SOLUZIONE ESERCIZIO LASER

1)
$$\nu_0 = \frac{c}{\lambda_0} = 474\ THz$$

$$\Delta\nu_{1/2} = 2\nu_0 \sqrt{\frac{2kT\ln 2}{m_{Ne} c^2}} = 1{,}65\ GHz$$

$$\hookrightarrow T = \left(\frac{\Delta\nu_{1/2}}{2\nu_0}\right)^2 \frac{m_{Ne} c^2}{2k\ln 2} = 476K\ (203°C)$$

2)
$$\Delta\nu_{1/2} = M \cdot \Delta\nu_{FSR}$$

$$\hookrightarrow \Delta\nu_{FSR} = \frac{\Delta\nu_{1/2}}{M} = \frac{c}{2\underset{\hookrightarrow 1}{n}L} \Rightarrow L = \frac{Mc}{2\Delta\nu_{1/2}} = 45{,}4\ cm$$

3)
$$\tau_{PH} \simeq \frac{n}{c\alpha_T} \Rightarrow \alpha_T = \frac{n}{c\tau_{PH}} = \frac{1}{c\tau_{PH}} = 0{,}083\ m^{-1}$$

$$\alpha_T = \alpha_S + \frac{1}{2L}\ln\left(\frac{1}{R_1R_2}\right) \Rightarrow \alpha_S = \alpha_T - \frac{1}{2L}\ln\left(\frac{1}{R_1R_2}\right) = 0{,}049\ m^{-1}$$

SOLUZIONE ESERCIZIO LED

1) $$E_{PEAK}[eV] = \frac{1{,}24\ eV \cdot \mu m}{\lambda_0} \simeq E_G$$

$$E_G = 1{,}55\,eV$$

2) $$\Delta E = 3kT$$

$\hookrightarrow$ $$E = \frac{hc}{\lambda}$$

$$dE = -\frac{hc}{\lambda^2} \cdot d\lambda \Rightarrow |\Delta \lambda_{1/2}| = \frac{\lambda_0^2}{hc} \cdot \Delta E =$$

$$= \frac{\lambda_0^2}{hc} \cdot 3kT \simeq 40\ nm$$

3) $$\eta_{EQE} = \frac{\phi_{PH\ OUT}}{\phi_{e^-\ IMMETTATI}} = \frac{P_{OUT}/h\nu}{I_F/q}$$

$$\lambda \nu = c \qquad \nu = \frac{c}{\lambda} = 374{,}7\ THz$$

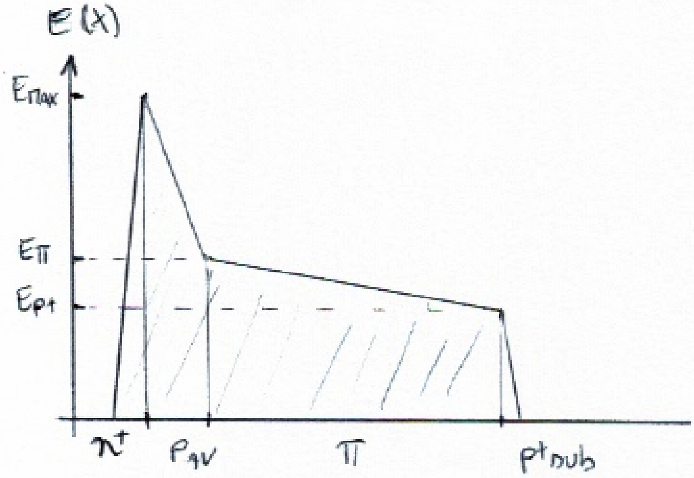
$$\eta_{EQE} = 0{,}303 \rightarrow 30{,}3\%$$

$$\eta_{PCE} = \frac{P_{OUT\ OTT}}{P_{EL\ LED}} = \frac{P_{OUT}}{I_C \cdot V_F} \rightarrow V_F = \frac{P_{OUT}}{I_F \cdot \eta_{PCE}} = 9{,}41\,V$$

SOLUZIONE ESERCIZIO APD

1) LA TENSIONE INVERSA AI CAPI DEL RIVELATORE SI RICAVA CALCOLANDO L'AREA SOTTESA DAL PROFILO DI CAMPO ELETTRICO.

RAPPRESENTIAMO IL CAMPO ELETTRICO $E(x)$



$$E_{p+} = E_{\pi} - \frac{q N_{A,\pi} W_{\pi}}{\varepsilon_{Si}} = (60 - 32)\frac{kV}{cm} = 28\frac{kV}{cm}$$

$$E_{max} = E_{\pi} + \frac{q N_{A,av} \cdot W_{p,AV}}{\varepsilon_{Si}} = (60 + 160)\frac{kV}{cm} = 220\frac{kV}{cm}$$

$$V_{rev} + \phi_{Bi} = \frac{(E_{p+} + E_{\pi}) \cdot W_{\pi}}{2} + \frac{(E_{\pi} + E_{max}) W_{p,AV}}{2} = (88 + 14)\,V = 102\,V$$

$$\Rightarrow V_{rev} \simeq 101\,V$$

2)

$$\frac{P_{ass,p}}{P_{inc}} = \eta_p = e^{-\alpha W_{n^+}}\left(1 - e^{-\alpha W_{p,AV}}\right) \simeq 7{,}8\%$$

$$\frac{P_{ass,\pi}}{P_{inc}} \simeq \eta_{\pi} = e^{-\alpha (W_{n^+} + W_{pAV})}\left(1 - e^{-\alpha W_{\pi}}\right) = 64\%$$

3) $t_{resp_{APD}} = t_{drift,e} + t_{avalanche} + t_{drift,p} =$

$$= \frac{W_\pi}{v_{sat}} + \frac{W_{p,av}}{v_{sat}} \cdot M \cdot K + \frac{W_\pi + W_p}{v_{sat}} = 0{,}2\,ns + 0{,}1\,ns + 0{,}21\,ns$$