2016

M.Sc.

2nd Semester Examination

ELECTRONICS

PAPER—ELC-204

Full Marks : 50

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.

Answer *Q. No. 1* and any *three* from the rest.

1. (a) Prove that for an unbiased P–N diode as Fermi level is constant throughout the function.

   (b) Discuss the differences between the input ionization and field ionization of a P–N function diode.

   (c) For a metal-semiconductor diode prove that

   $$a\phi_{Bn} + a\phi_{Bp} = Eg.$$

(d) What do you mean by surface state pinning effect in a Metal-semi conductor function ?

(e) Determine dopping concentration, N_D of the semiconductor side of a metal n-type Schottky diode from function capacitance.

2. (a) For an abrupt P–N junction derive the expression for depletion Layer width.

(b) Define depletion and diffusion capacitance.

(c) For a linearly graded function prove that built in potential is proportional with the third power of depletion Layer width.

4+2+4

3. (a) For a metal-semiconductor function show that the barrier height ϕ_{Bn} can be expressed as

$$\phi_{Bn} = C_2(\phi_{Cn} - x) + (1 - C_2)\left(\frac{E_g}{9} - \phi_0\right) - \Delta\phi$$

where the symbols have their usual meaning.

Simplify the above expression for low and high value of interface state density.

(b) How can you measure ϕ_{Bn} using current-voltage measurement method ?

(6+2)+2

4. (a) In a metal semiconductor field effect transistor (MESFET) prove that the transconductance in the saturation region is equal to the drain conductance Ce in the linear region.

   (b) What do you mean by Normally 'OFF' and Normally 'ON' MESFETs ?

   (c) For a MESFET operated in velocity saturation region prove that $gm/cgs = v_s Z$.

5+2+3

5. (a) Draw the Eber-Molls model of a transistor and derive the expression of emitter, base and collector current.

   (b) Draw the Gummel-Poon model of a transistor and indicate different parameters.

   Discuss how accuracy in this model is paid off by its complexity ?

6+(3+1)

6. (a) Explain how a negative resistance occurs in a Rend diode ? Write down some suitable applications of IMPATT diode.

(b) Prove that in a SCR the expression of anode current (I_A) can be given by

$$I_A = \frac{\alpha_2 I_g + I_{CO_1} + I_{CO_2}}{1-(\alpha_1+\alpha_2)}$$

where the symbols have their usual meanings.

$\left(3\frac{1}{2}+1\frac{1}{2}\right)+5$

[Internal Assessment — 10 Marks]