Code: AE2 **DECEMBER 2008**

Subject: PHYSICAL ELECTRONICS AND SOLID STATE DEVICES

Time: 3 Hours **Max. Marks: 100**

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.**
- **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 best alternative in the following: (2x10)

a. A diode that has no depletion layers and operates with hot carriers is the

(A) Tunnel diode **(B)** Gunn diode
(C) IMPATT diode **(D)** Schottky diode

b. For the operation of enhancement mode N channel MOSFET, value of gate voltage has to be

(A) high positive **(B)** high negative
(C) low negative **(D)** zero

c. A photo diode always operates under

(A) forward bias. **(B)** reverse bias.
(C) both are true. **(D)** zero bias.

d. PN junctions are classified as abrupt junctions and linearly graded junctions based on

(A) depletion layer width **(B)** doping concentration gradient
(C) built-in potential **(D)** breakdown voltage

e. JFET are normally used in

(A) ohmic region **(B)** saturation region
(C) cut-off region **(D)** breakdown region.

f. Silicon is the preferred material for manufacturing zener diodes because it

(A) is relatively inexpensive.
(B) needs low doping level.
(C) has high temperature and current capacity.
(D) has low break down voltage.

g. Transistors are

(A) current controlled current source.
(B) current controlled voltage source.
(C) voltage controlled current source.
(D) voltage controlled voltage source.

h. The low field electron mobility depends on

(A) Doping. **(B)** Electric field.
(C) Temperature. **(D)** None of the above.

i. In a laser, the following processes have to be minimized

(A) Absorption only.
(B) Absorption and spontaneous emission.
(C) Absorption and stimulated emission.
(D) Stimulated emission only.

j. Diode breakdown can be due to

(A) Zener effect. **(B)** Tunneling effect.
(C) Avalanche effect. **(D)** Any of these.

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

Q.2 a. The intrinsic sample of Germanium crystal has a hole density of 10^{13} per cm^3 at the room temperature. When doped with antimony so as to contain 10^{15} impurity atoms / cm^3, the hole density decreased to 10^{11} per cm^3 at the same temperature. Calculate the majority carrier density. **(8)**

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

Q.3 a. Explain why turn-on transient of a BJT is faster when the device is driven into over saturation. **(8)**

b. Differentiate between VLSI, LSI and MSI. Why do MOS ICs find wide applications in VLSI chips. **(8)**

Q.4 a. Consider a p-n junction diode with a Schottky barrier. Draw band diagrams, labelling the pertinent features to show the electron potential energies, both before and after the contact is made. **(8)**

b. Explain the formation of domains in a Gunn diode. Discuss LSA mode in brief. **(8)**

Q.5 a. Explain Hall-effect and describe its three applications. **(6)**

b. A sample of Germanium shows no Hall effect. If the mobility of electrons in Germanium is 3500 cm^2 / V-sec and that of holes is 1400 cm^2 / V-sec, what fraction of the current in the sample is carried by electrons? **(10)**

Q.6 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' in BJT. **(8)**

Q.7 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. Explain the working of a Tunnel diode and also explain, how it exhibits the negative resistance. **(8)**

Q.8 a. Describe the various steps used in the formation of a typical monolithic integrated circuit. **(8)**

b. Explain the operation of charge transfer devices. Also discuss any two application of the device. **(8)**

Q.9 a. Consider an abrupt p-n junction solar cell with uniformly doped n-and p-regions. Draw the energy band diagram of the illuminated cell under
(i) the short-circuit condition and
(ii) the open-circuit condition. **(8)**

b. Describe the principle of working of an LED. What are the merits of LEDs? **(8)**