Marks scored:

KATHMANDU UNIVERSITY
End Semester Examination [C]
November, 2018
(Special Compt.)

Level : B.Sc.
Year : IV
Exam Roll No. :
Registration No.:

Course : PHYS 421
Semester: II
F. M. : 20
Date NOV 15 2018

Time: 30 mins.

SECTION "A"

[20 Q.× 1 =20 marks]

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

1. At 300 k, the value of thermal voltage is ....
[a] 0.259 V [b] 0.0259 V [c] 1.259 V [d] 0.4569 V

2. ....is an indirect band gap material.
[a] Ge [b] CdTe [c] CdS [d] GaAs

3. A semiconductor has generally .... valence electrons.
[a] 2 [b] 3 [c] 4 [d] 6

4. Per capita energy consumption indicates the state of .... of a country.
[a] solar energy use [b] population
[c] environment [d] development

5. Solar cell with efficiency V_{oc}=0.5 V, I_{sc}=3.5 A, P_{in}=10 W and FF=60% has the efficiency of .... percent.
[a] 6.5 [b] 8.5 [c] 10.5 [d] 12.5

6. A photocell has a short circuit current of 40mA and an open voltage of 0.6V. What value of resistor across the cell would dissipate the most power?
[a] 6.7 Ω [b] 13.5 Ω [c] 18 Ω [d] 20 Ω

7. Conduction electron in metals follows................ statistics.
[a] Fermi-Dirac [b] Maxwell- Boltzmann
[c] Bose-Einstein [d] None of the above

8. The associated CO_2 emissions from PV panels compared to fossil fuels generated electricity are about
[a] 2.8% [b] 4.7% [c] 12.5% [d] 25%

9. The process of adding impurity to a pure semiconductor is called ....
[a] doping [b] diffusion
[c] mixing [d] None of the above

10. Quantum dots solar cells are based on ....
[a] Voltaic cell [b] Galvanic cell
[c] Gratzel cell [d] None of the above

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

11. The power from the sun intercepted by the earth is ....

12. The worldwide potential of geothermal energy is about.........

13. In equilibrium condition, the total current in the semiconductor is ....

14. The random motion of holes and free electrons due to thermal agitation is called ....

15. Free carrier concentration of an intrinsic semiconductor is of the order of .... per cm^3.

16. The life time of the minority charge carrier having diffusion length $(L = 100 \mu m)$ and diffusivity $(D = 25 cm^2 / sec)$ is ....

17. The current through the solar cell when the voltage across the solar cell zero is called ....

18. ....is defined as the ratio of the number of carriers collected by the solar cell to the number of photons of a given energy incident on the solar cell.

19. An optimum silicon solar cell with light trapping and very good surface passivation is about .... μm thick.

20. The equation for a solar cell in the presence of shunt resistance is given by...............

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Semester: II
F. M. : 55

SECTION "B"

[5Q × 4 = 20 marks]

1. What is the current status of solar photovoltaic technologies? What are the different solar photovoltaic technologies? What is the current production volume of solar photovoltaic technologies?

OR

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

2. How does the direct and indirect band gap nature of the semiconductor material effect the performance of a solar cell?

3. What do you mean by contact potential? Show that the contact potential in the case of P-N junction depends on the concentration of the donors and the acceptors and also on the carrier concentration.

4. What are the main applications of GaAs solar cells? Point out its advantages and disadvantages.

OR

Explain solar cells parameters with necessary formula and the I-V characteristics curve.

5. What are the design criteria for obtaining higher open circuit voltage 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

What are the carrier generation and recombination mechanism? Which of the recombination mechanism is most important in Si and GaAs? Explain.

7. Explain series and shunt resistance of a solar cell. How does these resistance of a solar cell affects the FF? what should ideally be the value of series and shunt resistance?

8. Explain briefly the different losses in solar cells. How can these losses be minimized?

9. Explain in detail the working mechanism and reaction involved in dye synthesized solar cell.

OR

Write the working principle of hot carrier solar cell with a schematic diagram. What are its limitations?

10. Calculate the reverse saturation current density of a P-N junction diode if the doping level at the P-side and N-side of the Si P-N junction are $1\times10^{14}B$ $atoms/cm^3$ and $1\times10^{18}P$, respectively, the diffusion length of the electrons and holes are $40\mu m$ and $100\mu m$, respectively and the diffusion coefficient of the electrons and holes are $35cm^2/s$ and $15cm^2/s$ respectively.