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

EXAMINATION FOR AUTHORISATION B

Paper 1

Date: 6th February 2024

Time: 9:00 – 11:00 (Two hours)

This examination paper includes ten questions. Candidates are requested to answer ALL questions clearly indicating the question number of the answered questions.

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

Candidates are requested to answer ALL 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 10 marks.

1. A boutique hotel is still under construction and an electrical temporary supply installation is required for the electrical team to safely connect the 110V, 50Hz electrical tools. A Three-phase and earth supply connection, without a neutral, are available nearby.

   (a) (i) Draw circuit diagram of a transformer having a three phase, 400V, 50Hz primary and three phase 110V, 50Hz secondary. **(6 marks)**
   (ii) State the type of transformer used in part (a)(i). **(2 marks)**

   (b) Calculate the phase voltage on the secondary side of the transformer. **(2 marks)**

2. (a) The solar panel invertor requires a capacitor to reduce the harmonics at the supply connection. The capacitor consists of two parallel steel plates separated by 2mm thickness of mica having relative permittivity, ε_r, of 6. Each plate dimensions are 0.1m by 0.1m. The permittivity of free space, εo, is given as 8.85×10^{-12}. Calculate:

   (i) The capacitance **(4 marks)**
   (ii) The electric charge **(2 marks)**
   (iii) The energy stored when the capacitor is charged to 400V. **(2 marks)**

   (b) If another identical capacitor is connected in parallel, what is the total value of capacitance? **(2 marks)**

3. An unskilled factory worker was working and suddenly noticed that smoke was coming out from the production line main electrical panel. Eventually, the main electrical panel caught fire. While trying to switch-off the main electrical panel the worker panicked and received an electric shock and fell down on the floor.

   (a) Write down two first actions necessary in such a situation. **(4 marks)**

   (b) List four first aid procedures to attend to the person who suffered the electric shock. **(4 marks)**

   (c) Name the type of extinguisher that is used to extinguish the fire in such a situation. **(2 marks)**

4. A ventilation system of a warehouse is connected to a three phase 400V, 50Hz supply. The three-phase star connection load consists of three inductive coils, each of the resistance 50 ohms and inductance 0.331H.

   (a) Draw a circuit diagram of the star connected loads. **(2 marks)**

   (b) Calculate:
   (i) The line current **(3 marks)**
   (ii) The power factor **(2 marks)**
   (iii) The total power. **(3 marks)**

5. (a) With the aid of a diagram explain the importance to earth all metal parts of an electrical installation. **(4 marks)**

   (b) Describe the method how to install and test an earth electrode system for a block of flats. Draw a sketch of the system showing how the earth electrode will be installed and tested. **(6 marks)**

6. (a) State why it is necessary to reduce the voltage for starting large three phase induction motor. **(4 marks)**

   (b) With the aid of a diagram show how the rotation of a three-phase induction motor can be reversed at the electrical installation point of connection. **(3 marks)**

   (c) List three factors to be considered when ordering an electric motor. **(3 marks)**

7. (a) With the aid of a diagram explain how the Distribution System Operator supplies electricity from a sub-station to a three-phase installation. In the diagram include the customer three phase control gear in the consumer unit. **(5 marks)**

   (b) Define the following terms as related to the protection of an electrical installation:
   (i) Overcurrent **(2 marks)**
   (ii) Prospective Short Circuit Current. **(3 marks)**

8. (a) Distinguish between a 'statutory' document and a 'non-statutory' document. **(4 marks)**

   (b) The IET BS 7671 is a crucial requirement in Electrical Installations. To comply with BS 7671 initial verification should be carried out. Explain briefly what is verified in this initial verification process. **(6 marks)**

9. (a) State the minimum IP rating for fixed equipment in ZONE 2 of a bathroom. **(2 marks)**

   (b) State three special locations which are divided into zones. **(6 marks)**

   (c) Calculate the maximum earth fault loop impedance permissible for a 30 mA RCD used to protect a circuit connected to a TT system. **(2 marks)**

10.(a) Name the instrument used by electricians to
   (i) measure accurately the resistance of the conductors in an electrical installation. **(1 mark)**
   (ii) detect insulation leakage between live conductors **(1 mark)**
   (iii) ensure that a residual current device will operate very quickly under fault conditions and within time limits set by IEE Regulations. **(1 mark)**

   (b) Explain when an electrician uses multimeters. **(2 marks)**
   (c) Explain why electricians today prefer using digital multimeters. **(2 marks)**
   (d) Explain the importance of an Earth fault loop impedance tester. **(3 marks)**

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