2018

M.Sc

2nd Semester Examination

ELECTRONICS

PAPER—ELC-202

Subject Code—27

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.

(Semiconductor Device)

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

1. (a) What do you mean by early effect in a transistor ? What is Punch-through ?

(b) Why activation energy method is preferred to determine the barrier height of a Schottky diode ?

(Turn Over)

(c) Draw the equivalent circuit model of a MESFET and indicate various extrinsic and intrinsic parameters.

(d) Draw the energy band diagram of a M-I-S structure having P-type semiconductor for a condition $\varphi_s > 0$.

(d) Prove that Fermi level remains constant along the P-N junction when no electric field is applied. 5×2

2. (a) Derive the Shockley equation showing the current-voltage relationship of a P-N junction diode.

(b) Compare the oprational characteristics between Fast-recovery diode and charge-storage diode. 8+2

3. (a) Prove that the barrier lowering due to Schottky effect is

$\Delta\phi = \sqrt{\dfrac{9\varepsilon}{4\pi\varepsilon_0}}$ where the symbols have their usual meaning.

(b) The expression of barrier height for a metal-semiconductor contact is given as

$$\phi_{Bn} = c_2(\phi_m - \chi) + (1 - c_2)\left(\frac{Eg}{9} - \phi_0\right) - \Delta\phi$$

where the symbols have their usual meaning prove that ϕ_{Bn} is independent of metal work function when $D_s \to \infty$.

(c) If a thin Layer of semiconductor having a doping concentration n_1 is introduced at the semiconductor surface, show that the reduction of barrier height

$$\Delta\phi = \frac{9}{\varepsilon_s}\sqrt{\frac{h_1 a}{4\pi}}$$

where 'a' is the thickness of the semiconductor having doping concentration n_1. 4+2+4

4. (a) Prove that in a MESFET, the drain conductive in linear region is equal to the transconductance in saturation region.

(b) For a MESFET operated under electron velocity saturation prove that

$$\text{gm}/\text{cgs} = U_s z$$

7+3

5. (a) Derive the expression of drain current of a MOSFET considering gradual channel approximation.

(b) Draw the LFCV and HFCV plots of a M-I-S diode and explain its nature of variation. (2+3+1)+2+2

6. (a) Write down the Ebers Moll equations for emitter, base and collector currents of a transistor and hence draw the Ebers-Moll-model.

   (b) Draw and discuss on the Gummel-Poon model of a Transistor.

   (c) Discuss various precondition required for a BJT for its high power and high frequency operations. (3+2)+3+2

[Internal Assessment — 10 Marks]