THREE-PHASE POWER

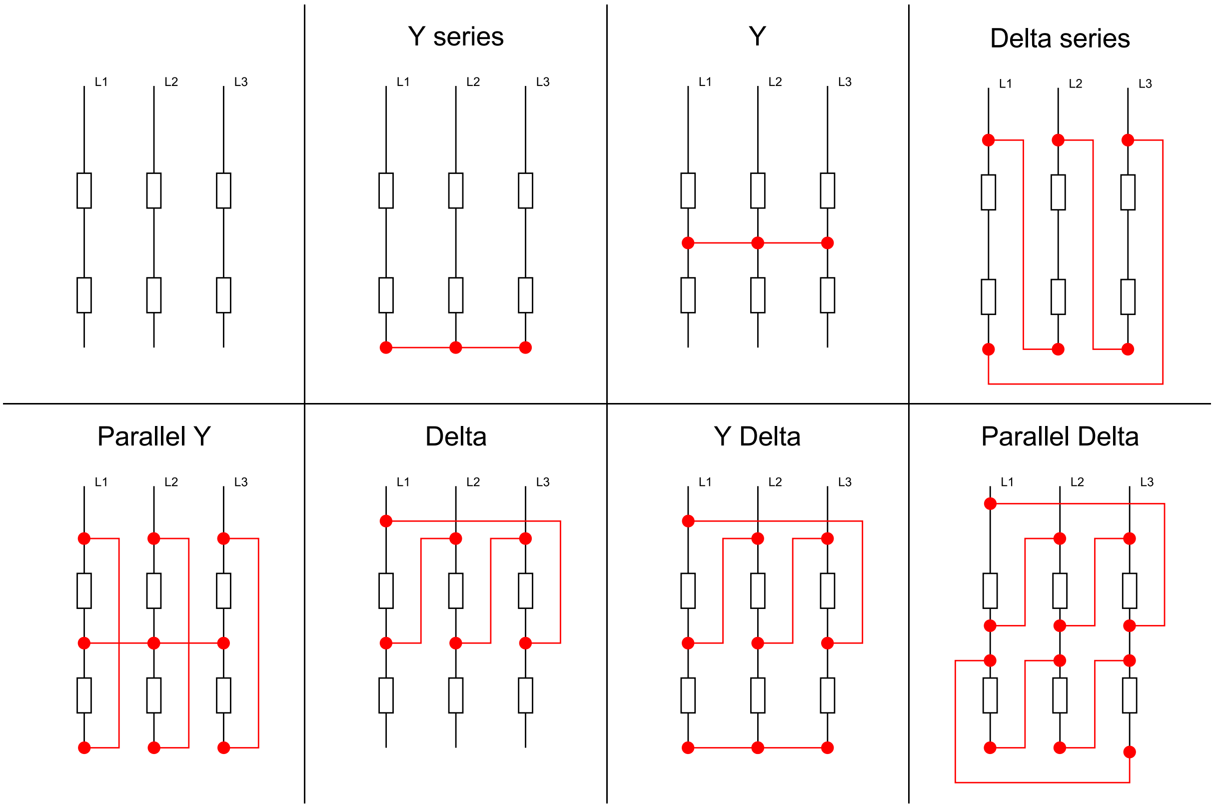
EXERCISE 1: THREE-PHASE POWER CALCULATIONS

On a three-phase 230/400V grid, two linear, three-phase and balanced receptors, A and B, are connected. Receptor A consists of three resistive elements delta-connected with a resistance of 69 Ω. Receptor B consists of three Y-coupled inductive elements with an impedance of 46 Ω and a power factor of 0.8.

1) **Draw** the diagram of the circuit.
2) **Calculate** I_A,the intensity of the line current of receptor A then I_B, that of receptor B.
3) **Calculate** I_T,the intensity of the line current of the overall circuit and its power factor.

EXERCISE 2: THREE-PHASE POWER MODULATION

An industrial furnace is equipped with two sets of three identical resistors. They can be connected in seven different configurations. These configurations allow the modulation of the power absorbed by the furnace.



U is the voltage between phases, V, the voltage between phase and neutral and R, the value of a resistor.

1) For each configuration, **express** P, the power absorbed by the furnace as a function of U and R, then I, the line current absorbed by the furnace, as a function of V and R.

Calculation: U = 400V and R = 40Ω.

2) For each of the seven configurations, **calculate** the power dissipated by the furnace and the intensity of the line current.

EXERCISE 3: REACTIVE ENERGY COMPENSATION

An manufacturer must install a high-power three-phase induction motor. This motor requires reactive energy compensation. The point is to calculate the appropriate capacitor bank.

The reactive energy is supplied by the electrical energy supplier:

- free of charge up to 40 % of the active energy consumed (tan φ = 0,4) during peak and peak winter hours, from November to March inclusive
- without limitation during off-peak winter hours, during all summer hours, from April to October inclusive.

The motor is marked **LS 315 SP 110kW,** (P_U = 110kW, cos φ = 0.85, φ = 94.8%) and will run on the **3x400V** three-phase grid.

1) **Calculate** the active power and current intensity that the motor absorbs on the power grid.
2) **Calculate** Q_M, the reactive power consumed by the engine.
3) **Calculate** Q_F, the reactive power delivered without penalty by the electrical energy supplier.
4) **Calculate** Q_C, the reactive power that the manufacturer must compensate.
5) Should the compensation be **global, partial** or **local?** On the diagram, **place** the capacitor bank in the right place.
6) **Calculate** the current intensity in the cable after compensation and the power gain at the transformer.