EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE - 2016/2017

FIRST SEMESTER (November 2018)

PH 203 Physical Optics II

Answer ALL Questions Time: 01 hour.

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1) Distinguish Fraunhofer diffraction from Fresnel diffraction. ... (10 marks)

When a parallel monochromatic beam of light of wavelength λ illuminates normally on a double slit having slit width b and slit separation d, the Fraunhofer diffraction pattern is given by $I_P = 4I_0\left(\frac{\sin\beta}{\beta}\right)^2 \cos^2\gamma$, where $\beta = \frac{\pi b}{\lambda}\sin\theta$, $\gamma = \frac{\pi d}{\lambda}\sin\theta$ and θ is the diffraction angle.

(a) Obtain the conditions for principal maxima and minima of the diffraction term $\left(\frac{Sin\,\beta}{\beta}\right)^2$. ... (20% marks)

(b) Obtain the condition for maxima of the interference term $Cos^2\gamma$. ... (20% marks)

(c) By explanation obtain the condition for the first missing order in terms of b and d. ... (25% marks)

(d) In a Fraunhofer diffraction arrangement, a double slit is illuminated normally by a light of wavelength $\lambda = 6000\,\text{Å}$ and the 3rd order bright fringe was measured to be at $\theta = 0.1^o$ (0.1 degrees). The intensities of bright fringes were observed to decrease starting from the central brightest to 4th, and the 5th bright fringe was missing. Find the values of d and b. ... (25% marks)

2) The transmitted intensity distribution due to multiple-beam interference arising in a Fabry-Perot interferometer is given by

$$I_t = I_0 \frac{T^2/(1-R)^2}{1+\frac{4R}{(1-R)^2}\sin^2(\phi/2)},$$

where $\phi = \frac{2\pi}{\lambda} 2d\cos\theta$ is the phase difference between two successive transmitted beams emerging through the parallel plates of the Fabry-Perot interferometer separated by a distance d; θ being the angle of the incident and transmitted beams. I_0 is the intensity of the incident beam and R and T are respectively the reflectivity and transmitivity of the plates.

(a) Obtain the conditions for maxima and minima for the above intensity distribution, and hence show that the *visibility* of Fabry-Perot fringes is given by $2R/(1+R^2)$. ...(30 marks)

(b) Show that the resolving power of Fabry-Perot interferometer is $m\frac{\pi\sqrt{R}}{1-R}$, where m is the *order*. ...(45 marks)

(c) A Fabry-Perot interferometer is used to study the Sodium D-lines having wavelengths 589.0 and 589.6 nanometers. If the reflectivity of plates is 0.9, find the minimum plate separation d to *just resolve* the D-lines. ...(25 marks)