Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (ECE-OLD)/SEM-4/EC-405/2013

2013

MICROELECTRONICS & OPTO-ELECTRONIC 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) When a transistor is used as switch its operation is confined to

   a) cut-off region b) saturation region

   c) active region d) both (a) & (b).

   ii) In a state of saturation a MOSFET acts as

   a) a close switch b) an open switch

   c) an amplifier d) an inductor.

   iii) Electron affinity depends on

   a) semiconductor material

   b) doping of the semiconductor

   c) applied potential

   d) none of these.

iv) Charge coupled devices are used to

a) store the charge b) transfer the charge

c) both (a) & (b) d) none of these.

v) Which of the following pairs are suitable for making a heterojunction ?

a) Si & Ge b) Si & GaAs

c) GaAs & AIAs d) GaAs & GaAlAs.

vi) Metal *n*-type semiconductor form ohomic contact if

a) $\varphi_m > \varphi_{sn}$ b) $\varphi_m = \varphi_{sn}$

c) $\varphi_m < \varphi_{sn}$ d) none of these.

vii) Stimulated emission is observed in

a) LED b) LASER

c) Solar cell d) Photodiode.

viii) Bulk micromachining makes micromechanical devices by etching deeply into

a) Germanium wafer b) Carbon wafer

c) Silicon wafer d) Gallium wafer.

ix) In Schottky barrier diode, the current mechanism is due to

a) minority carrier b) majority carrier

c) both (a) & (b) d) none of these.

x) Bilateral switch is

a) DIAC b) IGBT

c) Thyristor d) None of these.

xi) The condition, where the majority carrier concentration is greater near the Si-SiO_2 interface compared to the bulk in the MOSFET is called

a) accumulation b) depletion

c) inversion d) none of these.

xii) The radiative and non-radiative life time of an LED are 2·5 ms and 60 ms respectively. The internal quantum efficiency is

a) 96% b) 24%

c) 100% d) 104%.

GROUP – B

(Short Answer Type Questions)

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

2. What is a heterojunction ? How many types of heterojunctions are possible ? Draw the band diagrams of each type of heterojunction. 1 + 1 + 3

3. What do you mean by a two-dimension electron gas ? What are the advantages of two dimension electron gas ? 3 + 2

4. Describe with suitable diagrams the operation of a CCD.

5. Discuss the principle of operation of vertical power BJT.

6. With energy band diagram describe Schottky junction barrier formation. Describe its operation under external bias. 2 + 3

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) What is SCR ? Point out its major uses.

b) By using two-transistor analogy, briefly describe the basic operation of two-terminal SCR.

c) How does the presence of third terminal control the I-V response of SCR ? Explain with system diagram. 4 + 6 + 5

8. a) Explain how we can design a high electron mobility system using heterojunction.

b) What are the advantages of high electron mobility system ?

c) What do you mean Ballistic transport ? 6 + 4 + 5

9. a) What are Bulk micromachining and surface micromachining ?

b) Describe each with schematic diagrams. 5 + 10

10. a) What do you mean by luminescence proces ?

b) How does an LED work ?

c) Show the construction of typical LED.

d) What are the applications of LED ? 3 + 5 + 5 + 2

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

a) MEMS pressure sensor

b) OEIC

c) Laser diode

d) Solar cell

e) MOSFET scaling.