LNMIIT
The LNM Institute of Information Technology

End-Sem Examination
Semiconductor Devices and Circuits
B.Tech. (ECE) 2nd Year

Time: 3 Hrs **Total Marks: 40**

All Questions are compulsory.

Q1. Choose correct or the best alternative in the following: **5**

A. In an *n-p-n* transistor biased for operation in forward active region
i. emitter is positive with respect to base **ii.** collector is positive with respect to base
iii. base is positive with respect to emitter and collector is positive with respect to base **iv.** none of the above

B. Avalanche breakdown results basically due to
i. impact ionization **ii.** strong electric field across the junction
iii. emission of electrons **iv.** rise in temperature

C. Which of the following diodes is operated in reverse bias mode?
i. p-n junction **ii.** Zener
iii. Tunnel **iv.** Schottky

D. The depletion region in a Junction Diode contains
i. Only charge carriers (of minority type and majority type) **ii.** no charge at all
iii. vacuum, and no atoms at all **iv.** only ions i.e., immobile charges

E. In the active region of BJT, while the collector-base junction is _____-biased, the base-emitter is _____-biased.
i. forward, forward **ii.** forward, reverse
iii. reverse, forward **iv.** reverse, reverse

F. At which of the following condition(s) is the depletion region uniform in MOSFET?
i. No bias **ii.** $V_{DS} > 0$ V
iii. $V_{DS} = V_{GS}$ **iv.** None of the above

G. The region to the left of the pinch-off locus is referred to as the _____ region.
i. saturation **ii.** cutoff
iii. ohmic **iv.** All of the above

H. β_{dc} = _____
i. I_B / I_E **ii.** I_C / I_E
iii. I_C / I_B **iv.** None of the above

I. Work function is the maximum energy required by the fastest electron at 0 K to escape from the metal surface.
i. True **ii.** False

J. Recombination produces new electron-hole pairs
i. True **ii.** False

Q2. Can an ordinary diode be used as a zener diode? Justify your answer. **2**

Q3. What is intrinsic semiconductor. How do we make it extrinsic semiconductor, and why so ? **3**

Q4. An n-type silicon substrate at 300K has a donor concentration of 2.73×10^{16} cm^{-3}. **2**

a) Determine the concentration of electrons in the conduction band.

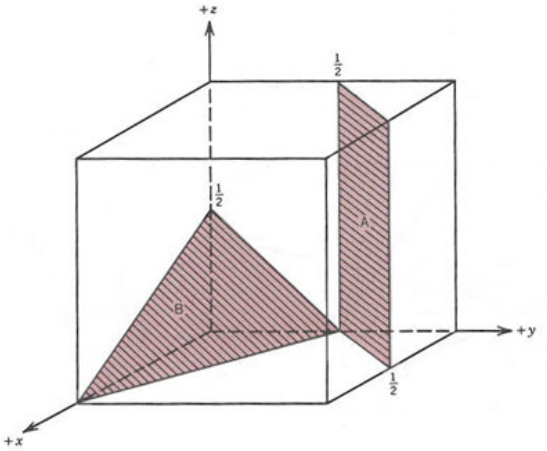
b) Determine the hole concentration in the valence band.

Q5. Give four names of the second order effects in MOSFETs and discuss any two in details. **4**

Q6. What is Gradual Channel Approximation (GCA) in MOSFETs? Drive the drain current equation for NMOS using ***GCA*** for all three operating regions. **4**

Q7. An NMOS transistor with device transconductance K = 20μA/V^2 and threshold voltage of 1.5 V is operated at V_{GS} = 5V and I_D = 100 μA. **Find V_{DS}.** **4**

Q8. (A) Determine the Miller indices for the planes shown in the following unit cell: **2**



Q8. (B) Sketch within a cubic unit cell the following planes: **3**

a) (1 0 -1) **b)** (2 -1 1) **c)** (3 -1 3)

Q9. Write the short notes on the followings in case of BJT: **2**

a) Base width Modulation **b)** Breakdown Voltage

Q10. What is BJT ? Give the simplified block diagrams and symbols of two types of BJT along with the doping concentrations. Explain the different modes of operations of BJT with the characteristic curves? **4**

Q11. Define and derive the expression for the threshold voltage, which is a basic parameter of the MOSFET. Discuss the dependence of the threshold voltage on the bias applied to the substrate, called the substrate bias effect. **5**