

5. a. The I.E.E. regulations require that electrical installations should be divided into separate circuits. (4 marks)  
Explain the purpose of this requirement.
- b. A factory load is connected to a 400/230 volts 3 phase 4 wire 50 Hz supply. The electrical load of the factory consists of the following:
- 6 welding sets each 5 kV A across 400 V 2-phase,
  - 3 motors 0.5kW rating across 230 V single phase at 0.8 efficiency and 0.86 pf lag,
  - 2 motors 4kW rating each across 400V 3 phase at 0.85 efficiency and 0.86 pf lag,
  - 30kW motor 3 phase at efficiency 0.87 and pf 0.83,
  - 15 socket outlets 13 amp each forming four ring circuits,
  - A discharge lighting load 7.5kW and filament lamp load of 10kW,
  - A heating load of 15kW.
- Calculate the total current demand for the main switchboard. (14 marks)
- c. Draw a block diagram for the above switchboard. (2 marks)
6. a. With the aid of a figure explain how a Direct On Line (d.o.l.) starter works and why it is used to control a three phase motor. (8 marks)
- b. A remote start/stop connection is required to control the motor. Draw the additional control circuitry to achieve a remote control. (4 marks)
- c. Briefly explain the different types of motor enclosures. (5 marks)
- d. Why do motors need regular maintenance? (3 marks)

**EXAMINATION FOR THE ISSUE OF A LICENCE  
TO ACT AS WIREMAN - LICENCE 'B'**

**Paper II (Electrical Installation Technology)**

**Time Allowed: 3 Hrs**

**February 2015**

**END OF PAPER**

**WRITE ALL YOUR WORK ON THE ANSWER BOOK PROVIDED.  
EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY  
DIAGRAMS AND FORMULAE.**

**START EACH ANSWER ON A FRESH PAGE.**

Answer any **FIVE** Questions

1. There are three categories of acceptable earthing systems described in BS 7671 (IEE Wiring Regulations), namely:
  - Earthed neutral (TN)
  - Independent earths (TT)
  - Isolated (IT)
  - a. TN systems are subdivided into three arrangements. State two of these sub-arrangements and draw an electrical diagram for each, showing the supply side, supply cables, consumer terminals and equipment. **(4 marks)**
  - b. Draw an electrical diagram for a TT system and an IT system. **(4 marks)**
  - c. Which earthing system is used in Malta? **(2 marks)**
  - d. What is the purpose of protective earthing and protective bonding? **(4 marks)**
  - e. The regulations state that for TT systems, the value of earth electrode resistance multiplied by the operating current of the protective device must not exceed 50V. In the case of an RCD used for a dwelling, what is the theoretical maximum value of earth electrode resistance? In practice what is the maximum value of allowable resistance? **(3 marks)**
  - f. What measures, if necessary, should be taken to decrease earth electrode resistance? **(3 marks)**
2. Fires in industrial and office buildings are a major hazard for persons and assets, and various considerations are to be taken when installing electrical services, fire detection and fighting equipment, and emergency systems.
  - a. State which type of fire extinguisher should be used for fires involving:
    - i. electrical equipment, **(2 marks)**
    - ii. flammable liquids such as transformer oil, **(1 mark)**
    - iii. flammable gases, **(1 mark)**
    - iv. paper and wood. **(1 mark)**
  - b. State what type of insulation should be used for low voltage wiring in buildings such as hotels, offices and factories, and its features important to avoid and contain fires and to minimise negative effects on people. **(3 marks)**
  - c. State what precautions should be taken in wall cable penetrations to minimise the propagation of fire. Explain the choice of materials. **(2 marks)**
3.
  - a. What is the difference between PVC and XLPE insulation ? **(4 marks)**
  - b. Give two reasons why trunking is often preferred over conduit in industrial installations. **(4 marks)**
  - c. With reference to metal trunking systems explain:-
    - i. how bonding is maintained, **(3 marks)**
    - ii. the precautions necessary to impede the spread of fire. **(3 marks)**
    - iii. Can fire alarm circuits be run in the same trunking with cables carrying the mains voltage? **(3 marks)**
    - iv. Why must feed and return conductors supplying a load be run in the same trunking? **(3 marks)**
4.
  - a. Explain the importance of earthing all parts of an electrical installation. **(5 marks)**
  - b. Describe the method of installing and testing an earth electrode system for a block of eight flats. Draw a sketch of the system. **(5 marks)**
  - c. What is meant by the earth-fault loop path? Draw a diagram of the path and indicate with arrows the route taken by the fault current for a TT system. **(4 marks)**
  - d. The supply voltage of a circuit is 230V, the external earth loop impedance  $Z_e$  is  $0.65\Omega$ . The resistance of the phase conductor is  $0.08\Omega$  and the fault resistance is  $3\Omega$ . Find the value of:
    - i. The total earth fault impedance ( $Z_s$ ), **(3 marks)**
    - ii. The fault current. **(3 marks)**
5.
  - d. What is the preferred type of distribution transformer that should be used for indoor application? **(2 marks)**
  - e. State and describe special requirements for the following installations:
    - i. Fire detection and alarm systems used in a factory with extensive cabling and oil-filled equipment, **(4 marks)**
    - ii. Emergency lighting systems used in hotels or shopping malls. **(4 marks)**