UGANDA INSTITUTE OF COMMUNICATIONS END OF SEMESTER ONE

INFORMATION AND TECHNOLOGY EXAMINATIONS

ACADEMIC YEAR 2023/2024

DEPARTMENT: ICT

SEMESTER: TWO

PROGRAMME(S): DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING (DEEE)

YEAR OF STUDY: TWO

COURSE: SOLAR ENERGY SOURCES

COURSE CODE : ELT2205

DATE: SUNDAY 10TH, DECEMBER 2023

TIME: 12:00 PM – 3:00 PM

DURATION: 3 HOURS

INSTRUCTIONS:

(i) This paper contains two Sections: A (40 marks) & B (60 marks).

(ii) Attempt ALL questions in Section A, and ONLY THREE questions in Section B.

(iii) All questions in Section B carry equal marks.

(iv) Credit will be given for use of relevant examples and illustrations.

(v) Begin each number in Section B on a new page of the answer sheet.

(vi) DO NOT write on this question paper.

SECTION A [40 MARKS]

Attempt **ALL** the Questions in this Section.

For questions 1 to 20, write the correct alternative in the answer booklet provided (1 mark @)

1. The two main classification of PV configurations are;
   A. Stand-alone systems
   B. Stand-alone systems with batteries
   C. Direct coupled system without batteries
   D. Grid coupled system

2. The two types of stand-alone PV power systems are;
   A. Grid coupled system
   B. Direct coupled system without batteries
   C. Hybrid systems
   D. Stand-alone systems with batteries

3. Module inverter-grid is a pv system configuration also known as;
   A. Grid tied PV configuration
   B. Direct solar system
   C. Inverter
   D. AC and DC system

4. Which of the following PV module mount is commonly used for street lighting in Uganda?
   A. Roof mount B. Pole Mount C. Ground mount D. Truckers

5. The solar charge controller/regulator is rated in;
   A. Power and voltage
   B. Amperes and Voltage
   C. Open circuit voltage
   D. Maximum Power Point Trucker

6. An inverter is rated in;
   A. Voltage
   B. Watts (power) and voltage
   C. Amperes and voltage
   D. Amperes

7. What is the Depth of Discharge (DOD) of a lead acid gel battery?
   A. 60% B. 50% C. 20% D. 95%

8. Mark a system technician, connects solar panels in 48V and solar batteries in in 12V, which best charge controller/regulator and inverter voltage do you recommend Mark to use on this system
   A. PWM 48V charge controller/ regulator and 12V inverter
   B. MPPT 48V charge controller/ regulator and 12V inverter
   C. PWM 48V charge controller/ regulator and 48V inverter
   D. MPPT 48V charge controller/ regulator and 48V inverter

9. The inverter sizing for small systems depends on:
   A. The total AC loads for the system and battery bank voltage
   B. The total DC and AC loads of the system and battery voltage

C. The DC loads and battery voltage
D. All the above

10. What is the SI unit of Energy?
A. Killo Watt hour (KWH) B. Watt hour (WH)
C. Power D. Both A and B

11. In a string wiring/connection:

A. The voltage is only increased B. The current is only increased
C. Both current and voltage are increased D. Voltage increases, current reduces

12. In parallel connection/wiring,
A. Voltage is increased B. B. Current is increased
C. Both voltage and current are increased D. All the above

13. If a client has a DC load of 100W and AC load of 200W, what is the size of the inverter would you recommend the client? Assume 20% system loss.
A. 360W B. 240W C. 300W D. 200W

14. What is the major importance of a solar charge controller/regulator?
A. Regulates the charging and discharging of the batteries
B. Prevents the back flow of charges to the solar panels when they are not receiving sun rays especially at night
C. Increases both voltage and current of the PV system
D. Both A and B

15. DC solar system consists of the following components except;

A. An inverter B. Solar charge controller/regulator
C. Batteries D. Solar panels/solar modules

16. A pure sine wave inverter charger is used when:

A. Batteries are to be charged by the solar panels
B. Batteries are to be charged by the grid
C. Batteries are to be charged by both solar panels and grid
D. All the above

17. What is the meaning of days of autonomy

A. Days where the system will be off
B. Days when no sun is expected
C. Days when the solar system will not be working
D. All the above

18. In series connection/wiring,
    A. Voltage is increased
    B. Current is increased
    C. Both voltage and current are increased
    D. All the above

19. If a client has only DC loads, which configuration would you recommend to this client?
    A. Grid tied
    B. Module-Inverter- grid
    C. Module-controller-battery-load
    D. Module- inverter-load

20. Which PV configuration is suitable for solar water pump systems?
    A. Grid tied
    B. Module-Inverter- load
    C. Module-controller-battery-load
    D. All the above

For questions 21 to 23, provide brief answers (2 marks @)

21. Define an inverter and explaine its main importance in a solar system.

22. Explain **two** major factors to consider before choosing ;
    i) An inverter.
    ii) Solar Charge controller/regulator.
    iii) Solar battery.
    iv) Cables.
    v) Solar Panels.

23. Write brief notes on the followining solar system components
    i) DC/DC converter.
    ii) MPPT.
    iii) PWM.
    iv) Batteries.

SECTION B [60 MARKS]

Attempt **ONLY THREE** questions in this Section.

Question 1

a) Explain the different PV system configuration and give **two** advantages and **two** disadvantages of each. **(4 marks)**
b) As a system designer, what do you depend on while choosing a PV system configuration. **(8 marks)**
c) Explain the two main classification of PV system configuration. **(8 marks)**

Question 2

a) Explain the steps for planning PV installation **(5 marks)**
b) Explain the photovoltaic effect **(5 marks)**
c) Explain the safety tips for;
   i) Solar Panel **(2 marks)**
   ii) Solar Panel mounting on roof **(2 marks)**
   iii) Batteries/battery bank **(2 marks)**
   iv) Solar Charge controller **(2 marks)**
   v) An inverter **(2 marks)**

Question 3

a) Define solar power **(2 marks)**
b) List down four disadvantages of solar energy **(4 marks)**
c) Briefly explain two technologies through which solar power can be generated **(4 marks)**
d) With the aid of a diagram, show the connection of the main components of a simple home solar system giving use of each of the components. **(4 marks)**
e) Design the solar power system required for the AC loads given below **(6 marks)**

Load	Quantity	Watts	Hrs./day
Fan	2	40	4
Lights	8	5	6
Phone charging	1	40	2
Radio	1	50	8
Tv	1	120	6

Assume days of autonomy = 3 days
Depth of discharge for a lead acid gel battery (DOD) = 50%,
Battery rated at 12V,100AH with battery efficiency of 86%,
Solar panel rated 100W-12V, short circuit current (Isc) = 6.34A
Sun Peak Hours = 5 Hrs.
Assume 20% system loss and all loads are AC loads

Question 4

Design a solar system for an AC refrigerator of 230 volts consuming power of 500W for 4 hours daily.
Assume 20% system loss and all loads are AC loads
Assume one day of autonomy
Assume Sun peak hour (SPH) of 5.5 hours

Consider;

A solar panel of 250W-24V with short circuit current (Isc) of 6.38A
Lead acid maintenance free gel battery of 150Ah-12V with battery efficiency of 86% and Depth of discharge of 50%.

Determine the size of: **(5 marks @)**

a) An inverter
b) Salar panel
c) Solar Charge Controller/regulator.
d) Batteries/battery bank.