

2009**M.Sc.****2nd Semester Examination****ELECTRONICS****PAPER—EL-1204****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.

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

1. Answer any five questions : 5×2
- (a) Distinguish between an abrupt and linearly graded p-n junction.
 - (b) Define the terms : (i) Depletion Capacitance and (ii) Diffusion capacitance.
 - (c) Distinguish between normally-on and normally-off field effect transistors.
 - (d) What is barrier height of a Schottky function? Describe it with an energy band diagram.
 - (e) Draw the basic circuit of a bipolar transistor using Ebers-Moll model.
 - (f) How does the conductivity of the channel can be increased using heterojunctions in HEMT?
 - (g) What do you mean by the Fermi level pinning of a Metal-Semiconductor junction?
 - (h) Explain on what factors the speed of response of a switching transistor depend.

(Turn Over)

2. Derive an expression for the depletion layer capacitance of a one-sided abrupt p-n junction. Explain how the diffusion potential and doping concentration of the device can be measured using the capacitance-voltage characteristics of the device. What do you mean by diffusion capacitance? How does it depend upon the bias voltage? 4+3+2+1

3. (a) Draw the energy band diagram of a Metal semiconductor junction without considering surface state effect.

(b) For a given semiconductor and for any metal prove that

$$q(\phi_{bn} + \phi_{bp}) = E_g$$

where the symbols have their usual meaning.

(c) For a Schottky junction, prove that

$$\frac{1}{c^2} = \frac{2(V_{bi} - V - K_T/9)}{9 \epsilon_s N_D}$$

where the symbols have their usual meaning. 2+4+4

4. Draw the energy band diagram of a metal-semiconductor contact involving interface states and interfacial layer and derive a general expression for the barrier height of the device. 2+8

5. Draw the physical structure of a MESFET and define the threshold voltage of the device. Suggest a method for the determination of the above parameter of the device. Explain why the channel characteristics of a long channel device differ from those of short channel device. What is saturated-velocity model? 3+3+2+2

6. (a) With a neat sketch describe the current components of an N-P-N transistor.

(b) Derive the Eber Moll equations of a transistor for I_E , I_C and I_B . Also draw the equivalent circuit describing these equations. 3+(4\frac{1}{2}+2\frac{1}{2})