

Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2017

Level : B.Sc.

Year : IV

Course : PHYS 421

Semester : II

Exam Roll No. :

Time : 30 mins.

F. M. : 20

Registration No. :

Date AUG 18 2017

SECTION "A"

[20 Q. × 1=20 marks]

Choose the most appropriate option.

1. Per capita energy consumption indicates the state of _____ a country.
a) population b) solar energy use c) development d) environment
2. Power from Sun intercepted by Earth is about _____
a) 1.10×10^{11} MW b) 4.0×10^{11} MW
c) 3.0×10^{11} MW d) 10.0×10^{11} MW
3. The bonding in semiconductor is _____ in nature.
a) covalent b) ionic c) hydrogen d) van der Waals
4. Silicon and Germanium crystals are _____ structure.
a) Simple Cubic b) Interleaved BCC c) FCC d) Interleaved FCC
5. Fermi level in *p*-type degenerate semiconductor lies _____
a) just below the conduction band
b) just below the valence band
c) at the middle of conduction and valence band
d) just above the valence band
6. GaAs is a _____
a) indirect band gap semiconductor b) insulator
c) indirect band gap metal d) direct band gap semiconductor
7. Free carrier concentration of intrinsic semiconductor is of the order of _____ per cm^3 .
a) 10^{10} b) 10^{17} c) 0 d) 10^{23}
8. Si Solarcell with $V_{oc} = 0.61$ V, $I_{sc} = 30$ mA and $FF = 76\%$ has efficiency of _____ percentage.
a) 12.0 b) 13.9 c) 13.7 d) 20
9. High bandgap materials are suitable for _____ solar cell.
a) silicon based solar cell b) thermo photovoltaics
c) organic solar cell d) dye-sensitized solar cell
10. Bypass diode in solar cell module is used to _____ series connected cells.
a) hot spots b) absorb more light
c) stop battery charging d) polarity guard

Fill in the blanks with appropriate words.

11. A photon of energy 1.1eV has _____ THz frequency and _____ nm wavelength.
12. Primitive lattice vectors of FCC lattice are _____, _____ and _____ in the unit of a.
13. A Silicon sample is doped with 10^{15} Al atoms per cm^3 , the electron and hole concentrations are _____ and _____ respectively.
14. _____ layer of anti-reflecting coating would highly decrease the reflection.
15. Multi junction solar cell is best for _____.
16. For charging 12 V battery we use PV module with _____ cells in series.
17. In lead acid cell, the overall battery reaction is _____.
18. The period within which the invested money can be recovered and saved is called _____.
19. Four commonly used set points are _____, _____, _____ and _____.
20. Diffusion of excess charge over time and position in a typical semiconductor sample obey the _____ rule.

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F. M. : 55

SECTION "B"

[5Q × 4 = 20 marks]

Attempt *ALL* questions.

1. Write the current status of Photovoltaic technologies, what is its production volume per year?.

OR

If a semiconductor sample is doped with 1×10^{15} P atoms/cm³ draw the energy band diagram showing E_F and E_i .

2. Calculate the density of atoms in [111] plane of Si and Ge, given lattice constant of Si is 5.431 Å and 5.658 Å respectively.
3. Explain how photo voltage is generated at the junction of *p-n* diode while illumination.
4. Briefly discuss the different losses in solar cell.
5. Draw the circuit diagram of buck-boost type DC-DC converter and relate V_{in} to V_{out} .

OR

Design a PV water pumping system to draw 25000 Liter of water from 20m depth during a day. Assume sun shine hour is 6 and pump efficiency is 30% and module used is 100 W_p .

SECTION "C"

[5 Q × 7 = 35 marks]

Attempt *ALL* questions.

6. Derive the I-V relation of *p-n* junction diode and how light illumination modify this current.

OR

Doping levels of *p-n* diode is 5×10^{14} B atoms/cm³ along p-side and 5×10^{14} P atoms/cm³ along n-side. Calculate the build in voltage and width of depletion layer. Assume $n_i = 10^{10}$ cm⁻³, $\epsilon_r = 11.8$ and $\epsilon_0 = 8.85 \times 10^{-12}$ F/m

7. What are the upper limits of V_{OC} and I_{SC} of a Si solar cell, discuss at least one method for both of them.
8. Write the working principle of thermo photovoltaic system with schematic diagram.
9. Discuss the mismatch in series and parallel combinations of solar cells and ways to reduce them.

10. What are the commonly used algorithms for MPPT charge controller? Discuss the climbing hill one in great detail.

OR

Design a solar system with the following load requirements used in non sun shine hours. You are free to choose the component types yourself but it should be on cost minimum basis. Assume 6 hours of Sun shine per day.

Load	Watts	Hour/day	Number
CFL	5	5	4
Fan	40	2	2
TV	100	1	1
Pump	120	1	1
Computer	150	3	2