AMIETE – ET (OLD SCHEME)

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

JUNE 2009

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 the best alternative in the following: **(2 × 10)**

a. A photo diode operates in _____ of I-V characteristics

(A) Ist quadrant **(B)** IInd quadrant
(C) IIIrd quadrant **(D)** IVth quadrant

b. To operate BJT in active mode

(A) $V_{BE} > 0, V_{CB} > 0$ **(B)** $V_{BE} < 0, V_{CB} > 0$
(C) $V_{BE} > 0, V_{CB} < 0$ **(D)** $V_{BE} < 0, V_{CB} < 0$

c. Schottky barrier is a

(A) metal semiconductor junction
(B) p-n semiconductor junction
(C) semiconductor insulator junction
(D) metal insulator junction

d. A diode having negative resistance is

(A) PIN diode **(B)** PN Junction diode
(C) Tunnel diode **(D)** Schottky diode

e. FET is

(A) current controlled device .
(B) a device having low input resistance.
(C) a unipolar device.
(D) a device that offers large gain-bandwidth product.

f. Junction capacitance is related with barrier potential as

(A) $C = KV^{-1/2}$ **(B)** $C = KV^{+1/2}$
(C) $C = KV$ **(D)** $C = \frac{K}{V}$

g. Fermi level in an intrinsic semiconductor lies

(A) in the middle of the conduction band
(B) closer to valence band than conduction band
(C) closer to conduction band than valence band
(D) in the middle of the forbidden band

h. The fastest logic gate is

(A) ECL **(B)** MOS
(C) DCIL **(D)** RTL

i. n-channel FETs are superior to p-channel FETs because

(A) they have higher input impedance.
(B) they consume less power.
(C) mobility of electron is greater than that of holes.
(D) none of them.

j. In the context of IC fabrication, metallisation means

(A) connecting metallic wires
(B) forming interconnecting conduction pattern and bonding pads.
(C) depositing SiO_2 layer
(D) covering with a metallic cap

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

Q.2 a. Outline an experimental set-up with necessary precautions for determining Hall coefficient, Hall angle and Hall mobility in a given semiconducting specimen. **(8)**

b. A Si is doped with 10^{17} As atoms/cm^3, what is the equilibrium hole concentration at 300 K? Where is E_F relative to E_i. **(8)**

Q.3 a. Discuss the flow of current with bias in the case of a metal-n-type semiconductor Schottky contact. **(8)**

b. How can one obtain rectifying and ohmic contacts in a junction device. Explain their importance. **(8)**

Q.4 a. Draw and explain the equivalent circuit of a MOSFET showing the passive capacitive and resistive components. **(8)**

b. Describe the switching characteristics of BJT and also discuss its frequency limitations. **(8)**

Q.5 a. Write short note on any **TWO** of the following:-
(i) MOS capacitor.
(ii) Kirk effect.
(iii) Base transport factor. **(4+4 = 8)**

b. Explain the transferred electron mechanism and show that for successful domain formation there is a critical product of electron concentration and sample length. **(8)**

Q.6 a. Explain 'crystal growth' and 'wafer preparation' in monolithic IC processing. **(8)**

b. Explain the Flip-chip Techniques. Also discuss the different packaging used in IC fabrication. **(8)**

Q.7 a. Explain short channel effects in MOSFET. **(8)**

b. Briefly explain the operation of a semiconductor LASER. Discuss its major applications. **(8)**

Q.8 a. What is donor concentration in a given sample of semiconducting material of 1 ohm-cm resistivity at $300\,\mathrm{K}$? The mobility for the sample is $3900\,\mathrm{cm}^2/\mathrm{V}-\mathrm{sec}$ and the electronic charge $e = 1.6\times10^{-19}$ coulomb. **(8)**

b. Explain the effect of temperature on diode characteristics. **(4)**

c. Explain drain resistance, transconductance and amplification factor, derive the relation between them. **(4)**

Q.9 a. Explain the origin of the negative differential mobility in a Gunn diode. Mention uses of Gunn oscillators. **(8)**

b. Explain the working of an IMPATT diode. Describe its applications. **(8)**