6. (a) With the aid of diagrams state Kirchhoff's Laws. **(3 marks)**

Refer to Figure 1:

(b) Using Kirchhoff's laws, determine each branch current I_1 and I_2 for the network shown in Figure 1. Calculate also the p.d. across the 6 Ω resistor.

Calculate the following:

i. the current I_1 **(6 marks)**

ii. the current I_2 and **(6 marks)**

iii. the p.d. across the 6 Ω resistor. **(5 marks)**

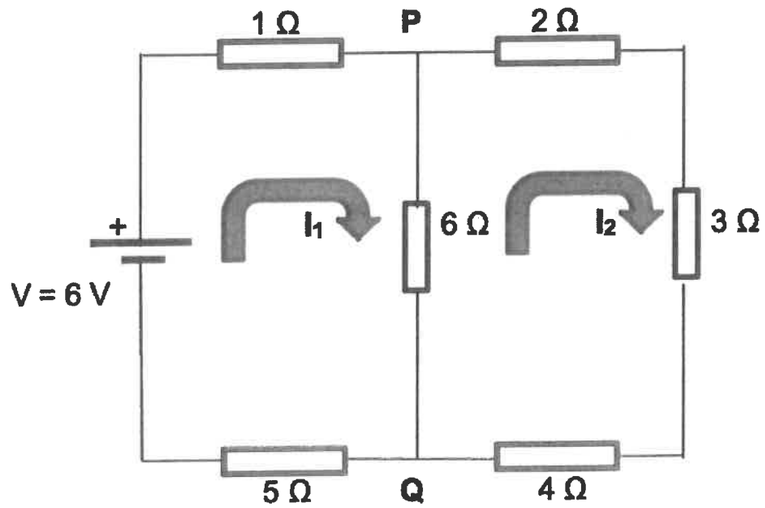

Figure 1

Total: 100 marks

END OF EXAMINATION PAPER

GOVERNMENT OF MALTA
MINISTRY FOR EDUCATION, SPORT, YOUTH
RESEARCH AND INNOVATION
DEPARTMENT OF EXAMINATIONS

EXAMINATION FOR AUTHORISATION B

Paper 1: Theory

Date: 13 July 2022

Time: 09:00 – 12:00 (Three hours)

t + 356 2598 2958 e myexams@gov.mt | www.myexams.gov.mt

This examination paper contains six questions. Candidates are requested to answer any FIVE (5) questions. Candidates are also requested to include all their work in the booklet provided. Every answer should include all workings, any necessary diagrams and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. (a) What is a Synchronous Motor? **(3 marks)**

   (b) Explain the operation of a Synchrounous Motor. **(7 marks)**

   (c) A Synchronous Motor taking 40 kW is working in parallel with a load of 80 kW having a power factor of 0.75 lagging. The power factor of the combined load is 0.9 lagging. Find the power factor and the reactive KVA of the motor. **(10 marks)**

2. (a) Briefly explain the following terms regarding induction motors:

   i. Stator losses **(2 marks)**
   ii. Rotor losses **(2 marks)**
   iii. Friction and Windage losses **(2 marks)**
   iv. Slip speed **(2 marks)**

   (b) An induction motor is required to be coupled to a hoist gearbox of a tower crane at a construction site. The power input to a 4 pole, three phase 400 V induction motor is 42 kW. The speed is 1410 revs/min. The stator losses are 1.3 kW, the friction and windage losses are 2.3 kW. Calculate:

   i. the percentage slip **(2 marks)**
   ii. the copper losses **(4 marks)**
   iii. the mechanical power developed at the hoist gearbox when the motor is directly coupled to the gearbox shaft **(4 marks)**
   iv. the efficiency. **(2 marks)**

3. (a) List the four conditions when an AC circuit is in Current or Parallel Resonance. **(8 marks)**

   (b) A coil of resistance 10 Ω and inductance 0.1 H is shunted by a 100 microfarad capacitor across a 240 V variable frequency supply. At what frequency will the current taken from the supply be a minimum? **(12 marks)**

4. (a) i. Write down the formula for the EMF Equation of a transformer. **(2 marks)**

   ii. Explain each term of the EMF Equation formula and state the units of each term. **(2 marks)**

   (b) Calculate the maximum value of flux in the core of a transformer having 2000 primary turns and supplied by 240 V, 50 Hz. **(8 marks)**

   (c) If the maximum flux density in the core of the above transformer is not to exceed 0.5 tesla, calculate the cross-sectional area of the core. **(8 marks)**

5. Three single phase loads are represented as given below:

   Phase 1: 10 Ω resistor in series to a 15 Ω reactance.

   Phase 2: 20 Ω resistor.

   Phase 3: 8 Ω resistor in series to an inductive reactance of 6 Ω.

   The three loads are connected in star across a three phase 4 wire system of 400 V 50Hz supply.

   (a) Draw a circuit diagram of the system. **(2 marks)**

   (b) Calculate each phase current. **(6 marks)**

   (c) Draw the phasor diagram of the system. **(5 marks)**

   (d) Give the value of current in the neutral conductor using any relevant method. **(7 marks)**