Solutions to Optical Physics 021018

1

The first intermediate image is situated in the field lens and ahs the size $h_1 = \alpha f_1$
Where α is the subtended angle by the object.
The second intermediate image is at z= 210mm and has the size

$$h_2 = \frac{60mm}{30mm} h_1 = 2\alpha f_1$$

This is situated in the front focal plane of the eye-piece with angle

$$\beta = \frac{h_2}{f_{okular}} = 2\alpha \frac{f_1}{f_{okular}} \Rightarrow M_a = \frac{\beta}{\alpha} = 8$$

Ray construction shows that the first lens is aperture stop. Imaging this in lens 2 gives an image in z=160mm (M=0,333), giving object distance -10mm to lens 3. Image after lens 3 will be at z=156,7mm, giving an object distance of 83,3mm to lens 4. Final image = exit pupil 47mm after last lens.
Size 40mm x 0,333 x 0,667 x 0,567 = 5mm

3

All wavelengths get a phase shift π because of reflection against denser medium.
The condition for constructive interference will be

$$2nd \cos b = (2m+1)\lambda$$

m=2 for green light (550nm) gives a phase difference of 6π for blue and 4π for red. This should be ideal.

$$d = \frac{5\lambda}{2 \cdot 1{,}8 \cos 23°} = 830nm$$

4

When everything is OK the fourier pattern will look like the pattern of a single slit
In a/ it will be the same (translation invariant)
b/ Different assumtions can be made regarding what a knot looks like, but regardless of that light will be scattered in direction parallell to the thred
c/ The pattern will be wider

5

This problem is very similar to that in 3 (with different physical background), with a change in colour, giving 5p for yellow as the best phase shift.

6

The coherence function ca be written as:

$$\gamma = 0{,}5 \exp(ik\Delta L)\left\{1 + \tfrac{1}{2}\left[\exp(i\Delta k \Delta L) + \exp(-i\Delta k \Delta L)\right]\right\} = \frac{\exp(ik\Delta L)}{2}\left\{1 + \cos\frac{2\pi \Delta f \Delta L}{c}\right\}$$

Where the factor in the large paranthesis (including the factor 2) is the visibility

$$V = \frac{1}{2}\left(1 + \cos\frac{\pi \Delta L}{L_{las}}\right)$$