2017

M.Sc. 2nd Semester Examination

ELECTRONICS

PAPER—ELC-202

Full Marks : 50

Time : 2 Hours

The figures in the 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) Prove that the Fermi level remains constant along the P-N junction when no electric field is applied.

(b) What do you mean by the Gummel number of a bipolar-junction-transistor ?

(c) Prove the for a metal-semiconductor contact

$$9\phi_{BP} + 9\phi_{Bn} = Eg.$$

(d) What do you mean by the nutral level of a metal semiconductor contact ?

(e) Define the terms accumulation, depletion and inverson in connection with a MOSFET. 2×5

2. (a) Discuss, different break down mechanism present in a P-N junction diode. Discuss the Impact ionization and field ionization processes.

(b) If N_A and N_D are the doping concentration of P and N region of a diode derive the expression of deplition Layer width.

(c) How can you determine the bandgap of a semiconductor from the temperature sensitive current measurement.

(1+4)+3+2

3. (a) For a metal semiconductor junction prove that the thermoionic current flowing through the junction is

$$J = A^{*}T^{2} \exp\left[\frac{-q\phi_{\beta n}}{kT}\right]\left[e^{\frac{qv}{kT}} - 1\right]$$

where A^{*} is the Richardson constant and $q\phi_{\beta n}$ is the barrier height of the junction.

(b) 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

$$\Delta\phi = \frac{q}{t_s}\sqrt{\frac{n_1 a}{4\pi}}$$

where a is the thickness of the semiconductor having doping concentration in n_1. 7+3

4. (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 pre-condition required for a BJT for its high power and high frequency operations.

(3+2)+3+2

5. (a) Derive the expression of drain current of a Si MESFET considering field dependent mobility model.

(b) Prove that for a MESFET operated under the two region model approach

$$L_1 = ZL\frac{\left(u_c^2 - u_1^2\right) - \frac{2}{3}\left(u_c^3 - u_1^3\right)}{1 - u_c}$$

where the symbols have their usual meanings. 6+4

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

(b) Draw the LFCV and HFCV plots of a MIS diode and Explain its nature of variation. 7+(1+2)

[Internal Assessment — 10 marks]