

## Examination in Optical physics 101018

All examination aids except those which provide contact with the outer world are allowed. Draw figures whenever possible!

1-2

Given a bulb with a light emitting area of a circle with diameter 2 mm, that should be used in a lamp construction (beamer) that can be converted between spot (smallest possible illuminated area) and flood (large illuminated area). The lens used has a focal length of 100 mm and a diameter of 50 mm. Plot (draw a diagram) the approximate relative intensity distribution at a wall 10 m from the lamp, when the distance from bulb to lens is 75 mm .

Radial axis must be graded. Thin lens, no aberrations and small angles may be assumed ☺

3

A surface emitting\* LED is used as light source in a two slit interference experiment. At what distance from the slits must the LED be placed in order to create a visibility better than 0.80 if the slit separation is 1.2 mm and the wavelength is 647 nm?

The emitting area of the LED is 100  $\mu\text{m}$  x 100  $\mu\text{m}$ .

\* Surface emitting = no plastic lens over the LED

4

A microscope objective is made from two lenses with  $f = 3.0\text{ mm}$  separated 1.5 mm and 2.0 mm diameter followed directly by a larger lens with focal length 200 mm giving an intermediate image 200 mm after the last lens. (The objective is made out of three lenses)

What will be the smallest resolved object separation according to Rayleigh's criterion (expressed in wavelengths)

5

A material having (small) absorption is mostly described as having a complex index of refraction. An alternative description is to add a term to the first order wave equation so that it becomes.

$$\frac{\delta E}{\delta \vec{x}} - \frac{n}{c_{vac}} \frac{\delta E}{\delta t} + QE = 0$$

Where Q is related to the imaginary part of the complex index of refraction N.

How are they related?

6

A wave plate has a  $2\pi$  phase shift for 550 nm and is placed between crossed polarizers. Optical axis is  $45^\circ$  between the transmission direction of the polarizers.

What will be the colour (= visual impression) of the transmitted light?

Illumination light is white.