_s = 30$ A(rms), and the efficiency be $\eta = 800/9$ %.
Find,
- The total complex power delivered to the load.
 - The effective value of the load voltage, $V_{L,\text{eff}}$.
 - The input impedance, Z_{in} .

- iv) The power factor at the load side.
 - v) The complex power supplied by the source.
- b) Let the switch be closed and the source voltage V_s be so adjusted that the effective value of the load voltage $V_{L,\text{eff}}$ is as in Part (a). Find,
- i) The capacitance C so that efficiency η is maximized. Also find η .
 - ii) The capacitance C so that the power factor at the load side becomes 12/13 lagging.

Answer a) (i) $2.4 + j1.8$ kVA, (ii) 100 V (rms), (iii) $(8/3) + j2 \Omega$, (iv) 0.8 lagging, (v) $2.7 + j2.7$ kVA.

b) (i) $C = 572.96 \mu\text{F}$, $\eta = 92.59 \%$, (ii) $254.65 \mu\text{F}$.

Question 3) The following circuit is in the sinusoidal steady state.



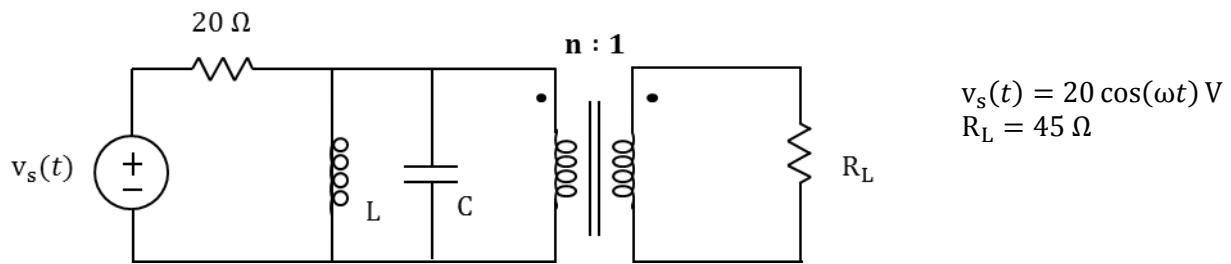
The turns ratio n and the capacitance C_L are so adjusted that the average power delivered to the load R_L is maximum and is equal to $P_L = 10$ W.

Find,

- a) The turns ratio,
- b) The capacitance C_L ,
- c) The magnitude of the source voltage, V_m ,
- d) The complex power delivered by the source.

Answer (i) 1/5, (ii) 1/1200 F, (iii) 20 V, (iv) 20 VA.

Question 4) Consider the circuit below.



The average power P delivered to R_L has the maximum possible value, $P_{\max}$, at $\omega = 10 \text{ rad/sec}$ and $P = P_{\max} / 2$ at $\omega = 8 \text{ rad/sec}$. (a half power frequency).

- a) Find $P_{\max}$. Determine the n , C , and L values.
- b) Find the other half power frequency.

Answer a) $P_{\max} = 2.5 \text{ W}$, $n = 2/3$, $C = 1/45 \text{ F}$, $L = 0.45 \text{ H}$. b) 12.5 rad/sec .