1 Electrònica

1.1 Díodes

$$V_p - V_n \geq V_\gamma \implies \text{PD}$$
$$\text{no PD} \implies \text{PI}$$
$$\text{PD} \implies I \neq 0$$
$$\text{PI} \implies I = 0$$
$$P_{cons} = \Delta V I$$
$$\text{PI} \quad \text{i} \quad \Delta V_{Z\text{co}} \geq V_Z \implies \text{regió Zener}$$

1.2 NMOS

$$V_{GS} = V_G - V_S \qquad V_{DS} = V_D - V_S$$
$$V_{GS} \leq V_T \implies \text{Tall (OFF)} \implies I_D = 0$$
$$V_{GS} > V_T \implies \text{Canal (ON)} \implies I_D \neq 0$$
$$V_{DS} < V_{GS} - V_T \implies \text{Regió òhmica}$$
$$V_{DS} < V_{GS} - V_T \iff V_{GD} > V_T$$
$$V_{DS} > V_{GS} - V_T \implies \text{Regió de saturació}$$
$$V_{DS} > V_{GS} - V_T \iff V_{GD} < V_T$$

1.3 PMOS

$$V_{GS} \geq V_T \implies \text{Tall (OFF)}$$
$$V_{GS} < V_T \implies \text{Canal (ON)}$$
$$V_{DS} > V_{GS} - V_T \implies \text{Regió òhmica}$$
$$V_{DS} < V_{GS} - V_T \implies \text{Regió de saturació}$$

1.4 Shockley

$$\text{Òhmica} \implies I_D = \beta \left(\left(V_{GS} - V_T\right) V_{DS} - \frac{V_{DS}^2}{2} \right)$$
$$\text{Saturació} \implies I_D = \frac{\beta}{2} \left(V_{GS} - V_T\right)^2$$

1.5 CMOS

$$t_{\text{PHL}} = 1,7 \frac{C}{\beta_N V_{DD}}$$
$$t_{\text{PLH}} = 1,7 \frac{C}{\beta_P V_{DD}}$$
$$t_{\text{P}} = \frac{t_{\text{PHL}} + t_{\text{PLH}}}{2}$$

$$\mathcal{U} = \frac{1}{2} C V_{DD}^2$$
$$P = f C V_{DD}^2$$
$$\text{DP} = P t_{\text{P}}$$

2 Ones

2.1 Equació d'ona

$$\text{Funció d'ona} \equiv \psi\left(x,t\right)$$
$$\frac{\partial^2 \psi}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 \psi}{\partial t} \implies \psi\left(x,t\right) = f\left(x \pm vt\right)$$
$$f\left(x + vt\right) \implies \text{mov cap a la dreta}$$
$$f\left(x - vt\right) \implies \text{mov cap a l'equerra}$$

2.2 Ones harmòniques

$$\psi\left(x,t\right) = A \sin\left(k\left(x - vt\right) + \delta\right)$$
$$f = \frac{1}{T}$$
$$\omega = \frac{2\pi}{T} = 2\pi f$$
$$k = \frac{2\pi}{\lambda}$$
$$v = \frac{\omega}{k}$$
$$v = \lambda f$$
$$I = \frac{P}{S} \qquad (\text{W/m}^2)$$

2.3 Ones electromatnètiques

$$c = v = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} = 3 \times 10^8 \text{ m/s}$$
$$E = cB$$
$$\vec{E} \perp \vec{B}$$
$$\vec{u} = \frac{\vec{E} \times \vec{B}}{|\vec{E} \times \vec{B}|} \implies * \quad \text{i} \quad **$$
$$\vec{B} = \frac{1}{c} \vec{u} \times \vec{E} \qquad (*)$$
$$\vec{E} = c\left(\vec{B} \times \vec{u}\right) \qquad (**)$$
$$\eta_E = \frac{1}{2} \varepsilon_0 E^2 \qquad \eta_B = \frac{1}{2} \frac{B^2}{\mu_0} \qquad (\text{J/m}^3)$$

$$\eta_{\text{ona}} = \varepsilon_0 E^2 = \frac{B^2}{\mu_0} = \frac{|E|\,|B|}{\mu_0 c} \qquad (\text{J/m}^3)$$

$$\text{Vec. de Poynting: } \vec{S} = \frac{\vec{E} \times \vec{B}}{\mu_0} \qquad (\text{W/m}^2)$$

$$I = \left\langle \left| \vec{S} \right| \right\rangle = c \left\langle \eta_{\text{ona}} \right\rangle = \frac{E^2}{2c\mu_0} = \frac{B^2 c}{2\mu_0}$$

2.4 Polarització

$$I_0 = \frac{E^2}{2c\mu_0}$$

$$I_1 = \frac{I_0}{2}$$

$$I_{n+1} = I_n \cos^2\theta$$