Tutorial - 2 (U20CS108)

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Date:

① The diffusion constant for holes in Si is $13\ cm^2/sec$. What is the diffusion current density if the gradient of the hole concentration, $\frac{dP}{dx} = -2\times10^{14}$ holes/cm³/cm ?

— $J_P = -e \times D_P \times \frac{dP}{dx}$

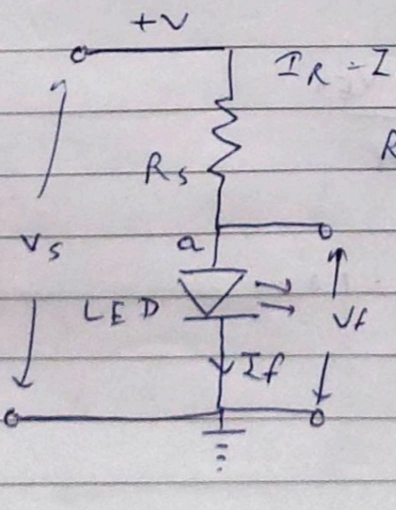
$D_P = 13\ cm^2/sec$

$J_P = + (1.6\times10^{-19}) \times 13 \times (-2\times10^{-14})$ hole/cm³

$= ~~-416 A/cm^{-2}~~$

$= -0.416\ mA/cm^2$

② An amber coloured LED with forward volt drop of 2 to 5.0 V dc supply. find series resistor to forward current less than 10 mA. Also forecum flowing through the diode if a 100 Ω series resistor.



$R_S = \frac{V_S - V_F}{I_F}$

→ Series resistor at 10mA

$$R_s = \frac{V_s - V_f}{I_f}$$

$$= \frac{5-2}{10\times10^{-3}}$$

$$= \underline{300\,\Omega}$$

→ $100\,\Omega = R$

$$R_s = \frac{V_s - V_f}{I_f}$$

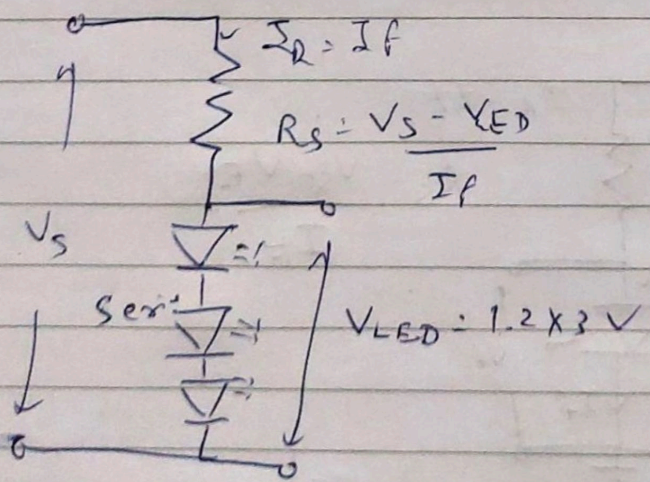
$$I_f = \frac{V_s - V_f}{R_s}$$

$$= \frac{5-2}{100}$$

$$= 30\times10^{-3}\,A$$

$$= 30\,mA$$

③



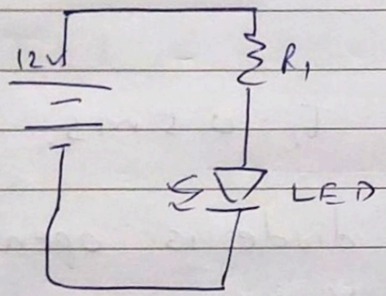
- $V_{LED} : 3 \times 1.2 = 3.6\,V$
  $R_S = V_S - V_{LED} : 1.4$ volts

  V_{LED} using upper formula

$$R_S = \frac{V_S - V_{LED}}{I_f}$$

- Here, we assumed LEDs have 5V device with forward current of about 10 mA.

(4)

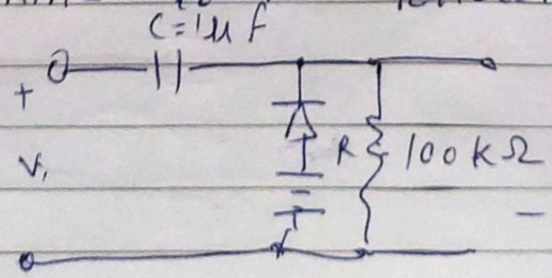


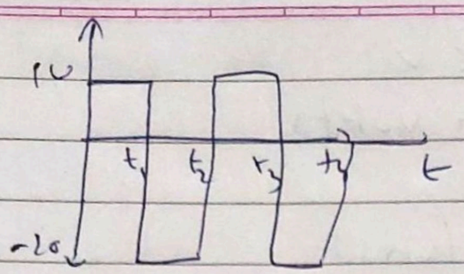
LED forward Voltage : 3.9V
LED forward current : 1400 mA

(V_{LED})
→ The resistor has voltage drop $= 12 - 3.7$
$= 8.1\,V$

- Now, Power Rating $= i \times V$
$= 8.1 \times 1400 \times 10^{-3}$
$= \underline{11.34 \text{ Watts}}$

(5) Determine v_o for following circuit (ideal diode)





→ frequency = 1000 Hz

$$T = \frac{1}{f}$$

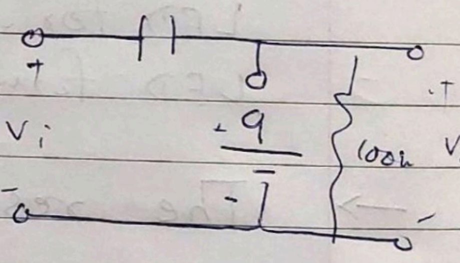
$$= \frac{1}{1000}$$

$$= 1 \text{ ms}$$

so, for each interval $t_1 = 0.5$ ms.

① for first interval, diode is open circuit, no current at output, $V_o = 0$

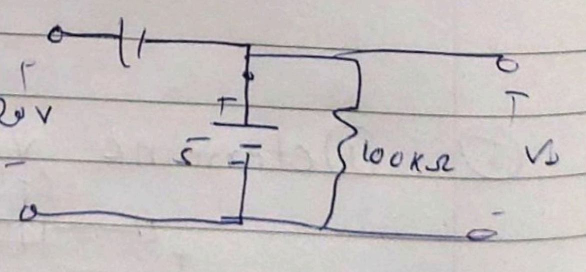
→ $0 < t < t_1$, $V_i = 10V$, $V_o = 0$



② for 2nd interval, diode is short circuit, $V_R = V_o = 5V$

$\therefore V = -20 + V_C - 5 = 0$

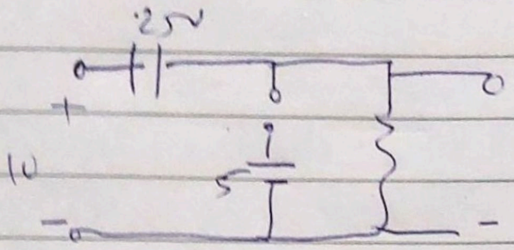
$\boxed{\therefore V_C = 25\ V}$



③ for 3^{rd} interval, diode open circuit.

I_R will produce, so $10 + 25 - V_o = 0$

$\therefore V_o = 35V$



→ Discharge at time $t = RC$

$= 100 \times 10^3 \times 10^{-3} \times 0.1 = 10ms$

$\therefore$ Total discharge $5\tau = 5 \times 10ms = 50ms >>$ interval time