

Mark scored:

KATHMANDU UNIVERSITY  
End Semester Examination  
July, 2018

Level : B. Sc.  
Year : IV

Course : PHYS 421  
Semester: II

Exam Roll No. : Time: 30 mins.

F. M. : 20

Registration No.:

Date JUL 19 2018

SECTION "A"  
[20 Q × 1 = 20 marks]

Choose and tick the most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

1. The power from the sun intercepted by the earth is .....  
 [a]  $2.1 \times 10^{11} MW$  [b]  $1.8 \times 10^{11} MW$   
 [c]  $6.8 \times 10^{11} MW$  [d]  $9.8 \times 10^{11} MW$
2. The intrinsic carrier concentration for Si is..... per  $cm^3$  at room temperature.  
 [a]  $1.5 \times 10^{10}$  [b]  $1.5 \times 10^{12}$  [c]  $1.5 \times 10^{15}$  [d]  $1.5 \times 10^{20}$
3. The amount of photo generated current increases slightly with the increase in.....  
 [a] Temperature [b] Photons [c] Diode current [d] Shunt current
4. The Auger recombination occurs at a ..... level of carrier concentration.  
 [a] low [b] high  
 [c] intermediate [d] both (a) and (c)
5. 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
6. Dye-sensitized solar cells are made from .....organic dye.  
 [a] Induline [b] Aniline  
 [c] Saranine [d] Ruthiummelallo
7. The GaAs lattice are formed by ..... bonding.  
 [a] ionic [b] Vander-wall [c] metallic [d] covalent
8. ....is an indirect band gap material.  
 [a] CdTe [b] GaAs [c] Si [d] CdS
9. If the dark saturation current,  $I_0 = 1 \times 10^{-10} A$ , Light generated current,  $I_L = 0.5A$ , Voltage,  $V = 0.5V$  then the Current =..... at room temperature.  
 [a] 0 [b] 0.4573 A [c] 1.5 A [d] 2 A
10. Quantum dot solar cells are based on  
 [a] Voltaic cell [b] Galvanic cell  
 [c] Gratzel cell [d] none of the above

Fill in the following blanks with appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

11. Conduction electrons in metals follows .....statistics.
12. The effective mass of electrons and holes in Si at room temperature is .....and .....respectively.
13. In equilibrium condition, the total current in the semiconductor is .....
14. At 300K, the value of thermal voltage is .....
15. The maximum voltage generated across the terminal of a solar cell when they are kept open is called .....
16. The number of photons absorbed in the solar cell if the current density obtained is about  $46\text{mA/cm}^2$  is.....
17. The fill factor is mainly related to the ..... losses in a solar cell.
18. Absorption coefficient is ..... for the photons having energy less than the band gap energy.
19. The worldwide potential of tidal energy is about.....
20. When the source of light is not sun light then the photo voltaic cell is used as.....

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SECTION "B"

[5Q × 4 = 20 marks]

1. What is the current status of solar thermal technologies? What is the current production volume of solar thermal technologies for power generation and for water heating?

OR

A Si sample is doped with  $1 \times 10^{16} P \text{ atoms/cm}^3$ . What will be the minority hole concentration at room temperature? Draw the energy diagram.

2. Explain the concept of direct and indirect band gap. How does the direct and indirect band gap nature of the semiconductor material effect the performance of a solar cell?
3. Explain how a photo voltage is generated across a P-N junction diode when it is illuminated by light.
4. What are the main applications of GaAs solar cells? Point out its advantages and disadvantages.

OR

What solar cells parameters can be extracted from measuring and plotting I-V curve of a solar cell?

5. What are the design criteria for obtaining higher short circuit current of a cell?

SECTION "C"

[5Q × 7 = 35 marks]

6. Intrinsic carrier concentration in a semiconductor is a function of temperature and the band gap of the semiconductor. Explain.

OR

Draw the energy level diagram of a P-N junction diode under equilibrium condition and show all possible carrier movements. Draw the carrier's profiles and explain it in brief.

7. How does the temperature of the solar cell affect its efficiency? Calculate the efficiency and peak value of a Si solar cell operating at  $27^{\circ}\text{C}$ , with short circuit current 2.2A, and operating under the illumination of  $1000\text{W/m}^2$ . The area of the solar cell is  $100\text{cm}^2$ .
8. Explain briefly the different losses in solar cells. How is its electrical loss mechanism different from the optical loss mechanism?
9. If the doping levels at the P-side and N-side of a Si P-N junction are  $5 \times 10^{14} B \text{ atoms/cm}^3$  and  $1 \times 10^{16} P \text{ atoms/cm}^3$ , calculate the built-in voltage of the junction at room temperature. Also estimate the width of the depletion layer.
10. Explain in detail the working mechanism and reaction involved in dye synthesized solar cell.

OR

Write the working principle of thermo photovoltaic system with a schematic diagram.

