



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (ECE-OLD)/SEM-3/EC-301/2011-12**

**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**

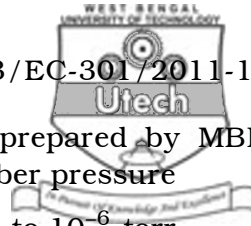
**( Multiple Choice Type Questions )**

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

- i) Si has the lattice patterns of
  - a) FCC type
  - b) Hexagonal type
  - c) Diamond type
  - d) Zinc blende type.
- ii) Doping effect of semiconductor results with the change of
  - a) Fermi level only
  - b) Bandgap only
  - c) Electrical conductivity only
  - d) All of these.
- iii) Zener diodes are
  - a) specially doped  $p$ - $n$  junction
  - b) normally doped  $p$ - $n$  junction
  - c) lightly doped  $p$ - $n$  junction
  - d) none of these.



- iv) Diffusion current in a p-n junction is influenced by
- a) concentration gradient of carriers
  - b) applied voltage
  - c) concentration of carriers
  - d) none of these.
- v) The doping level of emitter region of a transistor is
- a) greater than collector and base regions
  - b) less than collector and base regions
  - c) less than base but greater than collector region
  - d) greater than base but less than collector region.
- vi) Transistor switching transient time depends on
- a) carrier recombination life time
  - b) current amplification factor
  - c) both (a) & (b)
  - d) none of these.
- vii) Pinch-off voltage of FET depends on
- a) channel width
  - b) doping concentration of channel
  - c) applied voltage
  - d) both of (a) & (b).
- viii) For design of high speed electronic system the preferred one should be
- a) Si n-MOS
  - b) Si p-MOS
  - c) GaAs n-MOS
  - d) GaAs p-MOS.
- ix) Responsivity of photodetector varies an operating wavelength ( $\lambda$ ) as
- a)  $\lambda$
  - b)  $\lambda^2$
  - c)  $\lambda^{-1}$
  - d)  $\lambda^{-2}$ .



- x) Good quality semiconductor device prepared by MBE process involves the fabrication chamber pressure
- a)  $10^{-3}$  to  $10^{-4}$  torr      b)  $10^{-5}$  to  $10^{-6}$  torr
- c)  $10^{-10}$  to  $10^{-11}$  torr      d) None of these.
- xi) IMPATT stands for
- a) Impact Ionization Avalanche Transit Time
- b) Impact Ionized Avalanche Triggered Transit
- c) Impedance Ionized Avalanche Triggered Transit
- d) None of these.
- xii) The following is not a negative resistance device
- a) Zener diode      b) IMPATT diode
- c) Gunn diode      d) LED.

### GROUP – B

#### ( Short Answer Type Questions )

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

2. What are Miller indices of a crystal ? A plane intercepts at  $2a$ ,  $b/2$ ,  $3c$  in a simple cubic unit cell. What are Miller indices in a plane ?  $1 + 2 + 2$
3. Explain the principle of operation of a solar cell and define 'photovoltaic *emf*' and fill factor.
4. Describe briefly the basic structure of a schottky diode and explain why it is suitable on high frequency operation.
5. Sketch the cross-sectional view of a p-channel MOSFET with proper labels. Define flat band voltage and capacitance of a MOS device.
6. a) Why is Gunn diode called hot electron device ? 2
- b) Define avalanche resonance frequency of an Impatt diode. What is the main limitation of impatt diode ? 3



**GROUP – C**

**( Long Answer Type Questions )**

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

7.
  - a) Explain the working principle of a Zener diode and its use as a reference voltage device.
  - b) What is the difference between step graded and linearly graded semiconductor PN junction ?
  - c) Define diffusion capacitance and storage capacitance in PN junction.
8.
  - a) What is photovoltaic effect ?
  - b) What are quantum efficiency and responsivity ?
  - c) Write down the basic operating principle of solar cell. Derive the expression for  $V_{OC}$ .
9.
  - a) What do you mean by MOS capacitor ? 2
  - b) Draw the C-V dependence curve and specify the three different region in the graph. 2
  - c) Define flat band voltage with respect to MOS devices. 2
  - d) Derive the expression for flat band voltage and from there specify the expression for threshold voltage. 7 + 2
10.
  - a) Discuss the basic principle of operation and  $I_d - V_{ds}$  characteristics of  $n$ -channel JFET.
  - b) Derive the expression of pinch-off voltage for JFET.
  - c) Compare the properties of BJT and FET. How do you use JEET as VVR ? 5 + 5 + ( 3 + 2 )
11. Write short notes on any *three* of the following : 3 × 5
  - a) Varactor diode
  - b) Photolithography
  - c) Light emitting diode
  - d) Tunnel diode
  - e) P-I-N diode.