Optics
IDC 202

Practise Assignment I *

March 13, 2018

1. Consequences of Maxwell's equations.

   (a) Write down the Maxwell's equations in integral and differential forms.

   (b) Show that the $\vec{E}$ and $\vec{B}$ fields satisfy wave equations. Derive all steps explicitly.

   (c) How will you go about arguing that electromagnetic waves in vacuum are transverse.

   (d) What is the relationship between the $\vec{E}$ and $\vec{B}$ fields.

2. Electromagnetic boundary conditions.

   (a) From the Maxwell's equations, derive the conditions on the parallel and perpendicular components of the electric field, at the interface of two media.

   (b) Repeat the same for the components of the magnetic field.

3. Laws of reflection and refraction.

*These practise assignments will not be graded, but are important for understanding the course material and evaluation components may be based on these.

(a) With the aid of a clear diagram, set up a scenario involving an incident ray impinging at the interface of two media.

(b) Express the incident, reflected and transmitted plane, monochromatic $\vec{E}$ and $\vec{B}$ waves in complex notation.

(c) Within this setting prove that the there is a "plane of incidence" and the laws of reflection.

(d) Similarly, prove the law of refraction and describe the concept behind total internal reflection.

4. Optics and evolution ?

   https://www.quantamagazine.org/why-did-life-move-to-land-for-the-view-20170307/

   This is the actual paper : http://www.pnas.org/content/early/2017/03/06/1615563114

5. *Refractometry* is sometimes used, specifically in chemistry, to identify or quantify characteristics of a liquid. A particular example is *Brix testing* of sucrose levels in fruits. With your current understanding of optical principles, understand the basis of such techniques.