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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. Describe Hall effect in a semiconductor. Bring out its importance in determining the majority charge carrier concentration of a doped semiconductor
- 1B. Consider a semiconductor bar with 0.1 mm width, thickness 10 μm and length 5mm. A magnetic field of 5KG in the z-direction as current of 1mA is passing through the sample in x-direction. The voltage developed in the y-direction is measured as -2mV and voltage measured across the length of the sample (x-direction) is 100mV. Find the type, concentration and mobility of majority carrier.
- 1C. Distinguish between the Ohmic and rectifying contact. Explain when the MS contact (metal- n-type semiconductor) behave like an ohmic contact/rectifying contact.

(5+3+2)

2A. Show that minimum conductivity of a semiconductor occurs when

$$n o = ni \sqrt{\frac{\mu p}{\mu n}}$$

and what is the expression for minimum conductivity σ_{min} .

- 2B. Describe electron & hole currents in a forward biased pn junction by a neat schematic
- 2C. Reverse current, when the diode is switched from forward biasing condition to reverse biasing condition, is larger than normal reverse saturation current in pn- junction. Why?

(5+3+2)

- 3A. An abrupt pn junction has N $_{a} = 10^{18}$ /cm³, and N $_{d} = 5 \times 10^{15}$ / cm³ has a circular cross section with a diameter of 10 μ m. Calculate X $_{no}$, X $_{po}$, Q $_{+}$, and E $_{o}$, at equilibrium (300K). Sketch E(X) and charge density.
- 3B. Find an expression for electron current in the n-type material for a forward biased pn junction.
- 3C. Draw band diagram of semiconductor under an electric field.

(5+3+2)

- 4A. Explain why the Schottky contacts are called "hot electron devices" and derive an expression for I-V characteristics of those devices.
- 4B. Explain importance of surface preparation of semiconductor in forming a MS contact.
- 4C. Describe how Schottky diodes are advantageous over PN junction diodes.

(5+3+2)

- 5A. Explain working of a device which rests on a principle "gate-controlled potential barrier", with a band diagram.
- 5B Derive an expression for the junction capacitance of a PN junction. Explain its importance.

(5+5)