NATIONAL UNIVERSITY OF SINGAPORE

PC3247 Modern Optics

(Semester I: AY 2015-16)

Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

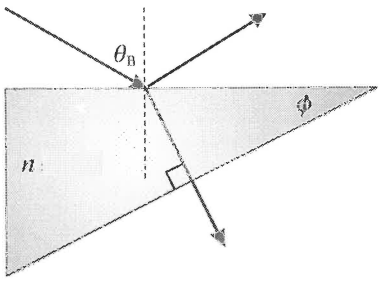
1. Please write your student number only. **Do not write your name.**
2. This examination paper contains **four** questions and comprises **two** printed pages.
3. Answer all **four** questions.
4. Please start each question on a new page.
5. This is a CLOSED BOOK assessment.
6. One Help Sheet (A4 size, both sides, hand-written) is allowed for this examination.
7. Permitted devices: non-programmable calculators.

1. Prove the Parseval's theorem for the light intensity,

$$\int_{-\infty}^{\infty} I(\vec{r},t)\mathrm{d}t = \int_{-\infty}^{\infty} I(\vec{r},\omega)\mathrm{d}\omega.$$

[10 marks]

2. Light goes through a glass prism with refractive index n. The light enters at Brewster's angle and exits at normal incidence as shown in the figure below.



a) Calculate θ_B.

b) Calculate ϕ.

c) What fraction of the incident light (power) is transmitted through the prism if it is p-polarized?

d) Repeat part c) for s-polarized light.

[20 marks]

3. Calculate the Fraunhofer diffraction pattern (light intensity) of two identical circular apertures with diameter D whose centres are separated by a spacing h.

[20 marks]

4. Calculate the Fresnel diffraction pattern (light intensity) behind a sharp edge. For simplicity, you may consider the sharp edge as a thin conductor occupying the lower half of the $z = 0$ plane. You may express your result in terms of Fresnel integral $(T) = \int_0^T e^{i\pi t^2/2} dt$.

[20 marks]

(WQh)

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