OCTOBER 2023
PHY 402SW
PHYSICAL OPTICS
1 HOUR 30 MINUTES

Candidate's Index Number
Signature:

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

FIVE-SEMESTER BACHELOR OF EDUCATION (SANDWICH) PROGRAMME
LEVEL 350, END-OF-SECOND SEMESTER EXAMINATION, OCTOBER 2023

4TH OCTOBER 2023 PHYSICAL OPTICS 2:30 PM - 4:00 PM

SECTION B
[40 MARKS]

Answer any TWO questions from this Section.
Please, note that if you answer more than two questions, only the first two will be marked.

1.

a. Explain the phenomenon of diffraction grating. **(6 marks)**

b. Derive the formula for the angular position of the maximum in a diffraction grating using the grating equation.
A diffracting grating has 3000 lines per centimetre. Calculate the angle of the third-order maximum for the wavelength of 500cm. **(14 marks)**

$n\lambda = d\sin\theta$

2.

a. Explain the phenomenon of dispersion of light. Why does a prism separate white light into its component colours? **(10 marks)**

b. Calculate the angular dispersion produced by a glass prison having an apex angle of 60° when a light ray of wavelength 500nm passes through it. the refractive index of the glass for violet light (λ = 400nm) is 1.52, and for red light (λ = 700nm is 1.5. **(10 marks)**

$d\sin\theta = (n+\frac{1}{2})\lambda$

$= (2+\frac{1}{2})\lambda$

$= \frac{5\lambda}{1} = d\sin\theta$

$5\lambda = 2d\sin\theta$

$\sin\theta = \frac{5\lambda}{2d}$

3.

a. State the condition for maximum and minimum intensity in Young's interference experiment. **(4 marks)**

b. In the case of two fields $\mathbf{E_1}$ and $\mathbf{E_2}$ the irradiance I can be expressed according as
$I = \langle E \bullet E \rangle = \langle (E_1 \bullet E_2) \rangle \bullet \langle E_1 \bullet E_2 \rangle$
where E* is complex.
From the above, show that the fringe visibility V is defined as the ration $V = \frac{I_{max} - I_{mn}}{I_{max} + I_{mn}}$. **(16 marks)**

4.

a. State the classical theory of Blackbody radiation. **(5 marks)**

b. State the Green's theorem from $\iint (V \text{ grad}_n U - U \text{ grad}_n)\, dA = \iiint (V\Delta^2 u - u\Delta^2 V) dV$ and from this show that the kirchhoff integral yields the theorem.

$$Up = \frac{u_\circ e^{-iwt}}{4\pi} \iint \left(\frac{e^{ikr}}{r} \, grad n_n \frac{e^{ikr^1}}{r^1} - \frac{e^{ikr^1}}{r^1} \, grad_n \frac{e^{ikr}}{r} \right) dA$$ **(15 marks)**