PHY2208 Optics Problem Sheet 3

1) What relative orientation must two perfect linear polarisers have if incident, unpolarised light is to be reduced in intensity by a factor of a) 2 and b) 4 ?

[Ans. a) TA's parallel, b) TA's at 45°]

2) An ideal polariser is rotated at an angular speed ω between a similar pair of stationary crossed polarisers. Show that the emergent light intensity will be modulated at *four times* the rotational frequency i.e:-

$$I = \frac{I_1}{8} \cdot (1 - \cos 4\omega t)$$

where I_1 is the intensity emerging from the first polariser and I is the final output intensity.

3) Polaroid plastic is often fabricated to include both an ideal polariser and an ordinary absorbing dye. Such polaroid is then designated HN-*x*, where *x* represents the % of initially unpolarised light passed by the polaroid. If unpolarised light is passed through two sheets of HN-32, whose TA's are parallel, what is the fractional intensity of the emerging beam?

[*Ans. 20.48%*]

4) Unpolarised light strikes a smooth glass (n=1.750) surface at an angle of incidence θ_i =35°. Calculate a) the amplitude and b) the intensity reflection coefficients for the *p* and *s* components.

[*Ans.* r_p*=0.21,*R_p*=0.044,*r_s*=-0.34,*R_s*=0.117*]

5) An initially circularly polarised beam propagates through glass (n = 1.5) and strikes a surface of polished silicon (n = 3.5). Calculate the angle of incidence at which the reflected wave will be completely *s*-polarised.

[Ans. 66.8°]

6) At λ=434nm, quartz has the following refractive indices:- n_e=1.5634 and n_o=1.55396. Calculate the minimum thickness required to make a) a half-wave plate and b) a quarter wave plate.

[*Ans. a) 0.02298mm b) 0.01149mm*]