– 13. auditorna vježba –

25) I_0 nepolarizirana

$\varphi_1 = 60^\circ$

$\varphi_2 = 90^\circ$

$$\boxed{I_n = I_{n-1} \cdot \cos^2(\varphi_n - \varphi_{n-1})}$$

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

$$I_2 = I_1 \cdot \cos^2(60^\circ)$$

$$I_3 = I_2 \cdot \cos^2(90^\circ - 60^\circ)$$

$$I_3 = \frac{I_0}{2} \cdot \cos^2(60^\circ) \cdot \cos^2(30^\circ)$$

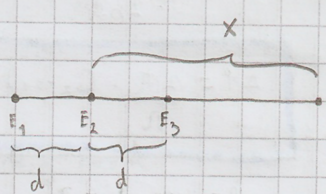
$$= \frac{I_0}{2} \cdot \frac{1}{4} \cdot \frac{3}{4}$$

$$= \frac{3I_0}{32}$$ u smjeru x-osi

Z1) $E_1 = E_0 \cdot \sin(\omega t - kx_1)$ $\quad d = ?$

$E_2 = E_0 \cdot \sin(\omega t - kx_2)$

$E_3 = E_0 \cdot \sin(\omega t - kx_3)$



$$E_{uk} = E_1 + E_2 + E_3$$

$$= E_0 \cdot [\sin(\omega t - kx_1) + \sin(\omega t - kx_2) + \sin(\omega t - kx_3)]$$

$$\boxed{e^{i\varphi} = \cos\varphi + i \sin\varphi}$$

$$E_{uk} = E_0 \cdot I_m \cdot (e^{i(\omega t - kx_1)} + e^{i(\omega t - kx_2)} + e^{i(\omega t - kx_3)})$$

$$\left| \begin{aligned} x_1 &= x + d \\ x_2 &= x \\ x_3 &= x - d \end{aligned} \right|$$

$$E_{uk} = E_0 \cdot I_m \cdot e^{i(\omega t - kx)} (e^{-kd} + 1 + e^{kd})$$

$$= \left| \cos\varphi = \frac{e^{-i\varphi} + e^{i\varphi}}{2} \right|$$

$$= E_0 \cdot I_m \cdot e^{i(\omega t - kx)} \underbrace{[2\cos(kd) + 1]}_{0}$$

$$2\cos(kd) = 1 \qquad d$$

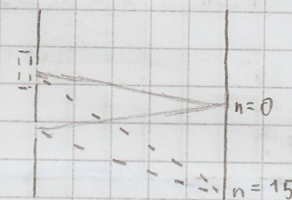
$$kd = \frac{2\pi}{3}$$

$$d = \frac{2\pi}{3k}$$

$$\left| k = \frac{2\pi}{\lambda} \right|$$

$$d = \frac{\lambda}{3}$$

Z2.1) $\lambda = 5 \cdot 10^{-7}$ m



$n = 1.6$

$l = ?$

$$\boxed{|s_2 - s_1| = m \cdot \lambda}$$

$$= 15\lambda$$

$$\boxed{(s_2 - s_1) + l \cdot (n_1 - n_2) = 0}$$

$$s_2 - s_1 = -l(n-1)$$

$$|s_2 - s_1| = l(n-1)$$

$$l(n-1) = 15\lambda$$

$$l = \frac{15\lambda}{n-1}$$

$$= \frac{15 \cdot 5 \cdot 10^{-7}}{1.6 - 1} = 1.25 \cdot 10^{-5} \text{ m}$$

Z2.2) $\lambda_1 = 4 \cdot 10^{-7}$ m

$N_1 = 10$ unutar 1.8 cm

$\lambda_2 = ?$

$N_2 = 10$ unutar 2.7 cm

$$\boxed{y = \frac{x}{N}} \quad \boxed{\frac{d\,y}{D} = m \cdot \lambda}$$

$$y_1 = \frac{1.8}{10} = 0.18 \text{ cm} = 1.8 \cdot 10^{-3} \text{ m}$$

$$y_2 = \frac{2.7}{10} = 2.7 \cdot 10^{-3} \text{ m}$$

$d_1 = d_2$, $D_1 = D_2$, $m_1 = m_2 = 1$

$$\frac{d}{Dm} = \frac{\lambda_1}{y_1} = \frac{\lambda_2}{y_2}$$

$$\lambda_2 = \frac{y_2 \lambda_1}{y_1}$$

$$= \frac{2.7 \cdot 10^{-3} \cdot 4 \cdot 10^{-7}}{1.8 \cdot 10^{-3}} = 6 \cdot 10^{-7} \text{ m}$$

Z3.1) $n = 1.33$

$\lambda_1 = 6.4 \cdot 10^{-7}$ m ~ max odbijena

$\lambda_2 = 4 \cdot 10^{-7}$ m ~ neodbijena

$\alpha = 30°$

$d = ?$

$$\boxed{2d\sqrt{n^2 - \sin^2\alpha} = (m + \tfrac{1}{2})\lambda \sim \text{max odbijena}}$$

$$\boxed{2d\sqrt{n^2 - \sin^2\alpha} = (m + 1)\lambda \sim \text{min odbijena}}$$

$$2d\sqrt{n^2 - \sin^2\alpha} = (m_1 + \tfrac{1}{2})\lambda_1 = (m_2 + 1)\lambda_2$$

$$6.4 \cdot 10^{-7} \cdot m_1 + 3.2 \cdot 10^{-7} = 4 \cdot 10^{-7} \cdot m_2 + 4 \cdot 10^{-7} \quad / \cdot 10^{7}$$

$$6.4 m_1 = 4 m_2 + 0.8 \quad /:6.4$$

$$m_1 = \frac{5 m_2}{8} + \frac{1}{8}$$

$$\boxed{m_1, m_2 \in N}$$

$m_1 = 1,\ m_2 = 1$ X

$m_1 = 2,\ m_2 = 3$ ✓ <— $2 = \frac{5 \cdot 3}{8} + \frac{1}{8}$ ✓

$$2d\sqrt{1.33^2 - \sin^2 30°} = (3+1) \cdot 4 \cdot 10^{-7}$$

$d = 6.5 \cdot 10^{-7}$ m

Z3.2) $\lambda_1 = 700$ nm $= 7 \cdot 10^{-7}$ m

$\lambda_2 = 5 \cdot 10^{-7}$ m

$n = 1.5$

$\alpha = 45°$

$d = ?$

$$2d\sqrt{n^2 - \sin^2\alpha} = (m + \tfrac{1}{2})\lambda$$

$$d = \frac{(m + \frac{1}{2})\lambda_1}{2\sqrt{n^2 - \sin^2\alpha}} = \frac{(m + 1 + \frac{1}{2})\lambda_2}{2\sqrt{n^2 - \sin^2\alpha}}$$

$$m \cdot 7 \cdot 10^{-7} + 3.5 \cdot 10^{-7} = m \cdot 5 \cdot 10^{-7} + 7.5 \cdot 10^{-7} \quad / \cdot 10^{-7}$$

$$2m = 4$$

$$m = 2$$

$$d = \frac{(2 + \frac{1}{2}) \cdot 7 \cdot 10^{-7}}{2\sqrt{1.5^2 - \sin^2 45°}} = 6.6 \cdot 10^{-7} \text{ m}$$

Z4) $n = 1.3\dot{3}$

$\lambda_p = 4.8 \cdot 10^{-7}$ m ~ min refleksija

$\lambda_c = 6.4 \cdot 10^{-7}$ m ~ max refleksija

$\alpha = 0°$

$$s_2 - s_1 = (m + \tfrac{1}{2})\lambda$$

$$2d\sqrt{n^2 - \sin^2\alpha} = (m + \tfrac{1}{2})\lambda$$

$$s_2 - s_1 = 2d\sqrt{n^2 - \sin^2 0°}$$

$$= 2nd$$

$$\boxed{\Delta\varphi = \frac{2\pi}{\lambda} \cdot (s_2 - s_1) + \pi}$$

$$\Delta\varphi = \frac{4\pi nd}{\lambda} + \pi$$

$$\Delta\varphi_p = \frac{4\pi nd}{\lambda_p} + \pi = (2m + 1)\pi$$

$$d = \frac{\lambda_p}{2n} \cdot m$$

$= |m = 1|,\ d = 180$ nm

$= |m = 2|,\ d = 360$ nm

$$\Delta\varphi_c = \frac{4\pi nd}{\lambda_c} + \pi = 2m\pi$$

$$d = \frac{\lambda_c}{4n}(2m - 1)$$

$= |m = 1|,\ d = 120$ nm

$= |m = 2|,\ d = 360$ nm

$d_{min} = 3.6 \cdot 10^{-7}$ m