221 CNE Course Syllabus

Course Code	221 CNE
Course Name	Magnetic Fields and Applications
Credit Hours	3
Contact Hours	4
Instructor Name	Dr. Ashraf Mahmoud Abdelrahman

Text Book (title, author, and year)
1. Engineering Electromagnetics, W. H Hayt, & John A. Buck, 8th Edition, Prentice Hall, 2010. 2. Field and Wave Electromagnetics, Addison-Wesley, 2nd Edition, 2006.

Specific Course Information	
Catalog Description	This course focuses on electromagnetic phenomena explored in modern applications including wireless communications, circuits, microwave communications, radar, and antennas.
Prerequisites	NIL
Co-requisites	NIL
Required/Elective	required

Course Learning Outcomes	
1	To define the concept of electric and magnetic fields.
2	To recognize mathematical skills used for analyzing electric and magnetic fields, calculating the electric and magnetic field intensities, and evaluating electrostatic boundary problem.
3	To calculate electric and magnetic fields from stationary and dynamic charge and determine the induction current distributions.
4	To explain the transmission principles of electromagnetic waves and derive energy expressions for the electrostatic and magneto-static fields.
5	To design models and solutions for specific electromagnetic wave propagation problem.
6	To operate simulation tools for simplifying the calculation of fields intensities and energy.
7	To act professionally and ethically when dealing with electromagnetic fields problems and applications.
8	To demonstrate the ability to communicate effectively through written mini-projects and assignments.

Mapping course LOs to the SLO.												
Course LOs #	Student Learning Outcomes											
	a1	a2	b1	b2	b3	b4	b5	c1	c2	c3	d1	d2
1	√											
2	√											
3			√									
4			√									
5			√	√								
6							√					
7									√			
8											√	

List of Theory Topics

Vector analysis: Vector algebra, Coordinate systems, Vector representation in different coordinate system, Differential elements.

The experimental law of Coulomb and Electric Field: Electric Field intensity Electric field due to different charge distributions, Electric Flux, Electric flux density Faraday's law Gauss law, integral form and differential form Flux of a vector through closed surface, Enclosed charges, Divergence, divergence theorem.

Energy and potential: Energy expended in a moving point charge Potential and potential difference Potential field of different charge distribution Potential gradient.

Current and current density: Continuity of current Conductor properties and its boundary condition Dipole and polarization Capacitance.

Steady magnetic field: Biot-savart law, Ampere's circuital law Gauss's law for magnetic field, Magnetic flux and magnetic flux density Scalar and vector magnetic potential.

Magnetic forces, Materials and Inductance: Force on a moving charge Force on a differential current element Force and torque on a closed circuit Magnetic boundary conditions Inductance and mutual inductance.

List of Lab Experiments

1. Magnetic Lines of Forces
2. The Electromagnet
3. Magnetic Field of a Solenoid
4. Magnetic Field due to the current through a long wire
5. Energized Solenoid with Soft Iron Core
6. Electron Beam and Magnetic Force Interaction
7. Conversion of points
8. Conversion of vectors
9. Implementation of Lorentz force on MATLAB.