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M.Tech. (ECE) III SEMESTER (Reappear)

Semiconductor Device Modeling (EI6-C 705-D)

Time : 3 Hours]   [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*

2. *Answer any four questions from Part-B in detail.*

3. *Different sub-parts of a question are to be attempted adjacent to each other.*

4. *Assume necessary and relevant data if missing.*

PART–A   COs

1. (a) What do you mean by Poisson's equations for semiconductor devices. Give its physical interpretation.
                                            (1.5) CO1

    (b) Is a semiconductor positively charged when doped with acceptor atoms? Justify your answer.
                                            (1.5) CO2

    (c) How does reverse short-channel effect influence the performance of the MOSFET? (1.5) CO2

(d) What happens to the energy gap of a pure semiconductor when doped with impurities?

(1.5) CO1

(e) What do you mean by scattering rates. What are the factors on which it depends? (1.5) CO3

(f) Differentiate between conventional current continuity equation and modified current continuity equation.

(1.5) CO3

(g) What is breakdown voltage in SiP-Paineudiodes.

(1.5) CO3

(h) What is Homo junction bipolar transistor? Compare it with hetro junction BJT. (1.5) CO4

(i) How does the mobility of carrier depend upon temperature and electric field strength? (1.5) CO1

(j) "The threshold voltage reduction has an exponential dependence channel length" justify the statement.

(1.5) CO2

PART–B

2. (a) Define Fermi level. What happen to the Fermi level when bias voltage is applied to the substrate? How is the Fermi distribution function used to calculate the electron and hole concentration in semiconductor ?

(8) CO1

(b) Explain boundary conditions applied to semiconductor devices. What is its significance? (7) CO1

3. (a) What are the reasons for broadening and narrowing of band gap upon doping? What are the effects of bandgap narrowing on the semiconductor devices? (8) CO2

(b) A sample of Germanium has concentration of donor atom equal to 3×10^4 atom/cm^3 and a concentration of acceptor atom equal to 4×10^{14} atom/cm^3. Determine the concentration of free electrons and holes in a sample of Germanium at 300°K. Is this p or n type germanium? (7) CO1

4. (a) What is the physical significance of poisson, drift-diffusion, and continuity equations? Explain discretization of both poisson's and current continuity equation. (8) CO2

(b) Show that $f(x) = x^4 + x - 1$ has real root α in the interval (0.5, 1.0)

Find $f'(x)$

Starting with the interval (0.5, 1.0), use interval bisection twice to find an interval of width (0.125) which contain α.

Using 0.75 as first approximation to α, apply Newton Raphson method once to $f(x)$ to find second approximation to α. (give your answer to three significant degree) (7) CO2

5. (a) How does reverse short-channel effect influence the performance of the system? Describe why and how the threshold voltage changes as the channel length decreases and channel width decreases. (10) CO3