# EE1100, Basic Electrical Engineering – HW 3

1. A first order, low pass filter is given with R = 50 Ω and C = 5μF. What is the frequency at which the gain of the voltage transfer function of the filter is 0.25?

2. A series L-R low pass filter has R = 50 Ω and L = 1 mH. If a series R-C filter is to be constructed with same magnitude response, calculate the value of C given that R = 5 kΩ.

3. A series R-L-C circuit has R = 50 Ω, L = 100 μH and C = 1μF. Calculate the resonance frequency and Q-factor .

4. A load of (8+j6)Ω is connected to a 230V (rms), 50 Hz, 1-phase supply. What will be the kVAR rating of the capacitor bank required, if the input power factor is to be improved to 0.95 lagging?

5. For the network shown below [the source voltage is 100V (rms)], determine the active power dissipated and the reactive power between points (a) A and B, (b) C and D, (c) E and F
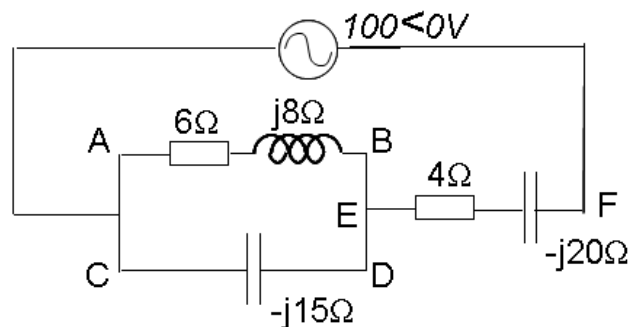
6. A current of i = 14.14 sin (ωt-π/4)A flows in a circuit which has an applied voltage v = 212 sin (ωt+π/12). Determine (a) circuit impedance, (b) active power, (c) reactive power, and (d) the apparent power. Draw the power triangle.

7. The circuit shown in figure below takes 100 VA at a power factor of 0.8 lagging. A current of 3 A (rms) flows through the circuit as shown. Determine the value of the impedance Z.
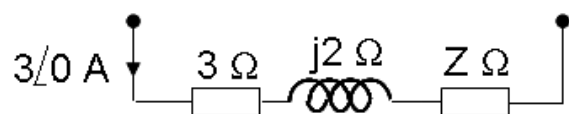
8. Given a parallel resonant circuit with L= 20 μH, ω_0= 500,000 and Q =100, what external resistor and capacitor should be connected in parallel to the get the lower values $\omega_{0(modified)}$ = 250,000 and $Q_{modified}$ = 40.

9. Find the average power dissipated in Fig. when C = 100 μF, R_1= 20 Ω , R_2 = 4 Ω, L = 4 mH and v = 10cos(2000 t) V. Then calculate the power dissipated in each resistor and confirm that $P_1 + P_2 = P$.
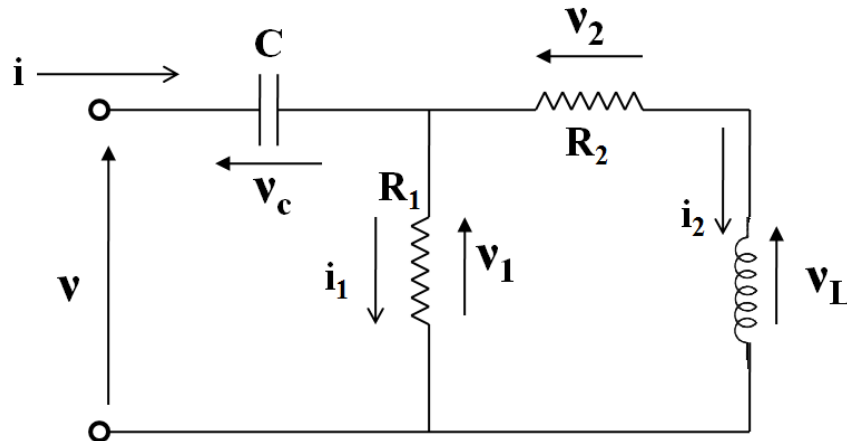
10. An AC motor having impedance Z_M = (3.6 + j 4.8) Ω is supplied from a 240 V (rms), 60 Hz source.

(a) Calculate $pf, |I|, P$ and Q.

(b) The power factor is corrected to unity by connecting a capacitor in parallel with the motor. Find C and the power P and current $|I|$ supplied by the source.

(c) The power factor is corrected to unity by connecting a capacitor in series with the motor. Find C and the power P and current $|I|$ supplied by the source. Also calculate the voltage $|V_M|$ across the motor.

11. An industrial furnace operates at 1300 V (rms) and requires 100 A (rms). The unit consists of a blower in parallel with a heater. The blower draws 50 kW and has a power factor of 0.707 lagging. Use a power triangle to find the resistance of the heater, assuming that it has unity power factor.

12. A star connected load consist of three identical coils, each of inductance (100/314) H and resistance 100Ω. If the supply frequency is 50 Hz and the line current is √2 A rms determine (a) the phase voltage and (b) the line voltage. Draw a vector diagram indicating (a) and (b).

13. The line-to-line input voltage to a 3-phase, 50 Hz, ac circuit shown in figure is 100V (rms). Assume that the phase sequence is RYB. What will be the reading of wattmeters W_1 and W_2?
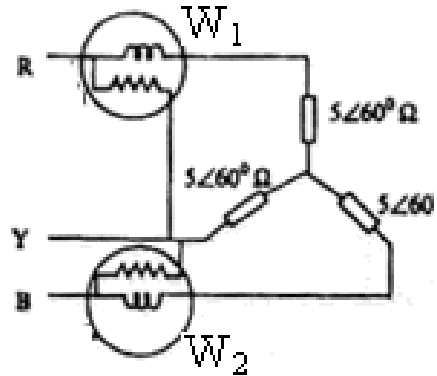
14. Two wattmeter method is employed to measure input power to a balanced 3-phase load. If the wattmeter readings are 9kW and 5kW determine (a) the total output power, and (b) the load power factor.

15. The input voltage, current and power to a motor (balanced 3-phase load) is measured as 415 V (rms), 10 A (rms) and 5.75 kW respectively. Determine the power factor of the system.

16. Two wattmeters connected to read the total power in a three phase system supplying a balanced load read 20 kW and -5 kW, respectively. Calculate the total active power and reactive power.

17. Three 400Ω resistances are connected in (i) star (Y) (ii) mesh (Δ) across a 400V (rms), 3 phase supply. Calculate the power taken from the mains in each case. If one of the three resistances is disconnected, what will be the power taken from the mains in each case?

18. The power input to a 400 V (rms), 50 Hz, 3 phase star-connected motor (balanced load) running on full-load is measured by two wattmeters which indicate 50 kW and 20 kW respectively. Calculate total input power, power factor and the line current. Draw a vector diagram indicating the phase voltages and line currents.

19. A balanced, star-connected load of $(10 + j3)$ Ω per phase is connected to a 400V (rms), 3 phase, 50 Hz supply. The phase sequence is RYB. Find the line current, power factor,

and active power, reactive power and the total Volt Ampere. Draw the phasor diagram of the system representing the phase voltages and currents.

20.

(a). The rated voltage in a 3-phase system is given as RMS line-to-line voltage. (True/False)

(b) Two wattmeter method can be used to find the power factor of an unbalanced star connected load. (True/False)

(c) The phase voltage of a 4-wire, 3- phase star-connected system is 230 V (rms). The line voltage is _____ V (rms).

(d) The phase current in a balanced 3- phase delta-connected system is 50 A rms. The line current is _____ A (rms).

(e) Two wattmeter method can be used for measuring reactive power in a 3-phase balanced load. (True/false)