

8. Yorug'lik difraktsiyasi. Turli tirqich va to'siqlardagi difraktsiya hodisalari. Difraktsion panjara va ularning asosiy xarakteristikalarini hisoblash. Ajrata olish qobiliyati, chiziqli va burchakli dispersiyalari.

1–masala. Proekcion apparat obektivining fokus oralig'i 20 sm ga, obektivdan ekrangacha bo'lgan oraliq 20 m ga teng. Diapozitivda rasmning kattaligi 4 sm ga teng bo'lsa, ekrandagi rasmning kattaligi nechaga teng bo'ladi?

Berilgani: $F=20\text{ sm}=0,2\text{ m}$; $f=20\text{ m}$; $h=4\text{ sm}=0,04\text{ m}$.

Topish kerak: H -?

Yechilishi: Diapozitivtan obektivning optikalik markazigacha bo'lgan oraliqni linza formulasidan topamiz:

$$d = \frac{F \cdot f}{f - F}$$

Rasmning kattaligi linzaning kattalashtirilishidan topamiz:

$$\frac{H}{h} = \frac{f}{d}, \quad H = \frac{h \cdot f}{d} = \frac{h \cdot f}{\frac{F \cdot f}{f - F}} = \frac{f - F}{F} \cdot h$$

Hisoblash:

$$H = \frac{0,04\text{ m} \cdot (20\text{ m} - 0,2\text{ m})}{0,2\text{ m}} = 3,96\text{ m} \approx 4\text{ m}.$$

2–masala. Fotoapparat optikalik kuchi 5 dioptriya bo'lgan obektiv (linzalar sistemasi)ga ega. Shunday fotoapparat yordamida kattaligi 160 sm bo'lgan odamning rasmini olmoqchi. Rasmning kattaligi 8 sm bo'lishi uchun odam fotoapparatdan qanday uzoqlikda turishi kerak?

Berilgani: $D=5\text{ dptr}$; $h=160\text{ sm}$; $H=8\text{ sm}=0,08\text{ m}$.

Topish kerak: d -?

Yechilishi: Fotoapparatning obiectivi bir yig'uvchi linzaning vazifasini bajaradigan linzalar sistemasidan iborat. Yig'uvchi linza formulasidan foydalanib, f ni topamiz:

$$f = \frac{F \cdot d}{d - F} \quad (\text{a})$$

Ikkinchi taraftan, fotoapparatning kattalashtirilishi:

$$\frac{H}{h} = \frac{f}{d} \text{ dan } f = \frac{H \cdot d}{h} \quad (b)$$

(a) va (b) ifodalarning birgalikda yechib hamda $F = \frac{1}{D}$ ekanligini etiborga olgan holda d ni topamiz:

$$\frac{F \cdot d}{d - F} = \frac{H \cdot d}{h}; \quad d = \frac{H + h}{H} \cdot F = \frac{H + h}{HD}$$

Hisoblash:

$$d = \frac{0,08 \text{ m} + 1,6 \text{ m}}{5 \frac{1}{\text{m}} \cdot 0,08 \text{ m}} = 4,2 \text{ m.}$$

3–masala. Spektrning chetki qizil nuri uchun shishaning sindirish ko'rsatkichi 1,510 ga teng, ultrafiolet nuri uchun 1,531 ga teng. Egrilik radiuslari 15 sm bo'lgan ikki tomonlama qavariq linzaning qizil va ultrafiolet nurlari fokuslari orasidagi oraliqni aniqlang.

Berilgani: $n_1=1,510$; $n_2=1,531$; $R_1=R_2=R=15 \text{ sm}=0,15 \text{ m}$.

Topish kerak: Δl ?

Yechilishi: Linzaning fokus oralig'i formulasini masala shartiga mos ravishta yozamiz:

$$F = \frac{1}{(n - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)} = \frac{R}{2(n - 1)}$$

Linzaning qizil nur uchun fokus oralig'i:

$$F_1 = \frac{R}{2(n_1 - 1)}$$

ultrafiolet nuri uchun bo'lsa:

$$F_2 = \frac{R}{2(n_2 - 1)}$$

Ko'rinishda anglatadi. Bu holda linzaning qizil va ultra fiolet nurlari uchun fokuslari oraliq quydagicha aniqlanadi:

$$\Delta l = F_1 - F_2 = \frac{R}{2} \left(\frac{1}{(n_1 - 1)} - \frac{1}{(n_2 - 1)} \right) = \frac{R(n_2 - n_1)}{2(n_1 - 1)(n_2 - 1)}$$

Hisoblash:

$$\Delta l = \frac{0,15 \text{ m} (1,531 - 1,510)}{2(1,510 - 1)(1,531 - 1)} = 5,8 \cdot 10^{-3} \text{ m.}$$