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ELECTRICAL ENGINEERING (POWER OPTION) LEVEL 6

ENG/OS/PO/CR/07/6

Install Solar System

November/December 2025

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

Time: 3 HOURS

INSTRUCTIONS TO CANDIDATE

1. Marks for each question are indicated in the brackets.
2. Attempt **ALL** questions in section A and **ANY THREE** (3) questions in section B.
3. This paper consists of **TWO** sections: **A** and **B**.
4. Candidates are provided with a separate answer booklet
5. **DO NOT** write on this question paper.

This paper consists of SIX (6) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

Attempt ALL the questions in this section

1. During the installation of a solar system, technicians require specific instruments and devices to carry out the work effectively. List FOUR tools used in solar system installation. (4 marks)
2. In solar PV technology, different system configurations are used depending on the application and energy needs of a client. Differentiate between a hybrid solar system and a stand-alone (off-grid) solar system. (4marks)
3. When designing and wiring a solar PV system, modules can be connected in different ways to achieve the required voltage and current. Enumerate TWO main methods of solar PV connections. (2 marks)
4. In solar PV systems, diodes are often incorporated to control current flow and protect modules. Differentiate between a blocking diode and a bypass diode as used in Solar systems (4 marks)
5. In the design of solar PV systems, it is important to ensure a continuous power supply even during periods of little or no sunlight by use of batteries. Define the term days of Autonomy as used in Solar PV systems (2 marks)
6. The performance and safety of a solar PV system greatly depend on how the solar panels are mounted. State THREE types of solar panel mounting structures (3 marks)
7. Inverters are available in different categories depending on their design and output characteristics. Identify THREE types of inverters (3 marks)
8. Edwin receives electricity from the 240 V AC mains supply and he intends to install a solar PV system that will function as a backup power source**.** The system is expected to support the following electrical loads during periods of power interruption.

i. Two - 10W lamps 5 hours daily

ii. 1500W - iron box 1 hour daily

iii. 50W - TV set 6 hours daily

Calculate the total power consumed by the user in 30 days. (4marks)

9. The performance of a solar PV system greatly depends on how the solar modules are mounted. State FOUR factors that should be considered when mounting a solar module (4 marks)

10. For a solar PV system to operate effectively and have a long service life, regular maintenance of the PV modules is required. State FOUR reasons for maintaining a PV solar module (4 Marks)

11. To ensure the batteries operate safely and efficiently, a charge controller is connected between the PV array and the battery bank. The charge controller plays a key role in regulating power flow and protecting the system

a) State THREE functions of a charge controller in a solar PV installation. (3 marks)

b) State TWO types of charge controllers. (2 marks)

12. Loads can be either DC or AC, depending on the system design. Define the term Load as used in solar systems (1 mark)

SECTION B (60 MARKS)

Attempt Any THREE Questions in This Section

13.

(a) Photovoltaic systems form a reasonable alternative to a conventional power supply. Explain SIX Advantages of solar photovoltaic technology (12 marks)

(b) For safe operation and reliable performance, a solar PV system must undergo several tests during and after installation. Describe FOUR types of tests carried out in solar system installation. (8 marks)

14.

(a) When choosing an inverter system, the designer should know its optimal features. Explain FOUR features of a good Inverter. (8 marks)

(b) The success and efficiency of a solar PV system largely depend on proper planning and execution during installation. Explain FIVE factors to consider when carrying out a Solar PV system installation (8 marks)

(c) In electrical and solar PV systems, protective devices are necessary to safeguard equipment and users from overcurrent conditions. Two common devices used are circuit breakers and fuses, both serving the same general purpose but operating in different ways. Differentiate between a circuit breaker and a fuse (4 marks)

15.

(a) In solar PV systems, earthing is an important safety and protection measure. It involves connecting the metallic parts of the system to the ground to minimize risks and enhance reliability. Discuss THREE importance of earthing of Solar PV modules (6 marks)

(b) A house has the following electrical appliance usage:

- One 18 Watt fluorescent lamp with electronic ballast used 4 hours per day.
- One 60 Watt fan used for 2 hours per day.
- One 75 Watt refrigerator that runs 24 hours per day with compressor run 12 hours and off 12 hours. The system will be powered by 12 Vdc, 110 Wp PV module.

i. Determine power consumption demands (2 marks)

ii. Size the PV panel (3 marks)

iii. Inverter sizing (2 marks)

iv. Battery sizing (3 marks)

(c) In solar PV system design, modules are interconnected in various configurations to achieve the required electrical output. Two common arrangements are strings and arrays, which play different roles in the system setup. What is the difference between a string and an array with reference to solar PV design? (4 marks)

16.

(a) During the installation of solar panels, the angle at which the modules are mounted relative to the ground (tilt angle) is an important design consideration. Explain FOUR significances of Tilt Angle in the Installation of Solar Panels (8 marks)

(b) In solar PV installations, different cables are used for interconnections between modules, batteries, inverters, and loads. To ensure safety, efficiency, and ease of maintenance, cables are usually marked with specific identifiers. Explain FIVE reasons for labelling Cables in Solar PV Installation (10 marks)

(c) In solar PV systems, the performance of modules depends on the amount of solar energy received on their surface. Define the term irradiance as used in solar PV systems (2 marks)