KATHMANDU UNIVERSITY
End Semester Examination
July, 2019

Marks Scored:

Level: B.Sc.
Year : IV

Course : PHYS 421
Semester : II

Exam. Roll No.:

Time: 30 mins.

F.M. : 20

Registration No.:

Date :

SECTION "A"
[20Q × 1 = 20 marks]

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

1. The amount of photo generated current increases slightly with the increase in.....
[a] diode current [b] shunt current [c] photons [d] temperature

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

3. The effective mass of electrons in Si at room temperature is .....
[a] $0.18m_0$ [b] $0.81m_0$ [c] $1.18m_0$ [d] $2.18m_0$

4. The diffusion coefficient of electrons in case of Si is .....
[a] 35 [b] 50 [c] 100 [d] 75

5. Solar cell with $V_{oc}= 0.6V$, $I_{sc}= 30mA/cm^2$ and FF= 76% has an efficiency of ..... percent.
[a] 5.50 [b] 8.50 [c] 10.52 [d] 13.68

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. The mobility of electrons in a material is expressed in the unit of .....
[a] V/s [b] $m^2/V-s$ [c] m^2/s [d] J/k

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. Two initially identical samples A and B of pure germanium are doped with donors to concentrations of 1×10^{20} and 3×10^{20} respectively. If the hole concentration in A is 9×10^{12}, then the hole concentration in B at the same temperature will be .....
[a] $3\times10^{12}m^{-3}$ [b] $7\times10^{12}m^{-3}$ [c] $11\times10^{12}m^{-3}$ [d] $27\times10^{12}m^{-3}$

10. Dye-synthesized solar cells are made from ..... organic dye.
[a] Induline [b] Aniline
[c] Saranine [d] Ruthium melallo

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

11. The value of thermal voltage at 300 K is .....

12. The world's estimated reserve of tar sands is about.....

13. A Si sample is doped with $1\times10^{16} P\ atoms/cm^3$. The minority hole concentration at room temperature 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 maximum voltage generated across the terminal of a solar cell when they are kept open is called.....

18. The generation of electron-holes pairs in direct and indirect band gap semiconductor is called .....

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

20. The absorption coefficient of GaAs at 550 nm is about .....

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SECTION "B"
[5Q × 4 = 20 marks]

1. What is the current world energy requirement? How are the world energy requirements going to change in future?

OR

A beam of photons of $500\ nm$ wavelengths is falling on a piece of an indirect band gap semiconductor. The absorption coefficient of the $500\ nm$ photons in the semiconductor is $10^4\ cm^{-1}$. What is the maximum distance the photons would be able to travel in the semiconductor before getting absorbed?

2. Describe the free charge carrier motion under the influence of electric field and concentration gradient?

3. Explain about the continuity of carrier concentration.

4. What is the principle of organic solar cells? What are HOMO and LUMO in organic materials?

OR

Draw the carrier concentration profile of an illuminated P-N junction. Explain the behavior.

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 diagram of a P-N junction diode under equilibrium condition, and show all possible carrier carriers movements. Draw the carrier's profiles.

7. Explain how series and shunt affects the FF and hence efficiency of a solar cell? Also define the term characteristics resistance.

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

9. What is a GaAs solar cell? Mention its structure and properties. What are the main applications of GaAs solar cells? Point out its advantages and disadvantages.

OR

Explain multi-junction solar cell in detail.

10. Calculate the efficiency and peak power of a Si solar cell operating at $27^0 C$, with short circuit current of $2.2A$, and operating under standard illumination of $1000\ W/m^2$. The area of the solar cell is about $100cm^2$.