UNIT # 02 (PART – III)

ELECTRONIC (SEMICONDUCTOR & LOGIC GATE)

EXERCISE –01

17. $I_0 = \beta I_{in} = \beta \dfrac{V_{in}}{R_{in}} = 50 \quad \dfrac{5}{1\times10^3} = 250$ mA

23. $I_C = 90\%\ I_E = \dfrac{90}{100} I_E \Rightarrow I_E = \dfrac{100}{90} \quad I_C = 11$ mA

$I_B = I_E - I_C = 11\text{mA} - 10\text{ mA} = 1\text{mA}$

25. $n_h = \dfrac{n_i^2}{n_e} = \dfrac{(10^{19})^2}{10^{23}} = 10^{15}$

27. $E = \dfrac{V}{d} = \dfrac{0.1}{10^{-6}} = 10^5$ V/m

28. $n_e = \dfrac{n_i^2}{n_h} = \dfrac{(10^{19})^2}{10^{21}} = 10^{17}\,m^{-3}$

29. $I = \dfrac{3-1}{100} = 20$ mA

32. $\beta = \dfrac{\alpha}{1-\alpha} = \dfrac{0.98}{1-0.98} = 49$

34. $\alpha = \dfrac{\Delta I_C}{\Delta I_E} \Rightarrow \Delta I_C = \alpha\,\Delta I_E = 0.95 \quad 100$ mA $= 95$mA

35. $\alpha = \dfrac{I_C}{I_E} = \dfrac{I_E - I_B}{I_E} = \dfrac{25-1}{25} = \dfrac{24}{25}$

49. $Y = \overline{\overline{A} + \overline{B}} = \overline{\overline{A}.\overline{B}} = A.B$ = AND gate

72. $R = \sqrt{2hR} = \sqrt{2\times240\times6.4\times10^6} = 55$ km

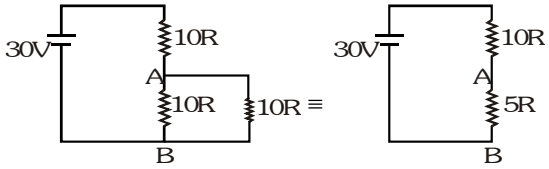
75. $F_C = 9\sqrt{N_{max}} = 9\sqrt{10^{11}} = 2$ MHz

76. $N_{max} = \dfrac{f_c^2}{81} = \dfrac{(10\times10^6)^2}{81} \approx 1.2 \quad 10^{12}\ m^{-3}$

83. $R = \sqrt{2R_e h} = \sqrt{2 \quad 6400 \quad 10^3 \quad 500}$ m $= 80$ km

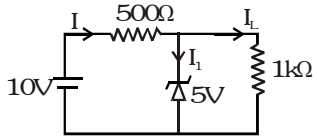
EXERCISE –02

1. ∵ diode is in F.B.



$V_{AB} = \left(\dfrac{5R}{5R+10R}\right) \quad 30 = 10$V

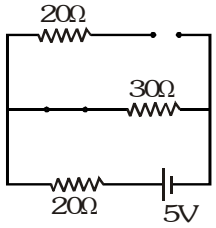
2.



$I_L = \dfrac{5V}{1k\Omega} = 5$mA, $\quad I = \dfrac{10-5}{500} = 10$ mA

$I_1 = I - I_L = 10$ mA $- 5$mA $= 5$mA

3. $I = \dfrac{5}{20+30} = \dfrac{5}{50}$ A



5. Voltage gain $= \beta \dfrac{R_0}{R_{in}} = 6 \quad \dfrac{24}{3} = 48$

6. $\beta = \dfrac{\Delta I_C}{\Delta I_B} \Rightarrow \Delta I_C = \beta\Delta I_B = 49 \quad 5\ \mu A = 245\mu A$

$\Delta I_E = \Delta I_B + \Delta I_C = 5 + 245 = 250\ \mu A$

7. $R_0 = \dfrac{\Delta V_{BC}}{\Delta I_C} = \dfrac{0.5V}{0.05mA} = 10\ k\Omega$

13. $I_C = 90\%\ I_E \Rightarrow I_E = \dfrac{100}{90} \quad I_C = \dfrac{100}{90} \quad 20 = 22$ mA

$I_B = I_E - I_C = 22 - 20 = 2$ mA

14. $\rho = \dfrac{1}{en_e\mu_e} = \dfrac{1}{1.6\times10^{-19}\times10^{13}\times1200}$

$= 520.9\ \Omega$/cm

15. $\sigma = en_e\,\mu_e \Rightarrow n_e = \dfrac{\sigma}{e\mu_e} = \dfrac{5}{1.6\times10^{-19}\times5000}$

$= 6.25 \quad 10^{15}\ cm^{-3}$

16. $I = \frac{V - V_b}{R} \Rightarrow 5 \quad 10^{-3} = \frac{(2 - 0.5)}{R} \Rightarrow R = 300\ \Omega$

17. $E = \frac{12400(eV - Å)}{\lambda(Å)} \Rightarrow \lambda = \frac{12400}{0.75} = 16500\ Å$

20. $\frac{V_0}{V_{in}} = \beta \frac{R_L}{R_{in}}$

$\Rightarrow V_0 = \beta \frac{R_L}{R_{in}} \quad V_{in} = 100 \quad \frac{10k\Omega}{1k\Omega} \quad 1mV = 1V$

21. $R_b = \frac{V_{EB}}{I_B} = \frac{7}{35 \times 10^{-6}} = 200\ k\Omega$

22. $I_C = \frac{V_{CC} - V_{CE}}{R_C} = \frac{10 - 5}{1k\Omega} = 5\ mA$

$V_{CC} = I_B R_B = \frac{I_C}{\beta} R_B$

$\Rightarrow R_B = \frac{\beta . V_{CC}}{I_C} = \frac{100 \times 10}{5mA} = 200\ k\Omega$

24. $\sigma = en_e(\mu_e + \mu_h)$
$= 1.6 \quad 10^{-19} \quad 1.072 \quad 10^{10}\ (1350 + 480)$
$= 3.14 \quad 10^{-6}$ mho/cm

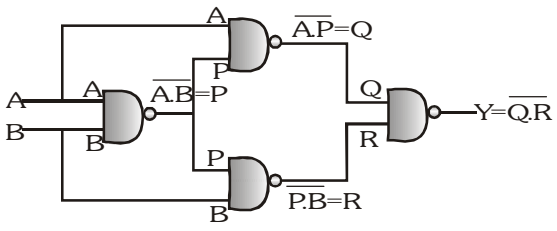
31. $Y = (A+B).A = A.A + AB = A+A.B = A(1+B) = A$

33. $Y = (W + X)(W + Y) = W.W + W.X + W.Y + X.Y$
$= W + W.X + W.Y + X.Y$
$= W(1+X+Y)+X.Y=W+X.Y$

34. $Y = (A + B) . (\overline{A.B}) = (A + B) . (\overline{A} + \overline{B})$
$= A.\overline{A} + B.\overline{A} + A.\overline{B} + B.\overline{B}$
$= A.\overline{B} + B.\overline{A}$ = XOR gate

43. $Y = (\overline{A} + B).A = A.\overline{A} + AB$ = AND gate

49.



Here $Y = \overline{Q.R} = \overline{Q} + \overline{R} = A.P. + P.B$

$Y = P.(A + B) = (\overline{A.B})\ (A+B)$

$Y = (\overline{A} + \overline{B})\ (A + B)$

$Y = \overline{A}.A + \overline{A}.B + \overline{B}.A + \overline{B}.B$

$Y = \overline{A}.B + A.\overline{B}$

when A = 1, B = 0

then $Y = \overline{1}.0 + 1.\overline{0} = 0.0 + 1.1 = 1$

when A = 1, B = 1

then $Y = \overline{1}.0 + 1.\overline{1} = 0.1 + 1.0 = 0+0=0$

when A = 0, B = 0

then $Y = \overline{0}.0 + 0.\overline{0} = 1.0 + 0.1 = 0+0=0$

EXERCISE –04

9. $A_C = -\left(\frac{h_{fe}}{1 + h_{oe}R_L}\right) = -\left(\frac{50}{1 + 25 \times 10^{-6} \times (10^3)}\right)$
$= -48.78$

12. Energy band $= \frac{12400(eV - Å)}{\lambda(Å)} = \frac{12400}{24800} = 0.5\ eV$

15. $\beta = \frac{I_C}{I_B} = \frac{5.488 \times 10^{-3}}{(5.6 - 5.488) \times 10^{-3}} = 49$

17. $I = neAv_d \Rightarrow v_d \propto \frac{I}{n}$

$\frac{v_{d_1}}{v_{d_2}} = \frac{I_1}{I_2} \quad \frac{n_2}{n_1} = \frac{7}{4} \quad \frac{5}{7} = \frac{5}{4}$

18. $I = \frac{12}{4 + 2} = 2A$

32. For how pass filter, frequency greater than $\frac{1}{C}$ can't pass through filter

$\Rightarrow f < \frac{1}{C} \Rightarrow f < \frac{1}{RC} = 4 \quad 10^4$ Hz = 40 KHz

in given options maximum frequency below 40 KHz is 10.62 KHz

33. LED is use in forward bias so I–V graph is to increase frequency of light emitted from LED; potential barriar to diode is increased so