Total number of printed pages: 6 **PG (GET) /2 Semester/ PGET2108**

2021

Solar PV Energy

Full Marks: 60

Time: Two hours

The figures in the margin indicate full marks for the questions.

A. Multiple Choice Questions 1 x 20=20

1. The region where the electrons and holes diffused across the junction is called _____
   a. Depletion Junction
   b. Depletion region
   c. Depletion space
   d. Depletion boundary
2. The current produce by the solar cell can be given by _____
   a) $I_L - I_D + I_{Sh}$
   b) $I_L + I_D - I_{Sh}$
   c) $I_L + I_D + I_{Sh}$
   d) $I_L - I_D - I_{Sh}$
3. Calculate the line voltage in star connection when phase voltage=311 V.
   a. 548.29 V
   b. 538.66 V
   c. 587.28 V
   d. 185.58 V
4. Calculate Fill factor using the data: P_{max}=15 W, V_{oc}=18 V, I_{sc}=4 A.
   a. 0.65
   b. 0.59
   c. 0.20
   d. 0.98
5. The amount of photo generated current increases slightly with an increase in _____
   a. Temperature

b. Photons

c. Diode current

d. Shunt current

6. _____ is one of the most important materials is also known as solar grade silicon.

   a. Crushed silicon

   b. Crystalline silicon

   c. Powdered silicon

   d. Silicon

7. A typical output of a solar cell is _____

   a. 0.1 V

   b. 0.26 V

   c. 1.1 V

   d. 2 V

8. The efficiency of a solar cell may be in the range _____

   a. 2 to 5%

   b. 10 to 15%

   c. 30 to 40%

   d. 70 to 80%

9. The current density of a photo voltaic cell ranges from

   a. 10 – 20 mA/cm^2

   b. 40 – 50 mA/cm^2

   c. 20 – 40 mA/cm^2

   d. 60 – 100 mA/cm^2

10. The most expensive type of the solar cells is:

    a. Amorphous

    b. Polycrystalline

    c. Monocrystalline

    d. None of the above

11. For satellite the source of energy is _____

    a. Cryogenic storage

    b. Battery

c. Solar cell

d. Any of the above

12. Reflecting mirrors used for exploiting solar energy are called _____

a. Mantle

b. Ponds

c. Diffusers

d. Heliostats

13. Which of the following area is preferred for solar power plants_____

a.Coastal areas

b. Hot arid zones

c. Mountain tops

d. High rainfall zones

14. The energy radiated by the sun in bright sunny day is about_____

a. 2.5 kW/m^2

b. 1.0 kW/m^2

c. 500 W/m^2

d. 200 W/m^2

15. In the shade:

a. PV cells absorb much less light

b. less current is generated in PV cells

c. the PV cell is cooler

d. all answers a, b, c

16. Improving the efficiency of a PV cell can be done by:

a. adjusting the light facing angle all day

b. placing colored acetates on the cell

c. cooling the cell

d. changing its direction to north

17. Developing solar energy is important because it:

a. does not produce pollution

b. keeps energy costs down

c. reduces our dependency on imported energy

d. all of the above

18. In a series connection:

a. the positive terminal is connected to the positive terminal

b. the negative terminal is connected to the negative terminal

c. the positive terminal is connected to the negative terminal

d. all of the above

19. The process or phenomena of radiation absorbed by the atmosphere and re-radiated towards the surface of the earth is called_____

a. Formation of smoke and fog

b. Newton effect

c. Greenhouse effect

d. Darwin effect

20 The energy that has been derived from earth's natural resources and that are not finite and non-exhaustible is _____

a. Non-conventional energy or renewable energy

b. conventional energy or renewable energy

c. Non-conventional or non-renewable energy

d. All of the above

B. Very Short Question 2*6=12

1. Find the theoretical maximum overall efficiency of GaAs solar cells in space?
2. How much energy per day (daily load) is used by a remote weather station given the following load characteristics?

Load	**Load Power (W)**	**Run Time (h/day)**
Charge controller	2.2	8
Data gathering	4.0	3
Modem (standby)	1.6	22.5
Modem (send/receive)	30.2	1.5

3. What are the three basic steps in the design of a PV system?
4. At what efficiency is a PV array running if insolation on the collector is 670 W/m^2, the total collector area is 10 m2, the voltage across the array is 50 V, and the current being delivered is 15 A?
5. A PV battery system has an end-to-end efficiency of 77%. The system is used

to run an all-AC load that is run only at night. The charge controller efficiency is 96% and the inverter efficiency is 85%. How much energy will need to be gathered by the PV array if the load is 120 W running for 4 h per night?

6. Discuss the reasons for low efficiency of solar cell?

C Short Question 4*7=28

1. Write short note on PV hybrid system and grid connected solar PV system
2. How photovoltaic power can be used to desalinate sea water for drinking purpose, describe it with neat sketch?
3. Explain the series of processes for the manufacture of crystalline and polycrystalline cells?
4. A monochromatic red laser beam emitting 1 mW at a wavelength of 638 nm is incident on a silicon solar cell. Find the following:

   a. The number of photons per second incident on the cell

   b. The maximum possible efficiency of conversion of this laser

   beam to electricity
5. The reverse saturation current Io of a silicon cell at 40°C is $1.8 \times 10{-}7$ A/m^2. The short-circuit current when exposed to sunlight is 5 A/m2.

   From this information, compute the following:

   a. Open circuit voltage

   b. Maximum power output of the cell

   c. The number of 4 cm × 4 cm cells needed to supply 100 W at 12 V. How must the cells be arranged? (Number of rows and number of panels in a row?)
6. The owner of a small cabin would like to convert her home to PV power. She has the following equipment and associated run times:

Household Equipment	**Power (W)**	**Run Time, day (h)**	**Run Time, night (h)**
Lighting (DC)	25	3	4
Stereo (AC)	40	4	3
Refrigerator (DC)	125	3[a]	3[a]
Water pump (DC)	400	1.5	0.5
Alarm clock (DC)	8	14	14
Computer (AC)	250	3	0
Answering machine (AC)	7	13	13
Coffee pot (AC)	1200	0.5	0

[a] The refrigerator is assumed to run 25% of the time.

a. What is the homeowner's daily energy requirement as measured from the load?

b. If she replaces her alarm clock with a wind-up clock, how much energy per day will she avoid using?

c. What would you suggest she do to cut back her daily load?

7. For the loads listed in above question no.6:

a. What size inverter (peak watts) should she purchase?

b. If the inverter is 88% efficient, how much more daily energy is

required from the PV array as compared to an all-DC system?

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