Haldia Institute of Technology
Department of Applied Science

Assignment - IV
Course: PH 301/PH 401
Module 2: Electromagnetic theory

1. What is displacement current?
2. Prove that the rate of change of electric displacement vector with respect to time is equal to the displacement current density
3. Write down the Maxwell's field equations
4. Write the Maxwell's equations for free space and static field.
5. Show that the wave equation in free space for electric field $\vec{E}$ is given by
   $\nabla^2 \vec{E} = \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2}$
6. Assuming a plane wave solution, establish the relation between the propagation vector ($\vec{k}$), electric field ($\vec{E}$) and magnetic field (B).
7. Distinguish between conduction current and displacement current. Find the displacement current within the parallel plate capacitor in series with a resistor which carries a current I. Area of the capacitor plates are A and the dielectric is vacuum.
8. Prove that the electromagnetic waves attenuate as it propagates through a conducting medium.
9. Define skin depth. Explain how skin depth decreases with increase in frequency of electromagnetic wave and conductivity of the medium.
10. What is Poynting vector? Find the expression of Pointing vector. Write the physical significance of unit vector.
11. Show that Poynting vector measures the flow of energy per unit area per second in an electromagnetic wave.
12. State and prove the pointing theorem.