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B.TECH.

Theory Examination (Semester-VI) 2015-16

ADVANCED SEMICONDUCTOR DEVICES

Time : 3 Hours

Max. Marks : 100

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Section-A

- 1. Attempt all parts. All parts carry equal marks. Write
answer of each part in short.(2×10=20)
 - (a) The Si energy gap changes monotonically with temperature. What is the basic concept behind this?
 - (b) Draw the energy level diagram of a PN junction.
 - (c) How a junction barrier is developed across an unbiased junction?
 - (d) 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.

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- om Why does current saturate in long channel MOSFET (e) 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.
- What is kinetic energy of a hole at the top of the valence (g) SUKER band?
- (h) Define minority carrier life time.
- What are the different types of degenerate Semiconduc-(i) tors?
- (j) What is meant by IMPATT diode?

Section-B

2. Attempt any five questions from this section. $(10 \times 5 = 50)$

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

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- (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. $(15 \times 2=30)$

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

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4. Explain the MESGET operation in case of Depletion mode and enhancement mode device. Draw the I-V characteristic also.

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- 5. A hetero-junction is formed between n-type Ge (with Nd= 1.5×10^{16} cm⁻³) and p-type GaAs (with Na= 8.5×10^{15} cm³).
 - i. Draw the thermal equilibrium energy band diagram of junction.
 - ii. Calculate the buit-in voltage of the junction.

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