



RAN-2303080101040002

M. Sc. Physics (Sem. - I) Examination November - 2025

PH - 414 : Elective 1 - Physics of Semiconductor Devices

સૂચના : / Instructions

- (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book

Seat No.:

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Student's Signature

Q. 1 Attempt any two. (18)

- (A) (i) What is recombination? Explain the effect of recombination on the carrier in optical transportation. (7)
(ii) Determine the diffusion coefficient for Ge having hole mobility $1900 \text{ cm}^2/\text{V-s}$ at $T=300\text{K}$. (2)
- (B) (i) Write the basic electrical parameters of a semiconductor materials. (3)
(ii) Classified basic equation for semiconductor device operation and explain current density equation in details (6)
- (C) (i) Explain the construction and working and I-V characteristic of a triac. (6)
(ii) The intrinsic stand-off ratio for a UJT is determined to be 0.6. if the inter base resistance is $10 \text{ k}\Omega$. What are the values of R_{B1} and R_{B2} (3)

Q. 2 Attempt any two. (18)

- (A) Explain how the depletion region is formed in a p-n junction. Why is there no current at equilibrium across the p-n junction? (9)
- (B) (i) What is meant by forward and reverse bias? Determine the current through a p-n junction during forward and reverse bias. (6)
(ii) In a p-n junction germanium diode at 300K saturation current $I_0 = 1 \mu\text{A}$ for an applied forward bias of 0.2 volts . Calculate current through diode. (3)
- (C) (i) Draw the equivalent forward biased circuit across p-n junction and discuss diffusion capacitance. (5)
(ii) Sketch C-V characteristics and explain the varactor or variable capacitance diode (4)

Q. 3 Attempt any two. (18)

- (A) (i) Describe the basic structure operation and characteristics of a Bipolar junction transistor. (5)
(ii) A p-n-p transistor has the following current components:
 $I_{Ep} = 2 \text{ mA}$, $I_{En} = .01 \text{ mA}$, $I_{Cp} = 1.98 \text{ mA}$ and $I_c = 0.001 \text{ mA}$.
Determine the emitter injection efficiency and base transport factor. (4)
- (B) Define forward biased common base transistor current gain and discuss different parameter to improve it. (9)

- (C) (i) Draw and discuss typical base current voltage characteristic of transistor divided in to four regions. (5)
(ii) Define and discuss cut-off frequency in microwave transistor. How to achieve high cut-off frequency? (4)

Q. 4 Attempt any two. (16)

- (A) (i) Explain the recombination process in LED. Discuss suitable materials to fabrication LED. (6)
(ii) Evaluate the critical angle at a GaAs semiconductor and air interface .index of GaAs $n_2 = 3.66$ and for air $n_1 = 1.0$. (2)
- (B) (i) Describe the basic operation and characteristics of a solar cell including the short circuit current, open circuit voltage. (5)
(ii) Discuss the advantage and disadvantages of an amorphous silicon solar cell. (3)
- (C) (i) Describe the construction and working condition of an LASER diode. Also indicate stimulated emission and population inversion in laser diode. (6)
(ii) To calculate the critical angle at a interface between GaAs semiconductor-air interface. Refractive index of GaAs = 3.66 and for air =1.00. (2)
