M.Sc. 2nd Semester Examination, 2010

ELECTRONICS

(*Semiconductor Devices*)

PAPER—EL-1204

(Theory)

Full Marks : 40

Time : 2 hours

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

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

1. Answer any *five* questions : 2×5

(*a*) What do you mean by the early effect in a transistor ?

(*b*) Discuss the function of a SCR as a variable half-wave rectifier.

(*c*) Why a power transistor cannot be used in high frequency operation ?

(*d*) Define the term threshold voltage of a junction field effect transistor. Write down its functional dependence on different device parameters.

(*e*) What is surface states pinning effect in a metal -semiconductor junction ?

(*f*) Distinguish between normal tunneling and resonant tunneling.

2. (*a*) Draw the circuit diagram of a CE amplifier using *n-p-n* transistor also draw its output characteristics.

(*b*) Derive the expression of depletion layer width of a *p-n* junction diode. Also, find the expression for depletion capacitance of the *p-n* junction diode. (2 + 2) + (4 + 2)

3. What do you mean by quasi-Fermi level ? Show that

$$pn = n_i^2 \exp\left\{\frac{q(\phi_p - \phi_n)}{kT}\right\}$$

where ϕ_p and ϕ_n are quasi-Fermi levels for holes and electrons and other terms have their usual meanings. Derive expressions for the minority carrier concentrations on the two sides of a forward biased *p-n* junction as a function of bias voltage. 3 + 3 + 4

4. (*a*) What do you mean by the barrier height of a metal-semiconductor junction. For a metal -semiconductor junction prove that

$$\phi_{bp} + \phi_{bn} = E_g,$$

where the symbols have their usual meaning.

(*b*) How can you determine the barrier height of a metal-semiconductor junction using activation energy method ? (2 +4) + 4

5. (*a*) What is an SCR ? Briefly explain its structure and characteristics. Can two transistors be connected to achieve the same effect ? Explain.

(*b*) What is so special about the SCR switch ? What is a Diac ? (1 + 2 + 2 + 2) + (2 + 1)

6. Draw the physical structure of a metal -semiconductor field effect transistor. Derive the current-voltage relation of the device under gradual channel approximation. 2 + 8