



# **EXAMINATION FOR AUTHORISATION A**

## **Paper 2**

**Date: Wednesday 29th January 2025**

**Time: 15.30 – 18:30 (Three hours)**

**Write only your Index Number in the space provided in the booklet.**

**This examination paper includes six questions. Candidates are requested to choose and answer any FIVE questions clearly indicating the question number of the answered questions.**

**Candidates are requested to answer ALL FIVE questions in the booklet correctly listing the answered question number in the space provided on the booklet's front sheet.**

**Answers should be written in Blue/Black Ink. Diagrams can be drawn in pencil.**

**All answers should include the necessary workings, diagrams and formulae.**

**Use a separate page for each different question.**

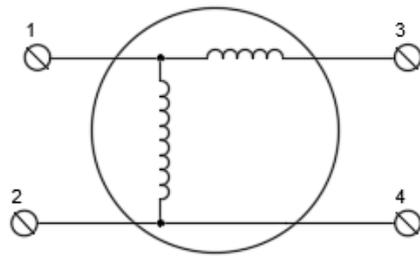
**Each question carries 20 marks.**

1. (a) Draw a sketch of a sinusoidal voltage waveform. On the same figure draw the sinusoidal current waveform at  $45^\circ$  lagging. **(5 marks)**
- (b) A series circuit, consisting of an inductor, having a resistance of  $5\Omega$  and an inductance of  $0.3\text{H}$ , is connected across a  $100\text{V}$ ,  $50\text{ Hz}$  AC supply.
- i) Draw up a circuit diagram showing the proper symbols. **(3 marks)**
- ii) Draw up a phasor diagram showing the voltage drop components across the inductance and resistance. **(3 marks)**
- iii) Calculate the series current in the inductor. **(5 marks)**
- iv) Calculate the phase angle and power factor. **(4 marks)**
- 2.(a) For each fault listed below, state which protection devices from the box can be used to detect the fault.
- i) Short circuit **(3 marks)**
- ii) Overload **(2 marks)**
- iii) Unbalance current between phase and neutral **(2 marks)**

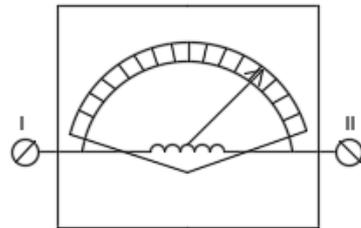
<p><b>FUSE, RCD, RCBO, MCB with magnetic element, Motor overcurrent module.</b></p>
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- (b) From the list of devices above list three devices that can provide isolation. **(3 marks)**
- (c) Draw a schematic diagram of an RCD and label the components. Show and explain how the RCD works. **(6 marks)**
- (d) Given the measuring instruments shown on page 3, explain how to connect the instruments for a given load to measure:
- i) apparent power in VA **(2 marks)**
- ii) power factor. **(2 marks)**

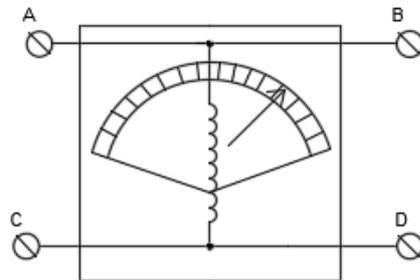
### WATTMETER



### AMMETER



### VOLTMETER



3. (a) Explain what is meant by diversity and give an example to show this. **(3 marks)**
- (b) Define the term Maximum Demand. **(2 marks)**
- (c) Calculate the current demand, including diversity, for a six-way consumer unit comprising the following circuits in a residential single-phase installation. Refer to Table 3.1 below for the diversity factors.
- i) Three instantaneous water heaters supplying 7.36kW electric showers, connected to the 230V supply. **(6 marks)**
- ii) An electric cooker comprising of the following:
- A hob with 4 x 2.5kW rings
  - A main oven rated at 2kW and
  - A grill/top oven rated at 2kW
- Note:** that cooker control unit incorporates a 13A socket outlet. **(5 marks)**
- iii) A lighting circuit consisting of 12 points. Assume a minimum of 100 watts per point. **(2 marks)**
- iv) One thermostatically controlled water heater of a rated power of 2.5kW **(2 marks)**

**Table 3.1:**

Cookers	10 A + 30% balance + 5 A for socket
Lighting	66% total demand
Instantaneous water heaters	100%X + 100%Y + 25%Z
Thermostatic water heaters	100%
<p>Note the following abbreviations:</p> <p><b>X</b> is the full load current of the largest appliance or circuit</p> <p><b>Y</b> is the full load current of the second largest appliance or circuit</p> <p><b>Z</b> is the full load current of the remaining appliances or circuits</p>	

4. (a) Explain the importance of conducting a ring final circuit continuity test. **(3 marks)**
- (b) Name the instrument used to conduct the test in 4 (a). **(2 marks)**
- (c) Explain why interconnections in a ring circuit are unacceptable. **(2 marks)**
- (d) Draw the following socket outlets circuits, clearly indicating the live, neutral and earth.
- i) Ring final circuit for five socket outlets and at least one spur. **(4 marks)**
- ii) Radial circuit for five socket outlets. **(4 marks)**
- (e) List three advantages and two disadvantages of a Radial Circuit. **(5 marks)**
5. A two-bedroom apartment having an area of 126m<sup>2</sup> (7m front by 18m length) consists of:
- Two lighting points (connected in parallel) controlled from one position for the open kitchen.
  - Two lighting points (connected in parallel) controlled from two positions for the balcony.
  - Three lighting points (connected in parallel) controlled from three positions in the corridor.
  - One lighting point controlled from one position for each room, i.e. master bedroom, bathroom, spare bedroom.
  - Radial circuit for two 1.2kW immersion heaters, one in the bathroom and the other in the kitchen.
  - Radial circuit for the 2kW dishwasher and another radial circuit for the 3.5kW oven.
  - Two ring circuits each serving ten 13 Amps socket outlets.

Obtain a bill of quantities (BOQ) for the two-bedroom apartment showing the material required to connect and complete the electrical installation. The installation of the conduit and conduit fittings are to be excluded. Assume 230V, 50Hz and power factor 0.8. The BOQ must include:

- (a) The description/specifications of the several types of switches, 13A socket outlets, double pole switches and cooker unit that are required for the installation. **(5 marks)**
  - (b) The quantity of each item required for the installation. **(5 marks)**
  - (c) An estimated length and cross-sectional area (CSA) of several types of single core PVC insulated cables. **(5 marks)**
  - (d) All components required to complete the consumer unit according to the Maltese legislation, Electrical Installation Regulations S.L.545.24. **(5 marks)**
6. The IET regulations section 703, specify the procedures for Rooms and Cabins containing Sauna Heaters.
- (a) Explain how the wiring system of the sauna electrical heater unit is carried out. **(5 marks)**
  - (b) Explain how the isolation, switching, control and accessories are placed in the sauna room. **(5 marks)**
  - (c) Draw a plan showing all the zone dimensions for a sauna. **(5 marks)**
  - (d) Draw a side elevation showing all the zone dimensions for a sauna. **(5 marks)**

**END OF EXAMINATION PAPER**

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