

Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(ECE-N)/SEM-3/EC-302/2012-13

2012

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) A *p*-type semiconductor contains holes and
 - a) Positive ions b) Negative ions
 - c) Pentavalent atoms d) Donor atoms.
- ii) Diffusion of free electrons across the junction of an unbiased diode produces
 - a) Forward bias b) Reverse bias
 - c) Breakdown d) the Depletion Layer.

3154(N)

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iii) When a pentavalent impurity is added a semiconductor becomes

- a) positively charged b) negatively charged
- c) neutral d) none of these.

iv) PIN diode has

- a) p and n layers separated by I layer
- b) p^+ and n^+ layers separated by I layer
- c) $p -$ and $n -$ layers separated by I layer
- d) either (b) or (c).

v) Under high electric fields, in a semiconductor with increasing electric field

- a) the mobility of charge carriers decreases
- b) the mobility of charge carriers increases
- c) velocity of carriers saturate
- d) both (a) and (c).



vi) Compared to Field effect phototransistors, bipolar phototransistors are

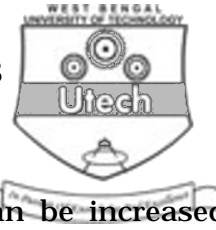
- a) more sensitive and faster
- b) more sensitive and slower
- c) less sensitive and slower
- d) less sensitive and faster.

vii) The probability of recombination of EHP in semiconductor is proportional to

- a) density of electrons
- b) density of holes and electrons
- c) density of holes
- d) none of these.

viii) Diffusion constant of holes and electrons are in ratio 4 : 1. Then the mobility of holes and electrons will be in the ratio

- a) 4 : 1
- b) 16 : 1
- c) 1 : 4
- d) 1 : 16.



ix) Consider the following statements :

The threshold voltage of a MOSFET can be increased by

1. Using thinner Gate oxide
2. Reducing the Substrate concentration
3. Increasing the Substrate concentration

of these

- a) (3) alone is correct
- b) (1) and (2) are correct
- c) (1) and (3) are correct
- d) (2) alone is correct.

x) Consider the following w.r.t. tunnel diode :

1. It is a 2 terminal device with no isolation between input and output
2. Same current can be achieved at 3 different voltage levels.

of these

- a) (1) only
- b) (2) only
- c) (1) and (2)
- d) none of these.



xi) If for CE model

$h_{ie} = 1 \text{ k.ohm}$, $h_{fe} = 50$ then for

common collector model h_{ie} , h_{fe} will be

- a) 1 k.ohm, 50 b) 1 k.ohm, -51
c) 1/51 k.ohm, 50 d) 1/51 k.ohm, -51.

xii) In a voltage regulator circuit, the maximum value of load current can be

- a) 2.5 mA b) 0.9 mA
c) 1.6 mA d) 3.4 mA.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Draw & explain E-K diagram for a direct & indirect band gap semiconductor with suitable example.
3. What is mobility & conductivity ? Define effective mass. Derive relation ship between energy & momentum. 1 + 1 + 3
4. State the difference between a *p-n* junction diode & Schottky diode. Describe punch through effect in BJT. 2 + 3
5. Explain negative differential resistance that occurs in an IMPATT diode.



GROUP - C

(Long Answer Type Questions)

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

6. Draw the V-I characteristic of JEET & explain it.

Draw FET small signal model. A JFET has $V_p = -4.5V$,
 $I_{dss} = 10m \text{ Amp}$ & $I_{ds} = 2.5 \text{ mA}$. Determine the
transconductance. $7 + 8$

7. Explain band bending & channel inversion in case of NMOS.

What is channel length modulation ? $10 + 5$

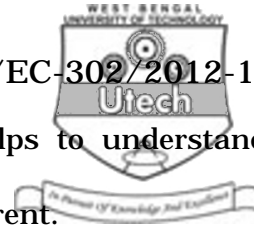
8. Briefly explain the operation of a photodiode. Explain how an
LED works as a source of light. Find the expression of drift
current in a $p-n$ junction diode. $5 + 5 + 5$

9. Explain how a Zener diode works as a voltage regulator.

Derive the expression for the depletion width along a $p-n$
junction. $5 + 10$

10. Write down the names of different steps in IC fabrication.

Explain photolithography. $5 + 10$



11. a) Explain how the junction theory helps to understand the gate control over the channel current.

b) Justify the reason of high doping of the gate compared to the channel doping.

8 + 7

