Total No. of Questions : 5]

SEAT No. :

**P2675**

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# M.Sc. I
# ELECTRONIC SCIENCE
# ELIUT01 : Foundation of Semiconductor Devices
# (2008 Pattern) (Semester - I)

*Time : 3 Hours]* *[Max. Marks : 80*

***Instructions to the candidates:***

1) ***All questions are compulsory.***
2) ***Figures to the right side indicate full marks.***
3) ***Draw neat diagrams wherever necessary.***
4) ***Use of non-programmable calculator is allowed.***

***Q1)*** Attempt any two of the following: **[2 × 8 = 16]**

a) What is ambipolar transport? Derive the ambipolar transport equation. State application of it.

b) What is distribution function? Explain Fermi-Dirac probability function at absolute zero and higher temperature.

c) Explain low frequency small signal two port equivalent circuit of BJT.

***Q2)*** Attempt any two of the following: **[2 × 8 = 16]**

a) Define the following terms:

i) lattice

ii) basis

iii) primitive vector.

For a bcc lattice of identical atoms with a lattice constant of 5A. Calculate maximum packing fraction and radius of atom. Assume atoms are hard spheres with nearest neighbours touching.

b) Explain principle of LED with energy level diagram. Why specific materials are used in LED?

c) Explain depletion mode and enhancement mode of MOSFETS. Show diagrametically $I_D$-$V_{DS}$ relationship for n-channel depletion mode MOSFET.

***P.T.O.***

***Q3)*** Attempt any four of the following: **[4 × 4 = 16]**

a) Define Miller indices of crystal planes. What are its applications?

b) Describe concept of excess carrier generation and recombination rate across a semiconductor.

c) Explain concept of buit in potential

i) under zero bias

ii) forward bias and

iii) reversed bias

d) Explain construction and energy level diagram of HBT. What are its special feature over BJT?

e) Explain the operation of MOS capacitor with suitable diagram.

***Q4)*** Attempt any four of the following: **[4 × 4 = 16]**

a) Explain the position of Fermi-level in extrinsic semiconductor. Draw energy band diagram with suitable equations.

b) Explain zener effect and avalanche effect in a reverse - biased pn junction.

c) Explain SCR structure, obtain relationship for switching action of SCR using two - transistor equivalent model.

d) Following are transistor parameters

$I_E$ = 1mA, $\beta$ = 100, $C_{je}$ = 1 PF, total emitter to collector time delay $\tau_{ec}$ = 103.9 PS at T = 300 k

Find : i) emitter resistance $r_e$

ii) cut off frequency $f_T$

iii) beta cutoff frequency $f_\beta$

Given K = $8.62 \times 10^{-5}$ ev/k.

e) Describe internal pinch off voltage and pinch off voltage of JFET, Give suitable mathematical relationships.

***Q5)*** Attempt any four of the following: **[4 × 4 = 16]**

a) Calculate first three energy levels of an electron in an infinite depth potential well of width 6A.

Given $\hbar = 1.054 \times 10^{-34}$ JS.

$m_e = 9.11 \times 10^{-31}$ kg.

b) Explain concept of effective mass.

c) Draw and explain I-V characteristic of a pn junction diode - obtain expression for ideal - diode equation of pn junction.

d) Explain Eber-moll model for BJT with equivalent circuit diagram.

e) Explain small-signal equivalent circuit for MOSFET amplifier. Obtain drain current relationship with $V_{gs}$.