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

$$t_{\text{PHL}} = 1,7\frac{C}{\beta_N V_{DD}}$$
$$t_{\text{PLH}} = 1,7\frac{C}{\beta_P V_{DD}}$$
$$t_{\text{P}} = \frac{t_{\text{PHL}} + t_{\text{PLH}}}{2}$$
$$\mathcal{U} = \frac{1}{2}CV_{DD}^2$$
$$P = fCV_{DD}^2$$
$$\text{DP} = Pt_{\text{P}}$$

2 Ones

2.1 Equació d'ona

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

2.2 Ones harmòniques

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

2.3 Ones electromatnètiques

$$c = v = \frac{1}{\sqrt{\varepsilon_0\mu_0}} = 3\times10^8\,\text{m/s}$$
$$E = cB$$
$$\vec{E} \perp \vec{B}$$
$$\vec{u} = \frac{\vec{E}\times\vec{B}}{|\vec{E}\times\vec{B}|} \implies * \quad \text{i} \quad **$$
$$\vec{B} = \frac{1}{c}\vec{u}\times\vec{E} \qquad (*)$$
$$\vec{E} = c\left(\vec{B}\times\vec{u}\right) \qquad (**)$$
$$\eta_E = \frac{1}{2}\varepsilon_0 E^2 \qquad \eta_B = \frac{1}{2}\frac{B^2}{\mu_0} \qquad (\text{J/m}^3)$$

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

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

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

2.4 Polarització

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

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

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

2.5 Reflexió i refracció

$$n = \frac{c}{v} \implies n \geq 1$$

$$\lambda' = \frac{v}{f} = \frac{c}{f}\frac{1}{n} = \frac{\lambda}{n}$$

$$n_1 \sin\alpha_1 = n_2 \sin\alpha_2$$

$$n_1 < n_2 \implies \alpha_2 < \alpha_1$$

$$n_2 < n_1 \implies \alpha_1 < \alpha_2$$

$$\alpha_1 = \alpha_c \implies \alpha_2 = 90^\circ$$

$$n_1 \sin\alpha_c = n_2 \sin 90^\circ \implies \sin\alpha_c = \frac{n_2}{n_1}$$

$$\alpha_1 \geq \alpha_c \implies \text{Reflexió total interna}$$

2.6 Fibres òptiques

$$n_{\text{recobriment}} < n_{\text{nucli}}$$

$$\sin\alpha_c = \frac{n_r}{n_c}$$

$$\sin\alpha_0 = n_n \sin(90^\circ - \alpha_c)$$