

## PYL 313 Fourier Optics and Holography

Minor I Exam

01 September 2015

Duration 1 hr.

Answer all questions. 5x5=25

1. The spectrum of a band limited signal  $g(x,y)$  occupies an area of  $2B_x \times 2B_y$  in its spectral domain. It is multiplied with a function  $s(x,y) = \text{comb}(5Xx)\text{comb}(2Yy)$ . What should be the impulse responses of the set of all possible filters that can be used to recover  $g(x,y)$  from  $g(x,y)s(x,y)$ ?
2. Sketch the Fraunhofer diffraction patterns of (a) sinusoidal amplitude grating (b) binary amplitude grating. What happens to the diffraction pattern, if in the binary amplitude grating, the ratio of transparent to opaque regions goes to zero? (i.e., the width of the transparent slit goes down to zero).
3. Find the Fraunhofer diffraction pattern of a circular aperture.
4. Prove  $\mathfrak{F}\{\nabla^2 g(x,y)\} = -4\pi^2(f_x^2 + f_y^2)\mathfrak{F}\{g(x,y)\}$  where  $\nabla^2$  is the Laplacian operator.
5. A wave incident on a screen produces a phase distribution given by  $\phi(x,y) = ax + by$ , where  $a$  and  $b$  constants. Write an expression for this optical field, propagation vector and spatial frequencies.

$$-4\pi^2(f_x^2 + f_y^2)$$
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