

PYL 313 Fourier Optics and Holography

Major Exam

22 November 2015

Duration 2 hrs.

Answer all questions.

1. ✓ A hologram is made using an object wave whose highest spatial frequency is f_m . A reference wave $\exp(j2\pi f_r x)$ is used to record the hologram on a film of emulsion thickness t . Write a condition under which the recorded hologram is considered as a thin hologram. (6)
2. ✓ How are the following complex amplitudes recorded in a Lee's type computer generated hologram? (a) $\frac{1}{\sqrt{5}}(2+i)$ (b) $\frac{1}{2\sqrt{3}}(\sqrt{2}+i)$ (c) $\frac{1}{\sqrt{28}}(2+i\sqrt{3})$ and (d) $\frac{1}{\sqrt{2}}(1+i)$ (6)
3. ✓ Describe a method of producing orthoscopic real image in holography. (4)
4. ✓ In recording an amplitude holo-grating with period d , the object wave is given by $a_1 \exp(j\phi_1)$. If the grating diffraction efficiency is 4%, write an expression for the reference wave complex amplitude. (6)
5. ✓ Three identical long narrow slits, each of width b are arranged with separation distance d between them. Derive an expression for the intensity distribution in the Fraunhofer diffraction pattern. (6)
6. Using angular spectrum of plane waves, find the complex amplitude at a distance z from a sinusoidal amplitude grating which was illuminated by a unit amplitude plane wave at normal incidence. (6)
7. What is a Vanderlugt filter? How is it made and used? (6)
8. ✓ Prove $\mathfrak{I}\mathfrak{I}\{g(x,y)\} = g(-x,-y)$ (6)
9. ✓ A point source is imaged using a lens with circular aperture. If the source is kept at a distance $2f$ in front of the lens, describe the image characteristics. (4)