# 2015

## 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.*

### (*Semiconductor Devices*)

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

**1.** (a) Explain the breakdown process due to impact ionization associated with a P-N Junction diode.

(b) Explain (with the help of band diagram) what is meant by ohmic contact.

*(Turn Over)*

(c) Explain, why activation energy method is preferred to measure the barrier height of a Schottky junction in comparison with current-voltage measurement method.

(d) When the reverse gate voltage of JEFT change from 4.0 to 3.9 volt, drain current change from 1.3 to 1.6 mA. Find the value of the transconductance.

(e) What do you mean by the Gummel number of a bipolar function transistor ?

**2.** (a) Derive the Shockley equation in connection with a P-N junction diode.

(b) Define the terms Depletion capacitance and diffusion capacitance. 8+2

**3.** (a) Describe clearly the formation of a Schotky Barrier assuming a metal / n-type semiconductor (with the help of Band diagram).

(b) Describe Schotky diffusion theory & hence find an expression current density in M/S junction.

3+7

**4.** (a) For a metal semiconductor junction prove that the thermionic 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

**5.** (a) What do you mean by field dependent mobility ?

(b) Derive the expression of drain current of a Si-MESFET using field dependent mobility model and show that it is equal to

$$I_D = \frac{I_P\left[3\left(u_2^2 - u_1^2\right) - 2\left(u_2^3 - u_1^3\right)\right]}{1 + \mu V_D / U_S L}$$

where the symbols have their usual meanings.

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

2+6+2

6. (a) Prove that the expression for anode current $I_A$ of a Silicon controlled rectifier as

$$I_A = \frac{\alpha_2 I_9 + ICO_1 + ICO_2}{1-(\alpha_1+\alpha_2)}$$

where the symbols have their usual meanings.

(b) Discuss the mechanism of generation of negative resistance in a Unijunction Transistor.

6+4

**Internal Assessment — 10**

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