# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

**Paper Code : EC-302**

## SOLID STATE DEVICES

*Time Allotted* : 3 Hours | *Full Marks* : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

### GROUP – A
### ( Multiple Choice Type Questions )

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) Solar cell is a

a) photodetector

b) photodiode

c) photovoltaic device

d) optical emitter.









ii) Which of the following is not a negative resistance device ?

a) Tunnel diode b) Zener diode

c) Impatt diode d) Gunn diode.

iii) If V is the voltage applied to the metal with respect to the *p*-type semiconductor in a MOS capacitor then $V < 0$ corresponds to

a) Depletion b) Accumulation

c) Inversion d) Strong inversion.

iv) When a positive voltage is applied to a $p-n$ junction, the barrier potential will be

a) decreased b) increased

c) unchanged d) none of these.

v) Effective electron mass depends on

a) temperature

b) doping concentration

c) bandgap

d) curvature.

vi) In case of BJT, the base width should be narrow to minimize

a) drift current

b) diffusion current

c) recombination current

d) tunnelling current.

vii) To turn off SCR, it is necessary to reduce its current to less

a) Trigger current

b) Holding current

c) Break-over current

d) none of these.

viii) Photodiode operates in

a) reverse bias

b) forward bias

c) without bias

d) none of these.









ix) A transistor configuration having highest current gain

a) Common base

b) Common collector

c) Common emitter

d) Emitter follower.

x) Metal *n*-type semiconductor form Ohmic contact if

a) $\varphi_m > \varphi_s$ b) $\varphi_m = \varphi_s$

c) $\varphi_m = 2\varphi_s$ d) $\varphi_m < \varphi_s$.

xi) Intrinsic carrier concentration depends on

a) bandgap

b) temperature

c) both (a) and (b)

d) none of these.

xii) Above Pinch off voltage in a JFET the current

a) decreases

b) becomes saturated

c) increases sharply

d) none of these.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. $3 \times 5 = 15$

2. a) What is density of states ?

   b) Explain the plot of Fermi-Dirac distribution function with energy for different temperatures.

   c) 3 volt is applied across a 1 cm long Si bar. Determine mobility with the drift velocity is 104 cm/s. 1 + 2 + 2

3. a) What are mobility and conductivity ?

   b) What are the effects of temperature and doping on mobility ? 2 + 3

4. a) What is meant by *DC* operating point or *Q* point in the context of transistor characteristics ?

   b) What is load line ? Why is biasing necessary ? 2 + 3

5. What is early effect ? Explain how the early effect modifies the input current in case of CB and CE configuration of an *n-p-n* transistor. 2 + 3









6. What are direct band gap and indirect band gap semiconductor ? Draw the E-K diagram of Si and GaAs. 2 + 3

## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Draw the V-I characteristics of JFET & explain it.

   b) Draw the small signal model.

   c) JFET has $V_p = 4 \cdot 5$ V, $I_{DSS_s} = 10$ mA and $I_{DS} = 2 \cdot 5$ mA. Determine the transconductance. 8 + 2 + 5

8. a) Describe briefly the principle of operation of a tunnel diode. Draw The I-V characteristics and mention the *– ve* resistance region.

   b) What is Thermal runway ?

   c) What is photo transistor ? 5 + 3 + 3 + 4

9. a) Derive the equation for the different current components in a BJT by Ebers-Moll model.

b) Describe the basic structure of schottky diode and explain why it is suitable for high frequency operation. 10 + 3 + 2

10. a) What is heterojunction ? What are the difference between schottky contact and ohmic contact ?

b) Show that for intrinsic semiconductor, the energy of Fermi level, $E_F = (E_C + E_V)/2$, where $E_C$ and $E_V$ are energy of conduction band and valance band.

2 + 3 + 10

11. Write short notes on any *three* of the following : 3 × 5

a) Varactor diode

b) Hall effect

c) Effective cell

d) Solar cell

e) PIN photodiode

f) Channel length modulation.