2018

CBCS

3rd Semester

ELECTRONICS

PAPER—C5T

(Honours)

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Illustrate the answers wherever necessary.

Semiconductor Devices

1. Answer any *five* questions :   5×2

   (a) What do you understand by direct and indirect semiconductors ?   2

   (b) Calculate the diffusivity of electrons having mobility 0.38 $m^2v^{-1}s^{-1}$ in Ge at 300K.   2

(c) How does a barrier field appear across a p-n junction ?

2

(d) Draw the output characteristics of a p-n-p transistor in CE configuration.

2

(e) Obtain a relation between current amplification factors α and β for a transistor.

2

(f) Sketch the depletion region before and after pinch-off of a JFET.

2

(g) What is a CMOS ?

2

(h) Draw the I-V characteristic of SCR.

2

2. Answer any *four* questions :

4×5

(a) Define the term 'effective mass of an electron'. Establish its mathematical expression.

$2+3$

(b) When is the Hall coefficient zero in a semiconductor ?

The electron and the hole mobilities in a semiconductor are 0.8 $m^2/(V.s)$ and 0.02 $m^2/(V.s)$

respectively. The electron concentration in the semiconductor is 2.5×10^{18} m^3, and the Hall coefficient is zero. Find the intrinsic carrier concentration. 2+3

(c) Explain with a circuit diagram the use of a Zener diode as a reference diode. 5

(d) Derive the relationship $I_C = \beta I_B + (1 + \beta)I_{CO}$, where the symbols have their usual significances. What is an Early effect? 3+2

(e) Draw an electrical circuit showing an n-p-n transistor in CB configuration. An n-p-n transistor with $\alpha = 0.38$ is operated in the CB configuration. If the emitter current is 3 mA and the reverse saturation current is $I_{CO} = 10$ μA, what are the base current and collector current? $2 + \left(1\frac{1}{2} + 1\frac{1}{2}\right)$

(f) Draw and explain the nature of the typical common-source drain characteristics of a JEET. 2+3

3. Answer any *one* question :   1×10

(a) What is the Fermi level? Calculate the position of the
    Fermi level in an intrinsic semiconductor.   2+8

(b) Sketch the structure of an n-channel depletion type
    MOSFET. Explain the operation and sketch the drain
    characteristics of the MOSFET. What type of gate
    voltage is necessary in a p-channel enhancement
    MOSFET to cause current flow ?   3+6+1

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