



Name :

Roll No. :

Invigilator's Signature :

**CS/B.Tech(ECE-N)/SEM-3/EC-302/2011-12
2011**

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) If a voltmeter is connected across the terminal of an unbiased Germanium *p-n* junction diode, the voltmeter reading will be
 - a) 0 V
 - b) 0.3 V
 - c) 0.6 V
 - d) 1.0 V.
 - ii) The capacitance of a varactor diode can be changed by varying
 - a) bias voltage
 - b) doping level
 - c) size of the diode
 - d) all of these.
 - iii) Which of the following diodes does not possess a negative resistance region in its characteristics ?
 - a) Tunnel diode
 - b) Gunn diode
 - c) Zener diode
 - d) IMPATT diode.
 - iv) At $T = 0K$, the Fermi-Dirac distribution function vs energy plot takes the form
 - a) step
 - b) linear
 - c) parabolic
 - d) exponential.



- xi) A voltage variable capacitance can be realized in
- Zener diode
 - Avalanche diode
 - Schottky diode
 - Varactor diode.
- xii) A BJT used in CE configuration offers
- low input impedance and high output impedance
 - high input impedance and low output impedance
 - low input and output impedances
 - high input and output impedances.

GROUP - B

(Short Answer Type Questions)

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

- What are direct band gap and indirect band gap semi-conductors? Draw the $E - K$ diagrams for Si and GaAs. $3 + 2$
- What is ambipolar transport? Why carrier generation and recombination rates are equal in thermal equilibrium? $2 + 3$
- What is contact potential? Derive an expression for it involving impurity concentration on either side of the structure. $2 + 3$
- Define mobility and write down its unit. Also give an equation that relates the mobility and diffusivity of carriers in a semi-conductor. What is the significance of the equation? $1 + 1 + 2 + 1$
- What do you mean by Pinch-off condition in JFET? Briefly describe the situation. $2 + 3$

GROUP - C

(Long Answer Type Questions)

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

- What is 'law of mass action'? Explain its significance. 4
 - Describe different breakdown mechanisms that may occur in a reverse biased semi-conductor $p-n$ junction diode. 11



8. a) With the help of energy band diagram, describe formation of Schottky barrier at the junction between a metal and an n -type semi-conductor. Explain why a Schottky diode is faster than a p - n junction diode. 6 + 2
- b) Describe the origin of 'diffusion capacitance' and 'depletion capacitance' in a p - n junction. Also discuss their dependence on the biasing condition of the diode. 5 + 2
9. a) What is early effect ? Explain how it influences the input characteristics of a BJT in CB configuration. 3 + 3
- b) Draw the output characteristics of a BJT used in CB configuration. Indicate different regions in the characteristics and explain them. 3 + 6
10. a) With the help of energy band diagram, explain the I-V characteristics of a tunnel diode. 7
- b) Describe operation of a $pnpn$ -structure on the basis of two-transistor analogy. 4
- c) Sketch the transfer characteristics of a depletion MOSFET operated in both depletion mode and enhancement mode. 4
11. Write short notes on any *three* of the following : 3 × 5
- a) Solar cell
 - b) Hall effect
 - c) Effective mass
 - d) PIN photodiode
 - e) Gunn diode.