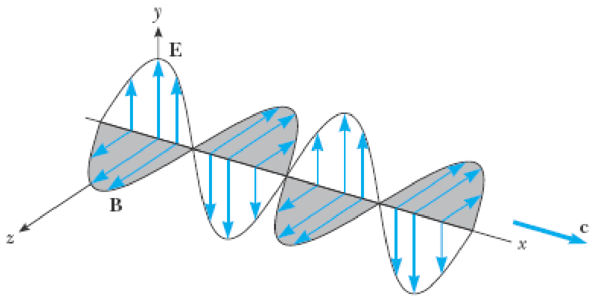
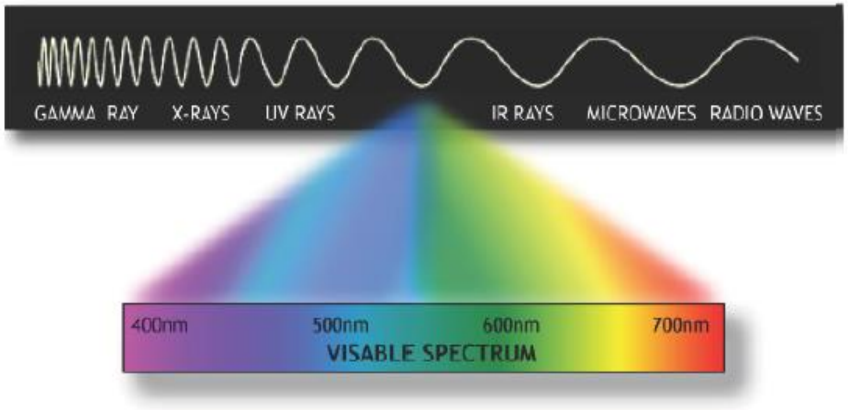
BME 304 Electromagnetics

Hilal GÖKTAŞ

Electricity & Magnetism is all around us:

Computers, mobile phones, TV, radio, electric lights, etc.
Atoms, molecules, all chemical reactions exist because of electricity.
Light is itself is an EM phenomenon as radio waves are.





We need electricity because muscle contractions require it.

We could not see without electricity.

Our heart would not beat without electricity.

Our nerve system is driven by electricity.

We could not even think without electricity.

Text Book:

Introduction to Electrodynamics; David J. Griffiths, 4th ed., Pearson Ltd.

Engineering electromagnetics; William H. Hayt, Jr., John A. Buck, 8th ed., McGraw Hill

Fundamentals of applied electromagnetics: Fawwaz T. Ulaby, Umberto Ravaioli, 7th ed., Pearson Ltd.

Topics:

- vector analysis and calculus

Electrostatics
Potentials
Electric Fields in Matter
Magnetostatics
Magnetic Fields in Matter
Electrodynamics

\+ Electromagnetic Waves

Maxwell's Equations

(1) $\nabla . \varepsilon_o \vec{E} = \rho$ Gauss' Law

(2) $\nabla . \mu_o \vec{H} = 0$ Gauss' Law

(3) $\nabla \times \vec{E} = -\frac{\partial \mu_o \vec{H}}{\partial t}$ Faraday's Law

(4) $\nabla \times \vec{H} = \vec{J} + \frac{\partial \varepsilon_o \vec{E}}{\partial t}$ Ampere's Law

James Clerk Maxwell
(1831-1879)

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Integral Form		Differential Form
(1) $\oiint \varepsilon_o \vec{E} \cdot d\vec{a} = \oiiint \rho \, dV$	← Gauss' Law →	$\nabla \cdot \varepsilon_o \vec{E} = \rho$
(2) $\oiint \mu_o \vec{H} \cdot d\vec{a} = 0$	← Gauss' Law →	$\nabla \cdot \mu_o \vec{H} = 0$
(3) $\oint \vec{E} \cdot d\vec{s} = -\frac{\partial}{\partial t} \iint \mu_o \vec{H} \cdot d\vec{a}$	← Faraday's Law →	$\nabla \times \vec{E} = -\frac{\partial \mu_o \vec{H}}{\partial t}$
(4) $\oint \vec{H} \cdot d\vec{s} = \iint \vec{J} \cdot d\vec{a} + \frac{\partial}{\partial t} \iint \varepsilon_o \vec{E} \cdot d\vec{a}$	← Ampere's Law →	$\nabla \times \vec{H} = \vec{J} + \frac{\partial \varepsilon_o \vec{E}}{\partial t}$

Course Grading

Mid-term exam: 30%

Homeworks: 20%

Presentation (Quiz): 10%

Final exam: 40%