2021-2022	**Common Trunk**	*Year2 - Sem.* 3
ELEC 202	**ELECTRICITY II**	Mandatory
ECTS: 3	Instructors: Dr.Ali Harmouch, Dr. Majed Elsaiid, Dr.Rida ElShal	*Language:* English
Total hours: 39	*Period : October-February*	

Description

This course starts with acknowledging students with the basics of vector algebra and vector calculus. The class introduces Maxwell's equations for static electromagnetics, in both differential and integral form, along with electrostatic and magnetic vector potential, and the properties of dielectrics and magnetic materials.

Learning outcomes

At the end of the course students are capable of

- Use vector algebra and apply it to physics.
- Use coordinate systems and their transformations.
- Recognize the basic concepts of static electric fields and their applications.
- Understand the concepts of electric charge separation
- Determine the electric force by Coulomb's law.
- Determine the electric field due to different charge distributions based on Coulomb's Law.
- Determine the electric field due to different charge distributions based on Gauss's Law using the symmetry of the source.
- Set a relationship between the electric field and electric potential.
- Determine the electric flux and electric energy.
- Define a capacitor
- Determine the electric field, energy of a capacitor.
- Calculate the capacitance of different capacitors. Capacitors in series and parallel.
- Describe the concepts of dielectric materials.
- Define the charging and discharging processes of a capacitor.
- Apply Poisson's and Laplace's equations for determining the physical properties (parameters) of different capacitors.

Content

Week 1

ELECTRIC CHARGES AND FORCES: Developing a Charge Model, Electric Charge, Electric force, Coulomb's Law, The Field Model.

Week 2

THE ELECTRIC FORCE AND FIELD: Electric Field Models, The Electric Field of Multiple Point Charges, The Electric Field of a Continuous Charge Distribution , The Electric Field of Rings, Disks, Planes, and Spheres, Motion of a Charged Particle in an Electric Field

Week 3

COULOMB'S LAW: Application to discrete and continuous charge distributions. Exercises

Week 4

GAUSS'S LAW: Symmetry, The Concept of Flux, Calculating Electric Flux, Gauss's Law formulation in point and Integral forms. The first Maxwell equation for static electromagnetics.

Week 5

GAUSS'S LAW: Divergence Theorem, Applications to different source distributions. Exercises

Week 6

THE ELECTRIC POTENTIAL: Electric Potential formulation, The electric Potential of a monopole, Electric potential for continuous charge distributions. Exercises.

Week 7

THE ELECTRIC POTENTIAL: The electric dipole, Equipotential surfaces, Streamline Equations of electric fields. Exercises.

Week 8

THE ELECTRIC POTENTIAL: Relationship between the electric field and electric potential, The gradient operator, The curl operator, The second Maxwell's equation for static electromagnetics, Faraday's law. Exercises.

Week 9

CURRENT AND RESISTANCE: Classification of materials as dielectrics or conductors, conduction and convection currents, resistance of materials, electric energy of discrete charges. Method of images, Exercises.

Week 11

CURRENT AND RESISTANCE:, Electric energy of continuous charge distributions, Relationship between electric energy and electric field, power. Boundary conditions for the normal and tangential components of E and D at dielectric-dielectric boundary, Boundary conditions for the normal and tangential components of E and D at dielectric-conductor boundary. Exercises.

Week 12

CAPACITANCE AND CAPACITANCE EXAMPLES : Application of Gauss's law for determining the capacitance of parallel-plate capacitors, cylindrical capacitors, and spherical capacitors. Exercises.

References

- William H Hayt, Jr. and John A Buck. Engineering Electromagnetics, 7E. McGraw Hill, 2006.
- Sadiku. Elements of Electromagnetics. 3/E.

Kraus. Electromagnetics with Applications

Evaluation

Midterm Exam

Final Exam