

## Examination Optical Modeling and Design I

Docents: Prof. Dr. Frank Wyrowski, Dr. Uwe D. Zeitner

Answer all questions in your own words and with mathematics where needed for your argumentation.

1. Give the name of five typical types of optical surfaces/interfaces?
2. What do the Sellmeier formulas describe? Do they include the optical absorption of a material?
3. When do we speak about homogeneous, isotropic and non-dispersive media respectively?
4. Formulate the three linear matter equations in the frequency domain.
5. In optics electromagnetic fields are typically described by complex generalizations of the real fields. How are both field expressions related?
6. What is the mathematical definition of a harmonic field?
7. Define a plane wave mathematically. Discuss in words or/and formulas conditions on the parameters of a plane wave, which makes them to a solution of Maxwell's equations in a homogeneous and isotropic dielectric. What is the difference between homogeneous and inhomogeneous plane waves?
8. How many components of the electric and magnetic field vectors are independent in homogeneous and isotropic media? Discuss the reasons with your own words.
9. What are basic concepts which constitute the use of geometrical optics to propagate fields through optical surfaces?
10. Make a sketch of the image formation with a real lens of thickness  $d$ . Mark the relevant quantities, planes, and distances.
11. What are the five primary types of aberrations in an imaging system?
12. Describe what needs to be considered for the construction of an achromatic doublet lens. What is the condition of achromasie?
13. Consider an imaging system composed of two lenses with the first lens (the one near the object) acting as stop. Sketch the position of the exit pupil. Describe what the concept of entrance- and exit-pupil can be used for.
14. What is the main property of a ray-cone emitted by an object point when it can be called "object-side telecentric"? Where is the location of the limiting aperture in an object-side telecentric imaging set-up consisting of only a single lens?