Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL 2018
SUBJECT: SEMICONDUCTOR DEVICE PHYSICS (ECE - 4015)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Derive an expression for minimum conductivity in a semiconductor in terms of mobilities of charge carriers.

1B. An unknown semiconductor has E_g = 1.1 eV and $N_c = N_v$. and it is doped with 10^{15} cm^{-3} donars where donar level is 0.2 eV below E_c. Given that E_F is 0.25 eV below E_c . Calculate N_I , P_o and N_o at 300K.

1C. Based on the band diagram where in E_I is in the middle of the gap, would you expect that conduction band density of states effective mass is greater than, equal or smaller than the valance band effective mass. Explain.

(3+5+2)

2A. Calculate the maximum electric field and width of depletion region at zero bias for an abrupt silicon PN junction with $N_A = 10^{19}$ cm^{-3} and $N_D = 10^{15}$ cm^{-3} at room temperature. Given that $N_I = 1.5 \times 10^{10}$ cm^{-3} $\epsilon_r = 11.9$ for Si $\epsilon_o = 8.85 \times 10^{-14}$ F cm^{-1}.

2B. Find an expression for the electron current in the n-type material of a forward biased PN junction.

2C. Derive an expression for voltage variable capacitance of P^+N junction. What is its importance.

(4+3+3)

3A. Show that the hole current feeding an exponential P'(x) can be formed from $Q_p / \tilde{\imath}_p$.

3B. Indicate by a schematic diagram, different current components in a forward biased P^+N junction.

3C. Show that there occurs a time dependent voltage across the PN junction if it is switched-off from its initial ON state instantaneously.

(3+2+5)

4A. The platinum work function is 5.0 eV and electron affinity for Si is 4.05eV. Determine barrier heights and built in voltage for an MS contact of Pt with N-type Si having a doping concentration of $N_D = 2.8 \times 10^{14}$ cm^{-3}. Given that $N_c = 2.8 \times 10^{19}$ cm^{-3}.

4B. What are the advantages of Schottky diodes over PN junction diodes.

4C. Derive an expression for IV characteristics of MS contacts.

(4+2+4)

5A. Describe accumulation, depletion and inversion phenomena of MOS capacitor with the aid of CV plot.

5B. Briefly explain the behaviour of ideal MOS structure with band diagrams.

(5+5)