Examination to Optical Modeling and Design I

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

1. What is the definition of the Fourier transformation between time t and angular frequency ω? (2P)
2. Describe the contents of the convolution theorem. (3P)
3. What is the shape of the autocorrelation function of a rectangular function (1D)? (2P)
4. What are the Fourier transformations of a constant function, a rect function, and a Gaussian function? (3P)
5. A cosine function should have a period of 5 μm. What is the maximum sampling distance in order to maintain the complete information of the cosine? (2P)
6. What are the three matter equations in the frequency domain for linear media? (3P)
7. Transfer one of them into the time domain. (3P)
8. When do we speak about homogeneous, isotropic and non-dispersive media respectively? (3P)
9. Define a plane wave. In which type of medium are they solutions of Maxwell's equations? Discuss further conditions on the parameters of a plane wave, which makes them to a solution. (5P)
10. What is the difference between homogeneous and inhomogeneous plane waves? (2P)
11. What is the dispersion relation of plane waves? (2P)
12. What is the message of the spectrum-of-plane-waves decomposition of any electromagnetic field in a homogeneous and isotropic medium? (3P)
13. How many components of the electric and magnetic field vectors are independent in homogeneous and isotropic media? Discuss the reasons. (5P)
14. In optics light fields are typically described by complex amplitudes of harmonic fields. How are they related to the real electric and magnetic fields? (3P)