Scheme of Valuation/Answer Key (SET2)

(Scheme of evaluation (marks in brackets) and answers of problems/key)

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC203

Course Name: SOLID STATE DEVICES (EC,AE)

Max. Marks: 100 Duration: 3 Hours

①

Part A

1a) Definition of Hall effect with diagram :- 3 marks

$$P_o = \frac{I_x B_z}{q t V_{AB}}$$

$$\mu_p = \frac{V_{AB}}{V_{CD}} \frac{L}{B_z w}$$

} 2 marks each.

b)

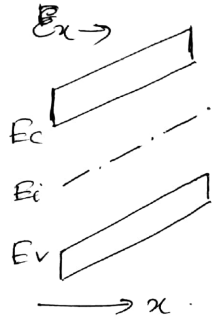


diagram :- 1 mark

explanation :- 2 marks.

~~c) a) $f(E_i) = \frac{1}{1+e^{(E_i-E_F)/kT}} = 2.08\times10^{-7}$~~

~~b) E~~

c) $B_z = 10^{-4}$ Wb/cm^2

From the sign of V_{AB}, we can see that the majority carriers are electron (1 mark)

$$n_o = \frac{I_x B_z}{q t(-V_{AB})} = 3.125\times10^{17} cm^{-3}$$ (2 marks)

$$\rho = \frac{R}{L/wt} = \frac{V_{CD}/I_x}{L/wt} = 0.002\ \Omega\ cm$$

$$\mu_n = \frac{1}{\rho q n_o} = 10000\ cm^2(V.s)^{-1}$$ (2 marks)

2a) Derivation - 7 marks

b)

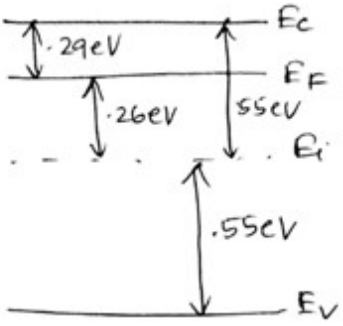


figure :- 1mark.

$E_F - E_i = \frac{E_g}{2} - (E_c - E_F) = .26eV$ (2marks)

$n_o = 3.30 \times 10^{14} cm^{-3}$

$p_o = \frac{n_i^2}{n_o} = 6.8 \times 10^5 cm^{-3}$ =>(2marks)

$\sigma = q(\mu_n n_o + \mu_p p_o) = .071 \Omega cm^{-1}$

=>(2marks)

3a) $J_{drift} = J_{n\,drift} + J_{p\,drift}$

$= (q n \mu_n + q p \mu_p) E_x$.

$\sigma = q n \mu_n + q p \mu_p = \sigma_n + \sigma_p$

derivation :-7marks

b)

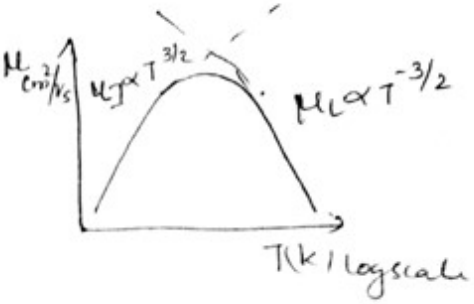
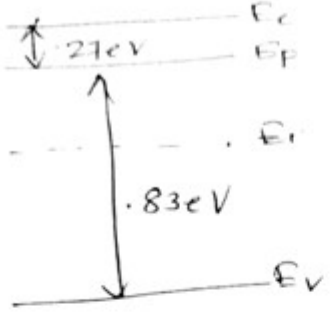


diagram :- 2marks

explaination :- 1mark.

⑧

c)



$N_c = 2.8 \times 10^{19}\ cm^{-3}$

$N_v = 1.04 \times 10^{19}\ cm^{-3}$

$n_0 = N_D = 8.65 \times 10^{14}\ cm^{-3}$

$p_0 = N_A = 1.42 \times 10^{5}\ cm^{-3}$ } ⇒

⇒ 2 marks each.

From figure

$E_C - E_F = .27eV$

$E_F - E_V = .83eV$

Part B

4a) 3 energy band diagrams :- 2 marks each

b) Ohmic & Rectifying contact :- 3 marks each

5a) Zener Breakdown
Avalanche Breakdown
} 3.5 marks each

b) Tunnel Diode; figure - 3 marks
Explanation - 5 marks

6a) $C_j = \frac{\varepsilon A}{W}$ $\quad \varepsilon = \varepsilon_0 \varepsilon_r = 11.7 \times 8.854 \times 10^{-12}$ F/m

$$W = \sqrt{\frac{2\varepsilon (V_0 + V_R)}{q} \left[\frac{1}{N_A} + \frac{1}{N_D}\right]}$$

$$V_0 = \frac{KT}{q} \ln \frac{N_A N_D}{n_i^2} = .717 \text{ V}$$

$C_j = .478$ pf

equations :- 3marks
Answer :- 3marks.

b) Derivation of Vo - 7 marks

Part C

7a) $I_{D(sat)} = \frac{1}{2} \mu_n C_i \frac{Z}{L} (V_G - V_T)^2$

$= \frac{Z}{2L} \mu_n C_i V_D^2 (sat)$

Derivation :- 5 marks

figure :- 2 marks

b) α, β & γ :- 2 marks each

c) Early effect & early voltage : 3 marks each

{ figure : 1 mark
explanation :- 2 marks }

8 a) Minority carrier distribution .

figure + Derivation :- 10 marks .

b) Mos capacitor, structure & equilibrium energy band diagram :- 4 marks .

Accumulation, Depletion & Inversion :- 2 marks each

9a) FINFET :

figure :- 2 marks

explanation :- 3 marks .

9 b) Sub threshold chara - 3 marks
Explanation - 2 marks

9 c) CV chara - 7 marks
Threshold voltage - 3 marks

Question paper pattern-Revised

Semester 3 to 8

The question paper shall consist of three parts. Part A covers modules I and II, Part B covers modules III and IV, Part C covers modules V and VI. Each part has three questions uniformly covering the two modules and each question can have maximum four subdivisions. In each part any two questions are to be answered. Mark patterns are as per the syllabus with **% for theory and **% for logical/numerical problems, derivation and proof.

**** refer course plan of the corresponding subject**

to be answered. Mark pattern is according to the syllabus with maximum 70 % for theory, derivation, proof and 30% for logical/numerical problems.