Solutions to exam in Optical Physics 091019

1

The object should be placed 10 mm before the first lens. The magnification is 25 times. FS is second lens. The field of view is a circle with 4 mm diameter. AS and Entrance pupil is the first lens (degenerate wit lens 3 and 5), so exit pupil is the last lens.

2

The brewster angle condition gives

$$\tan\frac{\alpha}{2} = \frac{1}{n}$$

The condition for TIR is

$$n\sin(90-\alpha) = n\cos\alpha \geq 1$$

Which combined gives (after some small calculations ☺)

$$\frac{n^2-1}{n^2+1}n \geq 1$$

This means n should be larger than 1.84, but you do not have to find that number to get full points.

4

The only case in which an arm gives light to the pattern is when the angle of the plate in the arm is 45°, else light will return to the laser. But in that case the contributions from the arms are perpendicular i polarisation. No visibility at all in any case!

5

The radial spread in the intermediate image plane is $r_{spot} = \frac{1.22\lambda(d-f_2)}{D_{obj}}$ which gives an angular spread of $\alpha = \frac{r_{spot}}{f_2} = \frac{1.22\lambda(d-f_2)}{D_{obj} f_2}$

The exit pupil is placed on a distance $s' = \frac{df_2}{d-f_2} \Rightarrow M_{eyepiece} = \frac{f_2}{d-f_2}$ which gives the size of the exit pupil $D_{exitp} = \frac{D_{obj} f_2}{d-f_2}$ which gives diffraction angle $\beta = \frac{1.22\lambda}{D_{exitp}} = \frac{1.22\lambda(d-f_2)}{f_2 D_{obj}}$

Hence a=b and as the angle determines the size of the retinal image, this proves the statement

6

Double slit pattern in x-direction, with slit width around ¼ of slit distance. Single slit pattern in direction perpendicular to transverse bar. Patterns are alike in horizontal direction oand in skew direction. But in horizontal direction an interference pattern is overalayered. 3-6 interference max in central diffraktion max.