Candidate's Index Number
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Signature:

MBER 2021
02SW
CAL OPTICS
RS

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
SCHOOL OF EDUCATIONAL DEVELOPMENT AND OUTREACH
INSTITUTE OF EDUCATION

VE-SEMESTER BACHELOR OF EDUCATION (SANDWICH) PROGRAMME
VEL 350, END-OF-SECOND SEMESTER EXAMINATION, DECEMBER 2021

MBER 23, 2021 **PHYSICAL OPTICS** **2:00 PM - 4:00 PM**

Answer FOUR QUESTIONS
Question 1 in section A and three other from section B

SECTION A
(40 MARKS)

) What is diffraction? Explain single-slit diffraction and give conditions for single-slit diffraction pattern. [8 marks]

) State the Poynting's theorem. What unit is S, the Poynting's vector in MKS sys s tem [8 Marks]

) Find the eigen value and corresponding eigen vectors for a linear polarizer with its transmission axis at 45 degrees [8Marks]

J) Describe the interference pattern due to Young's double –slit experiment. [8 Marks]

:) What is diffraction gratings. State the conditions for gratings dispersion D and its resolving power R. [8 Marks]

SECTION B
(60 marks)
Answer only THREE questions from this section

2.

a) Show that the average poynting flux is given by the expression $\frac{1}{2}\, R_e(E_o \times H_o^*)$ where E_o and H_o^* is the complex conjugate of the field amplitude of the light.. [10 Marks]

b) Three light – waves combine at a point where their electric field components are:

$E_1 = E_0 \text{ Sin } \omega t$

$E_2 = E_0 \text{Sin } (\omega t + 60^0)$

$E_3 = E_0 \text{Sin}(\omega t - 30^0)$

Find their resultant component E(t) at that point. [10 Marks]

3. The wavelengths of visible spectrum are approximately 400 – nm (violet) to 700 – nm (red)

a) Find the angular width of the first-order visible spectrum produced by a plane grating with 600 slits per millimeter when white light falls normally on the grating. [10 Marks]

b) Do the first –order and second-order spectra overlap? [10 Marks]

4. a) State the condition for maximum and minimum intensity in Young's interference experiment. [8 Marks]

b) The fringe patterns from Fabry – Perot interferometer is given by sum of two Airy functions:

$I_T = I_o\left(1 + F\text{Sin}^2\frac{\Delta}{2}\right)^{-1} + I_o\left(1 + F\text{Sin}^2\frac{\Delta^!}{2}\right)^{-1}$ where $F = \frac{4R}{(1-R)^2}$ the coefficient of finesse, which is a measure of the sharpness of the interference fringes. Show that the Reflecting finesse $\mathcal{F} = \frac{\Delta_{N+1}-\Delta_N}{\Delta-\Delta^!} = \frac{\pi}{2}\sqrt{F} = \pi\left(\frac{\sqrt{R}}{1-R}\right)$ where $\Delta - \Delta^!$ is small and $[\Delta - \Delta^!] = 4\,F^{-\frac{1}{2}} = 2\left(\frac{1-R}{\sqrt{R}}\right)$ [12 Marks]

5. a) Find the intensities of the first three secondary maxima in the single diffraction pattern measured relative to the intensity of the central maximum. [8 Marks]

b) A diffraction grating has 1.2×10^4 ruling uniformly spaced width w = 25.4 mm. It is illuminated at normal incidence by yellow light from sodium vapor lamp. This light contains two closely spaced emission lines(known as sodium doublet) of wavelengths 589.0 nm and 589.59 nm (i) at what angle does the first – order maximum occur (on either side of the center of the diffraction pattern) for the wavelength of 589.00 nm ? b) Using the dispersion of the grating , calculate the angular separation between the two lines in the first order.

[12 Marks]