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EEEC-013

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(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 131653

Roll No.

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B.TECH.

Theory Examination (Semester-VI) 2015-16

ADVANCED SEMICONDUCTOR DEVICES

Time : 3 Hours

Max. Marks : 100

Section-A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (2×10=20)

- The Si energy gap changes monotonically with temperature. What is the basic concept behind this?
- Draw the energy level diagram of a PN junction.
- How a junction barrier is developed across an unbiased junction?
- Make the energy band diagram of a metal and semiconductor junction at equilibrium. Consider Al metal having a large work function and n-type semiconductor.



- (e) Why does current saturate in long channel MOSFET when large drain voltage is applied on drain?
- (f) A pn junction photodiode is operated under photovoltaic condition similar to solar cell and having the similar I-V Characteristics. under illumination. State three major differences between photodiode and solar cell.
- (g) What is kinetic energy of a hole at the top of the valence band?
- (h) Define minority carrier life time.
- (i) What are the different types of degenerate Semiconductors?
- (j) What is meant by IMPATT diode?

Section-B

2. Attempt any five questions from this section. (10×5=50)

- (a) (i) Explain the recombination of excess carriers in semiconductors. Derive an expression for excess carrier lifetime.
- (ii) Derive an expression for hole and electron diffusion current.



- (b) Prove that for a linearly graded PN junction the maximum electric field in depletion region is $3/2$ times of average electric field.
- (c) Derive the current expression for long base ideal diode.
- (d) Write down the different methods to calculate the barrier height of a Schottky barrier diode.
- (e) Explain the formation of rectifying M-S contact barrier process using Schottky-Mott theory.
- (f) Derive an expression for a saturated drain current of a n-channel MESFET.
- (g) Explain the principle of operation, storage and transfer of charge in basic charge coupled device (CCD).
- (h) Derive an expression for power output and efficiency of a MSM BAITT diode.

Section-C

Attempt any two questions from this section. (15×2=30)

3. The donor and acceptor concentration in Si sample is 6×10^{15} and $2 \times 10^{15} \text{ cm}^{-3}$ respectively. Determine the position of Fermi



Level with respect to intrinsic energy level E_i at room temperature. Also find out the value and sign of Hall coefficient.

4. Explain the MESFET operation in case of Depletion mode and enhancement mode device. Draw the I-V characteristic also.
5. A hetero-junction is formed between n-type Ge (with $N_d = 1.5 \times 10^{16} \text{ cm}^{-3}$) and p-type GaAs (with $N_a = 8.5 \times 10^{15} \text{ cm}^{-3}$).
 - i. Draw the thermal equilibrium energy band diagram of junction.
 - ii. Calculate the built-in voltage of the junction.