Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.Tech. (E & C) DEGREE END SEMESTER EXAMINATION - April/May 2017

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.	An unknown semiconductor has band gap of 1.1 eV and $N_c = N_v$. It is doped with $10^{15}/cm^3$ donors where the donor level is 0.2 eV below E_c. Given that E_f is 0.5 eV below E_c, calculate n_i and concentration of electrons and holes in the semiconductor at 300K.
1B.	Describe Hynes -Shockley experiment. How it differs with Hall experiment.
1C.	Explain the importance of Fermi-Dirac statistics in determining the device characteristics
	(5+3+2)
2A.	Derive an expression connecting the mobility and diffusion constant of charge carriers in a semiconductor and calculate the ratio of diffusion constant and mobility at 300K.
2B.	A Si pn junction with a cross sectional area A = 0.001 cm^2, is formed with $N_A = 10^{15}/cm^3$, $N_D = 10^{17}/cm^3$, Calculate i) Contact potential Vo ii) Space charge width at equilibrium. iii) Calculate current with forward biasing 0f 0.5V. Given that μ_n = 1500 cm^2/V-s, μ_p = 450 cm^2/V-s, $\tilde{\imath}_n = \tilde{\imath}_p$ = 2.5 mS,. Which type of carriers carries most of the current? If you want to double the electron current what should you do?
2C.	Suggest ways of reducing the switching times in pn junction diodes
	(3+5+2)
3A.	Hall measurements are made on an n-type semiconductor bar of 500 µm wide and 20 µm thick. The Hall contacts are displaced 3 µm with respect to each other in the direction of current flow of 3 mA. The voltage between A and B with a magnetic field of 5 KG pointing out of the plane of the sample is 3.2mV and when the magnetic field is reversed the voltage changes to -2.8mV. What is the hole concentration and mobility.
3B.	Consider an n-type Si sample with a doping concentration $10^{16}/cm^3$. If it is illuminated such that the electron –hole pair at a rate of $10^{18}/cm^3$ per second are generated. Find out majority and minority carrier concentrations at steady state. Given that $\tilde{\imath}_p = 10^{-6}$s. Plot the decay of the carriers

	with time once the light source is switched off.
3C.	Briefly describe how n-channel MOSFET is fabricated
	(5+3+2)
4A.	Why some devices are named as hot electron devices? Derive an expression for the IV characteristic of those devices.
4B.	Compare and contrast the PN junction devices and Schottky diodes
4C.	Discuss Capacitance- Voltage characteristics of MOS capacitor
	(5+3+2)
5A.	With the aid of band diagrams describe basic operation of enhancement type n-channel MOSFET
5B.	Derive an expression for the variation of voltage across PN-junction diode when it is switched off suddenly.
5C.	
	(5+5)