

KATHMANDU UNIVERSITY
End semester Examination
August / September, 2017

Mark Scored:

Level : B. Sc.

Year : III

Exam Roll No. :

Time: 30 mins.

Course : PHYS 314

Semester : II

F. M. : 20

Registration No.:

Date

SEP 06 2017

SECTION "A"

[20 Q. × 1 = 20 marks]

Choose the most appropriate option.

- Degeneracy of X point in the reciprocal lattice of FCC crystal are _____ fold.
[a] four [b] two [c] six [d] eight
- Bandgaps of Si and GaAs _____ with increase in temperature.
[a] decrease [b] increase [c] do not change [d] exponentially decrease
- Typical bandgap of Germanium crystal at room temperature is _____.
[a] 0.67 eV [b] 0.1 eV [c] 1.0 eV [d] 1.1 eV
- If a material can absorb light of wavelength 550 nm then its band gap will be _____.
[a] 0.55 eV [b] 2.25 eV [c] 3.5 eV [d] 5.5 eV
- A Si crystal is doped with 10^{14} P atoms/cm³, hole concentration will be _____ cm⁻³.
[a] 10^{14} [b] 10^{20} [c] 10^{10} [d] 10^6
- Degenerate semiconductor follows the _____ distribution.
[a] Bose-Einstein. [b] Maxwell-Boltzmann
[c] Fermi-Dirac [d] Gaussian
- Free carrier concentrator of intrinsic semiconductor is of the order of _____ per cm³.
[a] 10^{10} [b] 10^{17} [c] 0 [d] 10^{23}
- Electron affinity of semiconductor is the difference between _____ bands.
[a] valance and min conduction [b] maximum valance and vacuum
[c] higher to lower conduction [d] vacuum to minimum conduction
- Fermi level on the _____ side remains unchanged in Schottky junction.
[a] metal [b] semiconductor
[c] near junction [d] $1/e$ nm from junction
- The first nearest neighbor atoms in fcc crystal are _____.
[a] 12 [b] 6 [c] 8 [d] 4

Fill in the blanks with appropriate words.

- In presence of conducting plane and point charge the work done to carry +1C charge at distance x from infinity will be _____.
- _____ constant $A = 120 \text{ A/cm}^2\text{K}^2$.

13. A Germanium sample is doped with 10^{17} P atoms per cm^3 , the hole and electron concentrations are _____ and _____ respectively. Assume all the dopant atoms ionize.
14. In normal operating mode of transistor _____ junction is forward and _____ junction is reversed biased.
15. Drift transistor has improved _____ factor over the ordinary uniformly doped transistor.
16. In FET the channel is controlled _____ by electric field.
17. Cutoff frequency is where _____ short-circuit gain _____.
18. The doping concentration in tunnel diode is _____ in comparison to ordinary p-n junction diode for rectification.
19. Total forward current in tunnel diode is the sum of three _____, _____, and _____ currents.
20. Gunn diode is the example of _____ device.

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Year : IV
Time : 2hrs. 30 mins.

Course : PHYS 314
Semester : II
F. M. : 55

SECTION "B"

[5Q × 4 = 20 marks]

1. Draw and clearly label the schematic diagrams of energy band structure, density of states, and carrier concentration of a) intrinsic, b) *p*-type and c) *n*-type semiconductors.

OR

Derive the expression of bond length in diamond lattice in terms of lattice constant *a*.

2. Plot and label the charge density, electric field and potential as a function of position and also plot the energy band diagram.
3. What do you mean by image force lowering? Derive the expression for potential difference due to image force lowering at the interface of metal semiconductor junction.
4. Explain the construction and working of a MOSFET.
5. Explain how the forward conduction works in a Silicon controlled rectifier (SCR) with the help of labeled diagram (Derivation of equation is not required)

OR

Using two band model calculate the drift velocity in GaAs and InP crystals. Use the input parameters of the crystals as realistic as possible.

SECTION "C"

[5 Q × 7 = 35 marks]

6. Derive the I-V relation of *p-n* abrupt junction diode with ideality factor η . Explain the situations of forward and reverse bias with energy band diagrams.

OR

For *n*-type Silicon sample doped with $2.86 \times 10^{16} \text{ cm}^{-3}$ P atoms, find the ratio of the neutral to ionized donors at 300 K. Given $E_C - E_D = 0.045 \text{ eV}$.

7. How the decay of excess carriers happens with distance and time independently?
8. Derive the expression of thermionic emission current at metal semiconductor junction.
9. Calculate the tunneling probability and current in tunnel diode. Use triangular potential barrier.
10. Discuss various modes of operations of TED devices. Use plots and equations to explain but derivations are not required.

OR

For metal-*n*-Si contact, the barrier height obtained by photoelectric measurement is 0.65 V while the voltage intercept obtained is 0.5 V. What will be the doping concentration using uniformly doping model? Use required input parameters as close as possible to real case.

