

6. A new electrical installation is required to supply the common area for a block of flats. The common area will be supplied from a three phase and neutral distribution board. As part of the new installation a lift needs to be installed. For the lift installation specify:

- (a) What cables are allowed in the lift shaft? (4 marks)
- (b) Can steel conduit be used in the lift shaft to provide power to the lift? (4 marks)
- (c) If the lift is 25m high, how can the cable be supported? (4 marks)
- (d) Can the lift shaft be used for short runs of other building services, i.e to run short runs of water pipes or conduit with circuits not connected to the lift? (4 marks)
- (e) For the lift installation, where should the main switch be installed? (4 marks)

EXAMINATION: AUTHORISATION B

Paper II (Installation Technology)
Time Allowed - 3Hrs

February 2016

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.

Choose any FIVE questions.

1. (a) Trunking and conduit are commonly used in electrical installations particularly in industry. Give TWO reasons why trunking is often preferred to conduit system of wiring. (5 marks)
- (b) With reference to steel trunking systems state:
 - (i) how bonding is maintained;
 - (ii) what precautions are taken to hinder the spread of fire;
 - (iii) the conditions under which fire alarm circuits and low voltage circuits may be run in the same trunking as cables carrying mains voltage;
 - (iv) what is meant by "space factor" and give a reason for its use;
 - (v) why cable supports are used in vertical trunking. (15 marks)
- 2 a. With reference to a three-phase squirrel cage induction motor:
 - i. draw a cross-section of the motor showing the squirrel cage and three-phase windings; (3 marks)
 - ii. draw a phasor diagram showing the current in the three windings; describe the construction of the motor; (3 marks)
 - iii. explain what is meant by the slip of the motor; (3 marks)
 - iv. what are the characteristics of the starting torque and the power factor of this type of motor? (4 marks)
 - v. explain what happens to the performance of the motor when it is mechanically loaded. (4 marks)
- 3 a. Explain with the aid of a diagram the principle and construction of a large synchronous motor; (10 marks)
- b. describe, using a diagram, one suitable method of starting the motor; (6 marks)
- c. how is the power-factor of the motor controlled? (4 marks)

- 4 A shop has the following single-phase loads, which are balanced as evenly as possible across the 400 V three-phase supply.

2 x 6 kW and 7 x 3 kW thermostatically controlled water heaters
 2 x 3 kW instantaneous water heaters
 2 x 6 kW and 1 x 4 kW cookers
 12 kW of discharge lighting (sum of tube ratings)
 8 x 32A ring circuits feeding 13A sockets.

Referring to the attached table:

- (i) calculate the demand for each of the above; (10 marks)
 - (ii) find the maximum demand; (5 marks)
 - (iii) suggest a suitable factor for future expansion; (2 marks)
 - (iv) suggest a suitable factor for diversity. (3 marks)
5. (a) Define the following terms as related to the protection of an electrical installation:
- (i) Overcurrent (2 marks)
 - (ii) Prospective Short Circuit Current (2 marks)
- (b) Name and explain two methods by which a Moulded Case circuit breaker can detect high current levels in a circuit. (4 marks)
- (c) A factory is supplied at its Main switchboard at 400/230V from a nearby substation. The transformer inside the substation had the primary winding connected in Delta while the secondary winding is connected in Star and the transformer is rated at 800 kVA. The reactance of the transformer secondary winding is 0.04Ω / phase and the resistance can be assumed to be negligible.
- A 4core 185mm², 45m long cable is used to provide supply to the factory from the substation. The resistance and reactance per phase per meter of cable is $1.4 \times 10^{-4} \Omega$ and $6.8 \times 10^{-5} \Omega$ respectively.
- (i) Make a neat sketch of the arrangement (3 marks)
 - (ii) Calculate the short circuit current on the main switchboard if a short circuit between any two phases occurs on the factory switchboard. (9marks)

Note that Thermostatic water heaters, Floor warming installations and Thermal storage heating are 100% for all types of premises. All LOADS with the exception of the discharge lighting can be assumed to be at unity power factor

Type of Circuit	Households	Small shops, stores, offices	Hotels, guest houses
Lighting	66% total demand	90% total demand	75% total demand
Heating & power	100% up to 10A + 50% balance	100%X+75% (Y+Z)	100%X+80%Y+60%Z
Cookers	10A+30% balance + 5A for socket	100%X+80%Y+60%Z	100%X+80%Y+60%Z
Motors (but NOT lifts)		100%X+80%Y+60%Z	100%X+50% (Y+Z)
Instantaneous water heaters	100%X+100%Y+25%Z	100%X+100%Y+25%Z	100%X+100%Y+25%Z
Standard circuits	100%X+40% (Y+Z)	100%X+50% (Y+Z)	100%X+50% (Y+Z)
Sockets & stationary equipment	100%X+40% (Y+Z)	100%X+75% (Y+Z)	100%X+75%Y+40%Z

