Code: AE25 **Subject: PHYSICAL ELECTRONICS AND SOLID STATE DEVICES**
Time: 3 Hours **Max. Marks: 100**

JUNE 2011

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. A Germanium atom contains

(A) Four orbits **(B)** Only two orbits
(C) 5-valence holes **(D)** 4-valence electrons

b. Zener breakdown depends on

(A) Electric field created across the depletion region
(B) Velocity of the carriers
(C) Number of donor ions
(D) Number of acceptor ions

c. In any specimen, the Hall voltage is proportional to

(A) Magnetic field B **(B)** B^2
(C) 1/B **(D)** $1/B^2$

d. In a reverse biased p-n junction diode, the density of minority carrier holes in the n-region at the junction equals

(A) Thermal equilibrium value pn_o **(B)** Zero
(C) $pn_o/2$ **(D)** $pn_o/4$

e. As the magnitude of the reverse collector junction voltage increases, the effective base-width

(A) Increases .**(B)** Decreases
(C) Remains unaffected. **(C)** Becomes zero.

f. In a p-n-p transistor, the emitter current flows

(A) Out of emitter lead **(B)** Out of base lead
(C) Into the emitter lead **(D)** Neither out nor in the emitter lead

g. A photoconductive cell is basically a

(A) Light-emitting diode (LED) **(B)** Light dependent resistor
(C) Photo-diode **(D)** Photo-electric relay

h. The diode in which the impurities are heavily doped is

(A) Varactor diode **(B)** PIN diode
(C) Tunnel diode **(D)** Zener diode

i. The SiO_2 layer in an IC acts as

(A) Insulating layer **(B)** Conducting layer
(C) Ionisation layer **(D)** Ohmic layer

j. The most commonly used integrated circuits are

(A) Monolithic **(B)** Flatpack
(C) Hybrid **(D)** None in particular

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Distinguish between depletion mode and enhancement mode MOSFETs. Explain the mechanism that leads to channel 'pinch off' at higher drain source voltage drop. **(8)**

b. Explain the phenomenon called 'Early Effect' **(8)**

Q.3 a. Explain why the performance of a bipolar transistor degrades at high frequencies. Discuss the important design considerations of a high frequency transistor. **(8)**

b. The intrinsic resistivity of germanium at 300° K is 47 Ohm-cm. What is the intrinsic carrier concentration? Given: $\mu_n = 3900\,cm^2$ per volt-sec and $\mu_p = 1900\,cm^2$ per volt-sec. **(8)**

Q.4 a. Explain 'crystal growth' and 'wafer preparation' in relation to monolithic IC processing. **(8)**

b. Explain the construction of a varactor diode. Give important applications of this diode. **(8)**

Q.5 a. Outline an experimental set up with necessary precautions for determining Hall coefficient in a given semi conducting specimen. **(8)**

b. Write a short-note on "charge transfer devices". **(8)**

Q.6 a. Explain the origin of the negative differential mobility in a Gunn diode. Mention some uses of Gunn oscillators. **(8)**

b. Explain the working of an IMPATT diode. What are the applications of this diode? **(8)**

Q.7 a. Prove that the Fermi level lies approximately at the centre of the energy-gap at room temperature in case of an intrinsic semiconductor. **(8)**

b. Explain short-channel effects in NMOS-transistor. **(8)**

Q.8 a. Consider an abrupt p-n junction solar cell with uniformly doped n- and p-regions. Draw the energy band diagrams of the illuminated cell under (i) the short circuit condition and (ii) the open circuit condition. **(8)**

b. Discuss the following with respect to BJT
(i) Punch-Through effect.
(ii) Current crowding effect. **(8)**

Q.9 a. Consider a p-n junction diode with a Schottky barrier. Draw a band diagram, labelling the pertinent features to show the electron potential energies, both before and after the contact is made. **(8)**

b. Compare Monolithic IC's and Hybrid IC's advantages & disadvantages? **(8)**