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19MS151

CT - 4
PH3104

Q1 (a).

$\overline{A\cdot B + B\cdot C + C\cdot A} = \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{C}\bar{A}$.

$\overline{A.B}\,.\,\overline{B.C}\,.\,\overline{CA} = (\bar{A}+\bar{B})\,.\,(\bar{B}+\bar{C})\,.\,(\bar{C}+\bar{A})$

$= (\bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}(1+\bar{C}))(\bar{C}+\bar{A})$. $\qquad (\overline{XY} = \bar{X}+\bar{Y})$

$= \cancel{\bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}(1+\bar{C})}$ $\qquad 1+\bar{C} = 1$

$= (\bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B})(\bar{C}+\bar{A})$

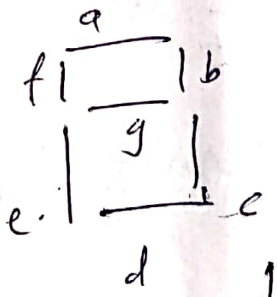
$= \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}\bar{A} + \bar{A}\bar{C}\bar{C} + \bar{A}\bar{C}\bar{A} + \bar{B}\bar{C} + \bar{B}\bar{A}$

$= \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{A}\bar{C} + \bar{B}\bar{C} + \bar{B}\bar{A}$ $\qquad \bar{X}+\bar{X} = \bar{X}$

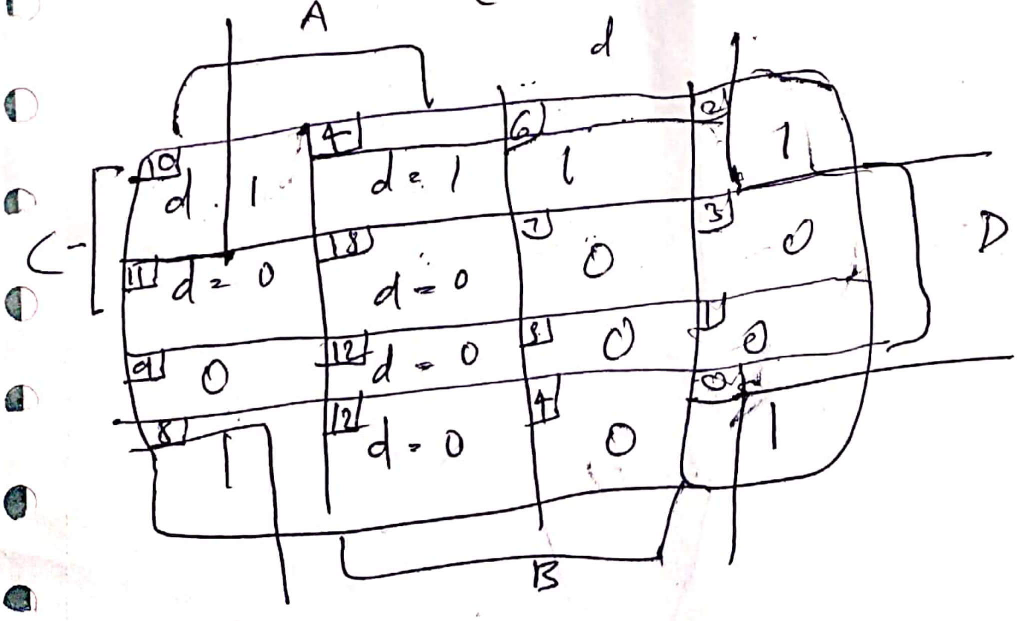
$= \bar{A}\bar{C}(\bar{B}+1) + \bar{A}\bar{B} + \bar{A}\bar{C} + \bar{B}\bar{C}$

$= \bar{A}\bar{C} + \bar{A}\bar{B} + \bar{B}\bar{C} = RHS$

Q1 (b).



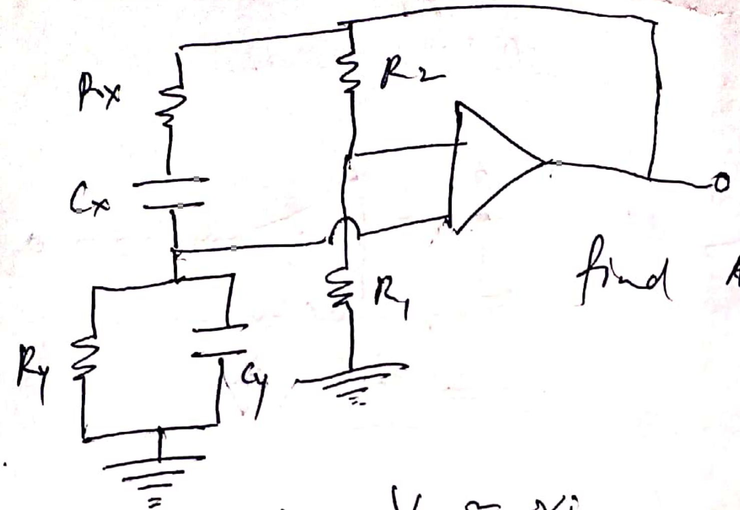
e = on → 0, 2, 6, 8.



$e \rightarrow \bar{B}\bar{D} + C\bar{D}$

$e \rightarrow \bar{D}(\bar{B}+C)$

Q2



find Av

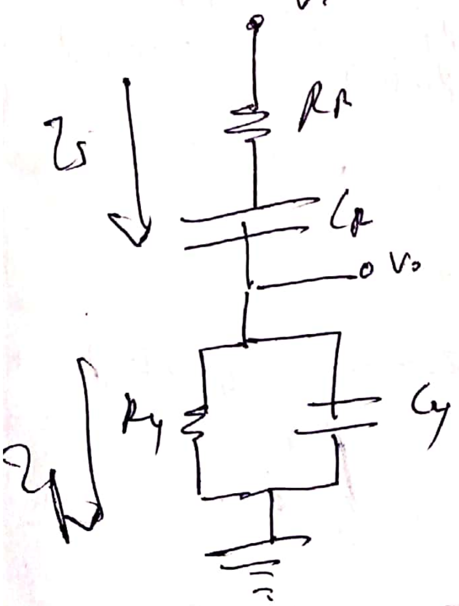
$V^+ = V_i \Rightarrow V_2 \simeq V_i$

$i = -\frac{V_i}{R_1}$

$\Rightarrow V_o = -i(R_1 + R_2) = \frac{V_i}{R_1}(R_1 + R_2)$

$A = \frac{V_o}{V_i} = 1 + \frac{R_2}{R_1}$

for feedback both



$\frac{V_o}{V_i} = \frac{Z_p}{Z_p + Z_s} = \frac{1}{1 + \frac{Z_s}{Z_p}}$

$Z_s = R_x + \frac{1}{j\omega C_x} = \frac{1 + j\omega C_x R_x}{j\omega C_x}$

$Z_p = \frac{R_y \cdot \frac{1}{j\omega C_y}}{R_y + \frac{1}{j\omega C_y}} = \frac{R_y}{R_y j\omega C_y + 1}$

$\frac{Z_s}{Z_p} = \frac{1 + j\omega(C_x R_x + C_y R_y) - \omega^2 C_x R_x \cdot C_y R_y}{j\omega C_x R_y}$

$\Rightarrow \frac{V_o}{V_i} = \beta = \frac{1}{1 + \frac{C_x R_x C_y R_y}{C_y R_y} + j\left(\omega R_x R_y - \frac{1}{\omega C_x R_y}\right)}$

$\frac{R_x R_2}{\omega R_1 C_y}$

β is real at $w = w_0$

$$w_0 = \frac{1}{\sqrt{C_x C_y R_x R_y}}$$

at $w = w_0$

$$\beta = \frac{1}{1 + \left(\frac{R_x}{R_y} + \frac{C_y}{C_x}\right)}$$

$$A = 1 + \frac{R_2}{R_1}$$

Self sustaining

$A\beta = 1$

$$\Rightarrow \left(1 + \frac{R_2}{R_1}\right) = 1 + \frac{R_x}{R_y} + \frac{C_y}{C_x}$$

$$\frac{R_2}{R_1} = \frac{R_x}{R_y} + \frac{C_y}{C_x}$$

$$\text{or} \quad \left(1 + \frac{R_2}{R_1}\right) \cdot \frac{C_x R_y}{R_x C_x + R_y C_y + C_x R_y} = 1$$

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