Preliminary Work (Three-Phase AC Power) [40 marks]

Important Note:

1. **You are required to complete the preliminary exercise BEFORE the lab session.**
2. **The preliminary exercise must be handwritten on paper and submitted in physical hardcopy format; typed submissions will not be accepted.**

1. Define three types of power in AC supply and sketch the power triangle that shows the relationship between the three powers. **[5M]**

2. An electrical load is connected to an AC source as shown in **Figure 1**. Show the direction of real power, P and reactive power, Q flow (source to load or load to source); and sketch the power triangle if the electrical load is composed of:

   (a) A resistance
   (b) An inductance
   (c) A capacitance
   (d) A resistance and an inductance
   (e) A resistance and a capacitance
   (f) A single-phase motor.

   [6 M]

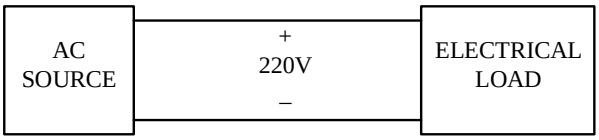

Figure 1

3. Consider the single-phase circuit in **Figure 2**.

   (i) Determine the current in each circuit. **[3M]**
   (ii) Calculate the real power, reactive power and apparent power in each circuit. **[3M]**
   (iii) Calculate the power factor of each circuit. **[2M]**
   (iv) Compare and discuss the calculated results of the two circuits. Why is the real power value different? **[6M]**

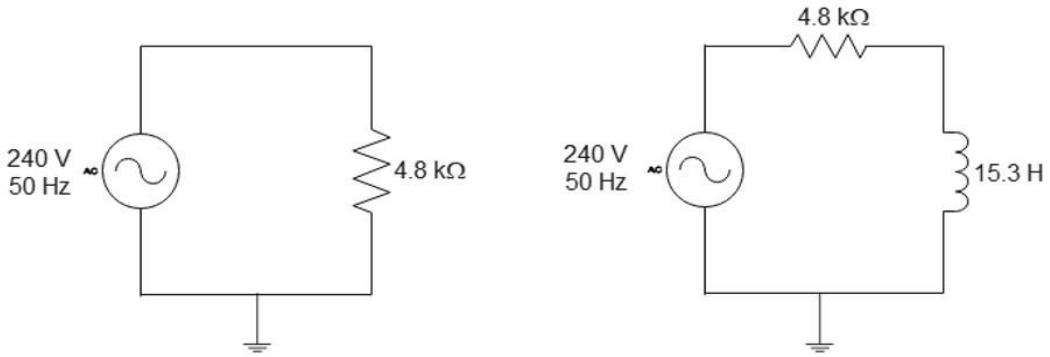

Figure 2

4. What is power factor correction? With the help of a power triangle, describe how power factor correction is done. **[3M]**

5. Why power factor correction is important in the power system? Explain the power factor surcharge. **[2 M]**

6. Draw the connection of the capacitor for power factor correction based on delta and star configurations in three-phase circuit. **[4 M]**

7. Experiment modules available in the laboratory are given in **Figure 4(a)** and are represented as block diagrams in Figure 4(b).
   Draw the connection required in **Figure 4(b)** in order to perform an experiment to measure three-phase AC power, phase voltage, and phase current for a three-phase circuit. For this case, consider the resistive load only. The load is Y (star)-connected with neutral. **[6 M]**

Figure 4(a)

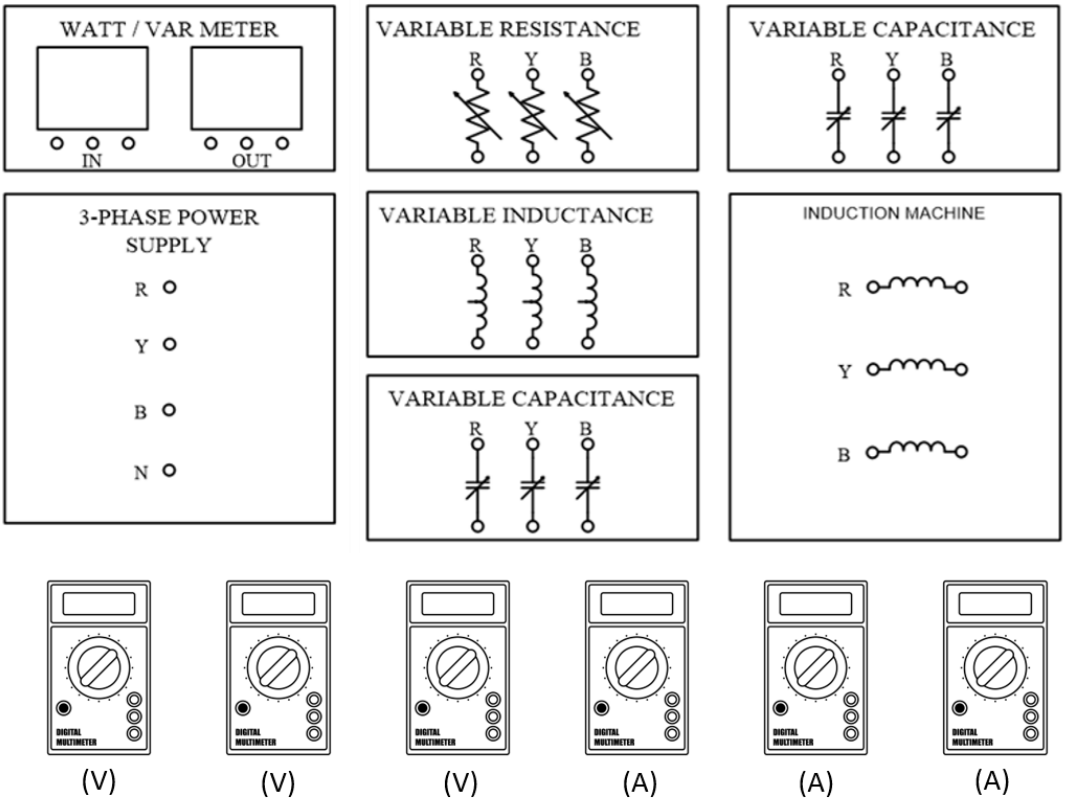

Figure 4(b)