Assignment 2
Electrodynamics and Radiative Processes I

20 marks for each question

Due on 3rd September 2019

1) Starting from Maxwell's equation write down Electric field (**E**) and Magnetic field (**B**) in terms of scalar potential (φ) and vector potential (**A**).
Write down the expression for Electric field when the field points are sufficiently far (far zone $R>>\lambda$ (c/u)). Consider β <<1 and derive the value of total power emitted from a single accelerated charge q.

2) Comment on frequency dependence of Thomson scattering cross section. Consider a nebula with a radius of $2x10^{20}$cm. The number density of charged particles in the nebula is n =10,0000. Comment on if the nebula will be optically thick or thin under Thompson scattering. At what value of n will the nebula start acting as a black body? (Ignore the contribution of medium between nebula and detector)

(3) Define $V\pm = E\pm iB$. Write Maxwell's equations with out sources in terms of V+ alone.

(4) A cube of side L contains a flat plate with variable surface charge density $\sigma=3xy$. If the plate extends from x=0 to x=L and from y=0 to y=L, what is the total electric flux through the walls of the cube.

(5) Two oscillating dipole moments (d_1 and d_2) are oriented in the vertical direction and are horizontal distance L apart. They oscilate in phase at the same frequency ω . Consider radiation at angle θ with respect to vertical and in a vertical plane containing two dipoles. Calculate power emitted per unit solid angle.
Show that when $L<<\lambda$, the radiation is same as from a single oscillating dipole of amplitude d_1+d_2.