Registration No: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech**
BSCP1207

3rd Semester Back Examination 2017-18
Physics of Semiconductor Devices
BRANCH : AEIE, BIOTECH, CSE,
ECE, EEE, EIE, ELECTRICAL, ETC, IEE, IT
Time : 3 Hours
Max Marks : 70
Q.Code : B878
Answer question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2×10)**

a) How is density of states related to energy in 3-dimensional metal?
b) What is the difference between direct band gap semiconductor and indirect band gap semiconductor?
c) Give examples of two materials for each case:
(a) indirect band gap semiconductor and
(b) direct band gap semiconductor.
d) What are the ways to make Ohmic contacts?
e) Define common-emitter current gain and common-base current gain.
f) Explain effective Richardson constant.
g) Why is Schottky junction diode preferred over pn junction diode for high-frequency device application?
h) Define Flat-Band voltage and Threshold voltage for MOS capacitor.
i) What do you mean by compensated semiconductors and compound semiconductor?
j) How is reverse saturation current of a pn junction diode related to temperature?

Q2 **a)** Show that in long pn junction diode, minority carrier concentration exponentially decreases with distance from edge of depletion region if low injection rate is assumed. **(5)**
b) Derive current-voltage relationship for ideal pn junction diode. **(5)**

Q3 **a)** Derive ambipolar transport equation. **(5)**
b) Show that, at low injection rate, ambipolar transport equation could be written by using minority carrier parameters. **(5)**

Q4 **a)** Explain Schottky effect. Show that actual Schottky barrier height proportionately related to position of maximum barrier height due to Schottky effect. **(5)**
b) Show that the Schottkey barrier lowering is around 0.03 V and the position of maximum barrier height is around 2 nm away from junction if it is assumed that
$E = 6.8 \times 10^4$ V/cm, inside the semiconductor. **(5)**

Q5 **a)** Explain thermoionic emission theory proposed by Bethe . **(3)**
b) Derive formula for current density due to flow of electron from n-type semiconductor to metal in a Schottky junction. **(7)**

Q6 **a)** Derive formula for concentration of electron in conduction band for an intrinsic semiconductor at temperature T. **(5)**

b) Show that for intrinsic semiconductor, Fermi level lies around middle of band gap at room temperature. **(5)**

Q7 **a)** Show that conductivity of an intrinsic semiconductor exponentially decreases with band gap at constant temperature. **(5)**

b) Explain the mechanisms mainly responsible for pn junction breakdown. **(5)**

Q8 **a)** Explain about the formation of accumulation, depletion and inversion layer at Silicon Oxide/n-type Silicon interface with diagram. **(5)**

b) Draw the energy band diagram of metal – oxide- semiconductor (p-type) structure before contact and after contact at thermal equilibrium. **(5)**