01

Spring-23

(1)

(a) $V_D = 0.76\ V$

$V_{ON} = 0.75\ V$

$I_D = 5mA$

$= 5\times10^{-3}\ A$

$T = 30^\circ C = 303K$

$V_T = \frac{KT}{q}$

$= \frac{(1.38\times10^{-23})\times303}{1.6\times10^{-19}}$

$= 0.0261\ V$

we, Know,

$I_D = I_s\, e^{\frac{V_D}{nV_T}}$

$\therefore I_s = 1.173\times10^{-15}\ A$

(b) From (a),

$I_s = 1.173\times10^{-15}\ A$

$V_D = 0.76\ V$

$T = 343K = 70^\circ C$

$V_T = \frac{KT}{q}$

$= \frac{(1.38\times10^{-23})\times343}{1.6\times10^{-19}}$

$= 0.0296\ V$

$30^\circ C \rightarrow I_s = 1.173\times10^{-15}\ A$

$40^\circ C \rightarrow I_s = 2.346\times10^{-15}\ A$

$50^\circ C \Rightarrow I_s = 4.692\times10^{-15}\ A$

$60^\circ C \Rightarrow I_s = 9.384\times10^{-15}\ A$

$70^\circ C \rightarrow I_s = 1.877\times10^{-14}\ A$

$$I_D = I_S e^{\frac{V_D}{nV_T}}$$

$$= (1.877 \times 10^{-19}) \times e^{\frac{0.76}{1 \times 0.0296}}$$

$$= 2.694 \times 10^{-3} \text{ A}$$

$$= 2.694 \text{ mA}$$

(c) $V_{ON} = 0.75$ V when. $T = 30°C$

when $T = 10°$ C

$$V_{ON} = 0.75 + (2.5 \times 10^{-3} \times 20)$$

$$= 0.8 \text{ V}$$

$V_D = 0.76$ V

$V_{ON} > V_D$

$I_D = 0$ A

Summer - 22

(1)

(a) $V_{ON} = 2.1\ V$, $V_{br} = 4\ V$

case	V_a	V_b	Biasing type	ON / OFF / Breakdown
1	10	5	Forward	ON
2	5	10	Reverse	Breakdown
3	-5	2	Reverse	Breakdown
4	-3	-5	Forward	OFF

(b) For case, 1,

$V_D = V_a - V_b = 10 - 5$

$= 5\ V$

$V_{ON} = 2.1\ V$

$I_S = 10\ nA$

$T = 25°C$

$= 298 K$

$V_T = \frac{KT}{q}$

$= \frac{(1.38 \times 10^{-23}) \times 298}{1.6 \times 10^{-19}}$

$= 0.0257\ V$

$I_D = I_S e^{\frac{V_D}{nV_T}}$

$= (10 \times 10^{-9}) \times e^{\frac{5}{1 \times 0.0257}}$

$= 3.054 \times 10^{76}\ A$

(c) $V_{ON} = 2.1\,V$

$I_S = 10\,nA$ when, $T = 25°C$

when, $T = 75°C$

$V_{ON} = 2.1 - (50 \times 2.5 \times 10^{-3})$

$= 1.975\ V$

at, $25°C \rightarrow I_S = 10\,nA$

$35°C \rightarrow I_S = 20\,nA$

$45°C \rightarrow I_S = 40\,nA$

$55°C \rightarrow I_S = 80\,nA$

$65°C \rightarrow I_S = 160\,nA$

$75°C \Rightarrow I_S = 320\,nA$

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03

Fall-21

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(i) $\because$ current flow through $P \to n$

$\therefore$ it is forward biasing

(ii) $I_D = 1\ mA = 1 \times 10^{-3}\ A$

$V_D = 1\ V$

$I_S = 10^{-4}\ nA = 10^{-13}\ A$

let; $V_T = x\ V$

we know,

$$I_D = I_S\, e^{\frac{V_D}{nV_T}}$$

$$\Rightarrow 1 \times 10^{-3} = 10^{-13}\, e^{\frac{1}{1 \cdot x}}$$

$$\Rightarrow 1 \times 10^{10} = e^{\frac{1}{x}}$$

$$\Rightarrow \ln(1 \times 10^{10}) = \ln e^{\frac{1}{x}}$$

$$\Rightarrow \frac{1}{x} = 23.026$$

$$\therefore x = 0.0434$$

$$\therefore V_T = 0.0434\ V$$

(iii) we know,

$$V_T = \frac{KT}{q}$$

$$\Rightarrow 0.0434 = \frac{(1.38\times10^{-23})\times T}{1.6\times10^{-19}}$$

From, (a)(ii) $\Rightarrow V_T = 0.0434$

$K = 1.38\times10^{-23}\ JK^{-1}$

$q = 1.6\times10^{-19}\ C$

$T = ?$

$\therefore T = 503.53\ K$

$= 230.53^\circ C$

(iv) $I_S = 10^{-4}\ nA$

reducing $10^\circ C$, $I_S = 5\times10^{-5}\ nA$

" $10^\circ C$, $I_S = 2.5\times10^{-5}\ nA$

(b) (i)

$V_D = 1\ V$, $V_{bn} = 5V$, $V_{ON} = 2V$

Reverse biasing

$|V_D| < |V_{bn}|$

$I_D = I_S$

(ii) $V_D = -1$, $V_{bn} = 5V$, $V_{ON} = 2$

Forward biasing

$V_D = 10V$

$V_D < V_{ON}$

$I_D = 0\ A$

04

(iii)

$V_D = 10V$, $V_{bn} = 5V$, $V_{ON} = 2V$

Reverse biasing

$V_D > V_{bn}$

$I_D = \infty$

(iv) $V_D = -10V$, $V_{bn} = 5$, $V_{ON} = 2V$

Forward biasing

$V_D = 10V$

$V_D > V_{ON}$

$I_D = I_s e^{\frac{V_D}{nV_T}}$

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Spring - 22

(a) at $10^\circ C$, $I_s = 2\,nA$

at $20^\circ C$, $I_s = 4\,nA$

at $30^\circ C$, $I_s = 8\,nA$

at $40^\circ C$, $I_s = 16\,nA$

at $50^\circ C$, $I_s = 32\,nA$

temperature will be $50^\circ C$

(b) Yes, temperature affect the turn-on (cut-in) potential of diodes. If we increase temperature, turn-on voltage will decrease. On the other hand, if we decrease temperature turn-on voltage will increase

$T \uparrow \quad V_{ON} \downarrow$

$T \downarrow \quad V_{ON} \uparrow$

(c) $I_s = 6\,nA$

$n = 1$

$V_{ON} = 0.2V$

$|V_{br}| = 3V$

$T = 35^\circ C = 308\,K$

$V_T = \frac{KT}{q}$

$= \frac{(1.38 \times 10^{-23}) \times 308}{1.6 \times 10^{-19}}$

$= 0.0265$

05

(i) $I_D = 5\ mA$ $(p \to n)$

Forward biasing

$$I_D = I_s e^{\frac{V_D}{nV_T}}$$

$$\Rightarrow 5\times10^{-3} = 6\times10^{-9}\ e^{\frac{V_D}{1\times0.0265}}$$

$$\Rightarrow \frac{V_D}{0.0265} = 13.633$$

$$\therefore V_D = 0.3613\ V$$

$$V_D > V_{ON}$$

(ii) $I_D = 0\ mA$ $(p \to n)$

Forward biasing

$$V_D < V_{ON}$$

(iii) $I_D = 6\ nA$ $(n \to p)$

Reverse biasing

$$|V_D| < |V_{br}|$$

Fall-22

1) a)

From the graph

$I_D = 20 \text{ mA} = 20 \times 10^{-3} \text{ A}$

$V_D = 0.8 \text{ V}$

$I_S = 1 \text{ pA} = 1 \times 10^{-12} \text{ A}$

$n = 1$

$V_{Tx} = ?$

we know,

$$I_D = I_S \, e^{\frac{V_D}{nV_{Tx}}}$$

$$\Rightarrow 20 \times 10^{-3} = (1 \times 10^{-12}) \times e^{\frac{0.8}{1 \times V_{Tx}}}$$

$$\Rightarrow \frac{0.8}{V_{Tx}} = 23.72$$

$$\therefore V_{Tx} = 0.0337 \text{ V}$$

(b) from (a)

$V_{Tx} = 0.0337$ V

$V_{Tx} = \frac{K T_x}{q}$

$\Rightarrow 0.0337 = \frac{(1.38\times10^{-23}) \times T_x}{1.6\times10^{-19}}$

$\Rightarrow T_x = 391.05$ K

$\simeq 391$ K

$T_x = 118°C$

(c) As it is a silicon diode. turn on voltage of silicon diode is 0.7 V

$V_{ON} = 0.7$ V

$V_D = 0.5$ V

$V_{ON} > V_D$

$\therefore I_D \approx 0$

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(d) from (b)

$T_x = 391\ K$

$= 118°C$

given, $T = 401\ K$

$= 128°C$

increasing 10°C,

$V_{ON} = 0.7 - (10 \times 2.5 \times 10^{-3})$

$= 0.675$

$I_s = 2\ pA$

at 0.8 V, $I_D = 22.20\ mA$