652.

Problem 46.5 (RHK)

A single slit is illuminated by light whose wavelengths are λ_a *and* λ_b, *so chosen that the first diffraction minimum of the* λ_a *component coincides with the second minimum of the* λ_b *component*. (a) *We have to find the relationship that exists between the two wavelengths*. (b) *We have to find whether there are any other minima in the two patterns that coincide*.

Solution:

(a)

The condition for diffraction minima in a single slit diffraction is

$a\sin\theta = m\lambda,\ m = 1, 2, 3....$

It is given that the first diffraction minimum of the λ_a component coincides with the second minimum of the λ_b component. Therefore, we obtain the following relation by applying these conditions;

$\lambda_a = 2\lambda_b$.

(b)

For answering the second part of the problem, we will determine integers m_a and m_b such that

$m_a\lambda_a = m_b\lambda_b.$

As

$\lambda_a = 2\lambda_b,$

we have

$2m_a = m_b.$

We find that the fourth minimum of λ_b will coincide with the second minimum of λ_a, and so on.