

BLANK PAGE

EXAMINATION FOR AUTHORISATION B

Paper 1: Theory
Date: 1st February 2023
Time: 09:00 – 12:00 (Three hours)

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) State Kirchoff's laws as applied to an electrical circuit. (4 marks)
- (b) For the circuit shown in Figure 1 using Kirchoff's laws find:
- the current flowing in in each branch. (10 marks)
 - the current flowing in the 20Ω resistor. (6 marks)

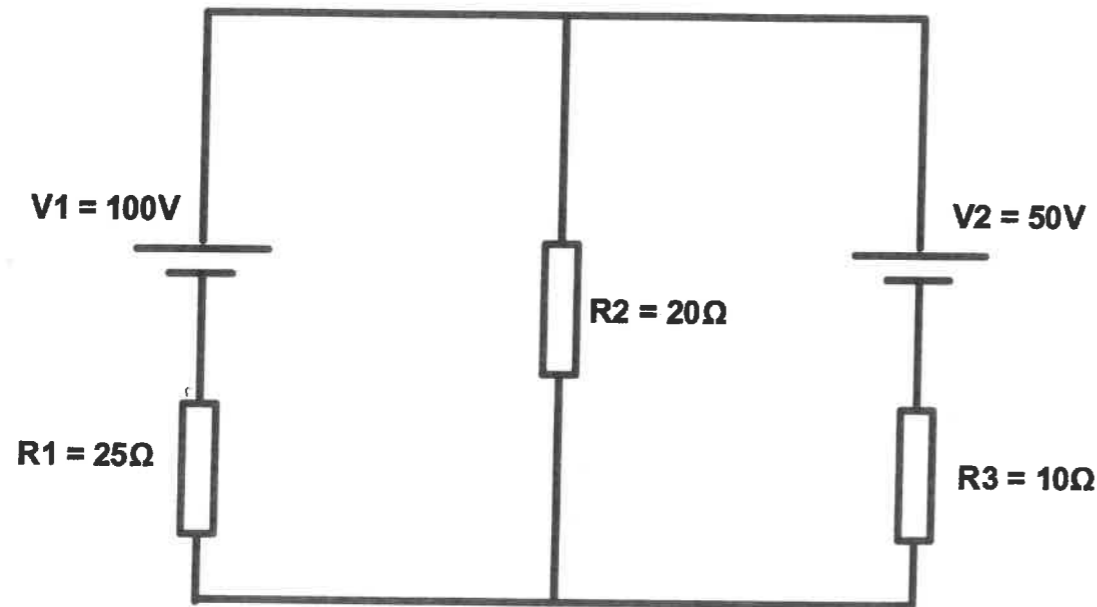


Figure 1

2. A factory is supplied at 400V, three-phase 50Hz supply from a 250kVA transformer. The plant at the factory consists of a 70kW motor having an efficiency of 80% and a power factor of 0.82. The other loads amount to a total of 100kVA at a power factor of 0.76 lagging.
- Calculate the total current, the total kVA and the power factor of the supply at the factory intake point. (9 marks)
 - It is required to install a further motor having an output of 42kW, an efficiency of 80% and a power factor of 0.83. Capacitors are installed in parallel with the factory load (at supply intake point) such that the kVA rating of transformer supplying the factory is not exceeded. Calculate:
 - the total kVAr rating of the capacitors. (6 marks)
 - the value of each capacitor, assuming the three capacitors are connected in Delta. (5 marks)

3. Two watt-meters are used to measure the input of a 400V, three-phase motor which has a full load output of 20 h.p.
- The efficiency of the motor is 88% and its power factor is 0.8.
- Draw a neat diagram of the arrangement. (4 marks)
 - Find the reading on each of the watt-meters. (8 marks)
 - Find the full-load current. (8 marks)

4. A DC Series motor has a total resistance of 0.4Ω and it takes a current of 30A at 100V. If the iron and friction losses of the motor are 500W, find:
- the Back E.M.F of the motor. (5 marks)
 - the copper losses. (5 marks)
 - the Break Horse Power. (5 marks)
 - the Commercial Efficiency. (5 marks)

5. Consider three branches which are made up of a resistance of 50Ω , an inductance of 0.15H and a capacitance of $100\mu\text{F}$ respectively. These are connected in parallel across a 100V, 50Hz supply.
- Sketch the RLC circuit. (3 marks)
 - Calculate the current in each branch. (6 marks)
 - Calculate the supply current. (6 marks)
 - Find the phase angle between the supply current and the supply voltage. (5 marks)

6. (a) With reference to transformers explain the following losses:
- Transformer core losses. (3 marks)
 - Hysteresis losses. (3 marks)
 - Eddy Current Losses. (3 marks)
- (b) Describe an Isolating Transformer (3 marks)
- (c) The primary winding of a delta-star connected 50VA transformer is supplied with a 100V, 50Hz three-phase supply. If the transformer has 500 turns on the primary and 100 turns on the secondary winding, calculate the following:
- the secondary side voltages. (4 marks)
 - the secondary side currents. (4 marks)

Total: 100 marks

END OF EXAMINATION PAPER