



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

# **EXAMINATION FOR THE ISSUE OF A LICENCE TO ACT AS WIREMAN**

**Authorization B**

**Sample Paper II**

**Time: 3 Hours**

This examination paper contains six (6) questions. Candidates are requested to answer any FIVE (5) questions. They are also requested to include all their work in the booklet provided. All answers should include all workings, any necessary diagrams, and formulae. Use a fresh page for each different question. Each question carries 20 marks.

1. a. For each of the following state the unit of measurement:
    - (i) Apparent power
    - (ii) True power
    - (iii) Reactive power **(3 marks)**
  - b. With the aid of a diagram, explain the relationship for the above i.e. active power, apparent power and reactive power. **(3 marks)**
  - c. What is meant by 'Power Factor'? **(3 marks)**
  - d. (i) Calculate the total current when the circuit supplied voltage is 120 V and the impedance is 84.85  $\Omega$ .  
(ii) For the above, calculate the apparent power. **(6 marks)**
  - e. State the disadvantages of a **Low Power factor**. **(5 marks)**
2. The **Two Wattmeter Method of Power Measurement** is commonly used in a 3-phase, three-wire star or delta connected balanced or unbalanced load.
- a. Draw a well labeled diagram for a **Two Wattmeter Method** for the following:
    - (i) 3-phase, three-wire star
    - (ii) 3-phase, three-wire delta. **(8 marks)**
  - b. Explain how to control harmonic currents affecting the neutral. **(4 marks)**
  - c. Explain the difference between **Line Voltage** and **Phase Voltage**. **(4 marks)**
  - d. Calculate the phase voltage if the line voltage is 460 volts, given that the system is a three-phase balanced star connected system. **(4 marks)**
3. a. Why is it required to balance as much as possible the single-phase loads on a three phase four wire system? **(5 marks)**
- b. In a three-phase four wire system the line voltage is 400V and the following single-phase loads are connected as follows:
- a resistive load of 25 kW between L1 and Neutral
  - a resistive load of 17 kW between L2 and Neutral
  - a resistive load of 10 kW between L3 and Neutral
- Calculate:
- (i) The current in each line **(3 marks)**
  - (ii) The current in the Neutral conductor **(5 marks)**
  - (iii) Sketch a phasor diagram to show all the currents **(2 marks)**
- c. The main neutral conductor supplying these loads was accidentally broken when the 17 kW load was being disconnected from the supply. When the supply was switched ON again to supply the 25kW and 10 kW loads, the main neutral conductor was missing (broken). Calculate the voltage across the 25 kW load and the 10 kW load. **(5 marks)**

4. a. Briefly state some advantages of using a current and a voltage instrument transformer. **(5 marks)**

b. A current transformer has a single turn on the primary winding and a secondary winding of 60 turns. The secondary winding is connected to an ammeter with a resistance of 0.15 ohms. The resistance of the secondary winding is 0.25 ohms. If the current in the primary winding is 300 Amps.

Calculate:

(i) The reading on the ammeter **(3 marks)**

(ii) The potential difference across the ammeter **(4 marks)**

(iii) The total load in VA on the secondary **(3 marks)**

c. What precautions must be observed when using current and voltage transformers? **(5 marks)**

5. A new electrical installation is to be installed in a small factory. The following loads will be connected:

Factory Lighting: 60, twin 125W fluorescent luminaries at 0.6 pf

External Lighting: 12, 300W floodlights at 0.7 pf

AC Motors: 6, single-phase motors, 3kW each at 0.7 pf

Welding sets: 2, 3-phase welding sets, 5kVA 400V each

The supply available from the utility is a 400V 50 Hz 4-wire system.

a. Calculate

(i) the total load per phase assuming the load is evenly distributed on all phases. **(10 marks)**

(ii) the rating of the main Moulded Case Circuit Breaker (MCCB), ratings given in Table 3.1. A 20% Future Growth Factor must be considered. **(3 marks)**

b. What size of Distribution Board you would recommend for this installation. Distribution Board sizing is given in Table 3.2. **(7 marks)**

<i>Table 3.1 – Moulded Case Circuit Breakers</i>					
Rating (A) $I_n$	40	63	100	125	160

<i>Table 3.2 – 3P&amp;N MCB Distribution Boards</i>					
Busbar Rating (A)	200	200	200	200	200
3P Ways	4	6	8	12	18

6. a. Several points are considered when maintaining motor starters. Describe four (4) main points. **(4 marks)**
- b. A conveyer belt is used to transport a PVC box from Station A to Station B, 20m away. When the box arrives at Station B, operator B fills the box and send it back to Station A. Operator at Station A empties the box and send it back to Station B.
- (i) What type of motor starter is required for the AC motor, driving the conveyer belt and explain how this operation is achieved using one motor. **(6 marks)**
- (ii) Draw a circuit diagram for the motor starter showing the control at Stations A and B, emergency stops at both stations, limit switches to stop the motor, electrical interlocks and any electrical latching required. **(10 marks)**

**Total: 100 marks**