ELECTRICAL TRADE THEORY N2

QUESTION 1: CONDUCTORS AND CABLES

1.1 Name TWO factors that need to be considered when selecting a cable.

1.2 Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.2.1–1.2.5) in the ANSWER BOOK

1.2.1 Cables working at their maximum current rating need to be well-ventilated to allow for adequate heat dissipation.

1.2.2 If the ground is not rocky, the best way to hide unsightly cables is to bury them

1.2.3 Once ducting exists, it is cheaper to install cables in the ducts than digging trenches and burying them.

1.2.4 Since air acts as an insulator, it is cheaper to install cables in the open air because the cables need not be covered with insulation.

1.3 Determine the full load line current of a 380 V, 100 kW, three phase motor that has a full load power factor of 0,9.

1.4 Calculate the maximum short-circuit current that a PVC insulated cable, which has copper conductors with a cross-sectional area of 10 mm^2, can carry for a maximum time of 2 seconds.

HINT: Make use of the table below to solve this problem.

TYPE OF INSULATION	TYPE OF CONDUCTOR	CIF
PVC	Copper	96
PVC	Aluminium	62
XLPE	Copper	143
XLPE	Aluminium	92
PAPER	Copper	116
PAPER	Aluminium	78

QUESTION 2: TRANSFORMERS

2.1 A 100 kVA, ideal single-phase transformer's secondary voltage is 220 V. The supply to the transformer is 11 kV.
Calculate:

2.1.1 The turns ratio

2.1.2 The value of the primary current at full load

2.1.3 The maximum secondary current

2.2 A three phase transformer has a delta connected primary and a star connected secondary. The transformer supplies a line current of 900 A to a certain load. If the primary line voltage is 6,6 kV and the secondary line voltage 380 V, determine:

2.2.1 The primary and secondary phase voltages

QUESTION 3: ELECTRONICS

3.1 Explain how a thyristor operates as a power controlling device.

3.2 Draw a neat, fully labelled circuit diagram of a full-wave bridge rectifier built with FOUR diodes.

QUESTION 4: SWITCHGEAR, CONTACTORS AND RELAYS

4.1 Explain the purpose of a relay.

4.2 For the efficient distribution of power from power stations to consumers; electrical energy from a 3-phase 11 kV alternator, is transformed to 132 kV for long-distance transmission. At the substation it is transformed back to 11 kV, and then to a 3-phase 380 V 4-wire and to single-phase 220 V 2-wire systems. Show by means of a sketch how this is done in practice. Assume that there are consumers that need a 3-phase supply while others require single-phase supply.

4.3 Overhead conductors are not covered with insulating material. State the two main purposes of the insulators used in this type of electrical distribution systems.

4.4 Name TWO methods to minimize damage caused by arcing in circuit breakers.

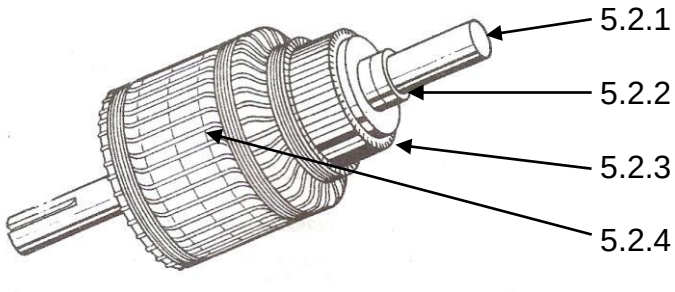
QUESTION 5: DC MOTORS AND STARTERS

5.1 Name TWO components that need regular replacement in DC motors.

5.2 Write 5.2.1 to 5.2.4 down in your ANSWER BOOK and correctly name all the components identified by the arrows, selecting only FOUR of the following names:

- stator windings
- armature windings,
- slip rings,
- commutator
- shaft
- spacers

– end plates



5.3 Explain the need for a motor starter.

5.4 Explain what happens to the speed of a series motor as the load decreases.

5.5 Name TWO methods of reversing the direction of rotation of DC motors.

QUESTION 6: AC MOTORS AND STARTERS

6.1 For a single-phase capacitor-start, capacitor-run motor in which the capacitor values are not the same:

6.1.1 Draw a neat, fully labelled circuit diagram of the above.

6.1.2 State one application of this type of motor.

6.1.3 State why single phase motors are not all similar to this type of motor.

6.2 The overcurrent protection devices used for motors must meet certain requirements. Discuss these requirements under the following headings:

6.2.1 The tripping value

6.2.2 The time delay

6.2.3 Multiphase motors

6.2.4 Automatically controlled motors

6.3 Give a short description of how a squirrel-cage rotor is constructed.

QUESTION 7: EARTHING

7.1 State which TWO parts of the earthing system should be connected to the consumer's earth terminal.

7.2 The cable sheath is being used as the earth continuity conductor. The cable is to be joined. Explain how earth continuity is maintained if the joint is made inside a metal joint box.

7.3 State what must be done with the earth conductor of a three-core cable that is connected to electrical appliances that have floating earths.

7.4 Explain how the following items in an outdoor substation is earthed.

7.4.1 The transformer windings

7.4.2 The metal enclosure of the transformer

7.4.3 The lightning rods that are mounted on the highest points above the substation

QUESTION 8: PROTECTION

8.1 Answer the following questions on phase-imbalance protection:

8.1.1 State the purpose of phase-imbalance protection

8.1.2 State what equipment requires phase-imbalance protection

8.1.3 Explain how three-phase overload relays protect circuits against single phasing.

8.2 State on which conductor in a circuit a fuse should be installed.

8.3 Name the application and purpose of a valve arrestor.

8.4 List the FOUR main components of the bimetal type overload relay.

QUESTION 9: MEASURING INSTRUMENTS

9.1 Explain how the watt-hour meter is able to give a reading which is proportional to the energy consumed.

9.2 Draw a neat, fully labelled circuit diagram to show how a wattmeter is connected to a single-phase system. Assume that the wattmeter is rated for the high voltage and current present in the system. Label the coils of the meter.
