



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 × 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  $T = 0\text{K}$ , the Fermi-Dirac distribution function *vs* energy plot takes the form ..... .
 

a) step	b) linear
c) parabolic	d) exponential.

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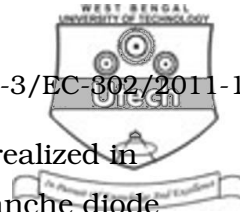
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surface and Fermi  
in an  $n$ -channel

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- 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.  $2 + 3$

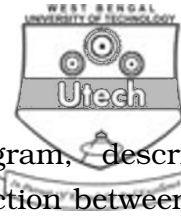
### GROUP – C

#### ( 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

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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.