Electromagnetic waves

Lecture 7

Gauss Law

Bashaer Albdulhamza

Araa Hassa

Tow stage
Department of medical
physics   Al-Mustaqbal
University-College

Gauss Law :-

- The total electric flux through any closed surface is proportional to the total electric charge inside the surface.

Point Charge Inside a Spherical Surface:

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}$$

$\vec{E} \parallel \vec{dA}$ at each point

$$\boxed{\Phi_E = E \cdot A = \frac{1}{4\pi\varepsilon_0}\frac{q}{R^2}\left(4\pi R^2\right) = \frac{q}{\varepsilon_0}}$$

- The flux is independent of the radius R of the sphere.

Point Charge Inside a Non spherical Surface:

- Divide irregular surface into d A elements, compute electric flux for each

(E d A cos φ) and sum results by integrating.

- Each d A projects onto a spherical surface element → total electric flux through irregular surface = flux through sphere.

(b)

$E_\perp$ ϕ $\vec{E}$

dA

$dA \cos \phi$

The projection of the area element dA onto the spherical surface is $dA \cos \phi$.

q

$$\boxed{\Phi_E = \oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}}$$

Integral through a closed surface

Valid for + / - q

If enclosed q = 0 → Φ_E = 0