NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
NAVAL ENGINEERING PROGRAM

MB226 – PHYSICS III

I. GENERAL INFORMATION

CODE	:	MB226 Physics III
SEMESTER	:	3
CREDITS	:	5
HOURS PER WEEK	:	7 (Theory – Practice - Laboratory)
PREREQUISITES	:	MB224 Physics II
CONDITION	:	Compulsory

II. COURSE DESCRIPTION

The course prepares students in the understanding and explaining the physical phenomena related to electricity and magnetism and their interactions. Students analyze the principles of electrostatics and magnetism, electric and magnetic fields, electromagnetism and their application in mechanical-electrical energy transformations. Direct current and alternating current circuits with diverse configurations are solved. The concept of impedance is applied for analyzing resonance and power factor in alternating current circuits. Laboratories experiences are carried out to verify the validity and applicability of physics laws and principles. Physics problems with engineering applications are analyzed and solved.

III. COURSE OUTCOMES

1. Apply the fundamental principles of Electrostatics, Electricity and Magnetism.
2. Identify the parameters related to Electrostatics, Electricity and Magnetism.
3. Understand the static manifestation and the dynamics of electric charges.
4. Understand the magnetic effects under the electric charges and conduct wires.
5. Understand the mechanical-electrical transformations in changing electromagnetic fields.
6. Analyze and solve direct current circuits with diverse configurations.
7. Analyze and solve alternating current circuits, transient responses, phasor representation and power factor.

IV. COURSE CONTENTS

1. ELECTROSTATICS

Charge and Coulomb's law / Electric charge and matter / Electrization phenomena / Conductors and insulators / Coulomb's law / Definition / Electric field lines / Electric field of a punctual and continuous charges / Gauss's law / Electric field of an infinite line and uniform charged-plane / Punctual charges motion in a constant electric field / Applications: Cathode ray tubes / Electric power / Electric potential energy / Potential difference / Electric potential / Potential calculus: punctual and continuous charges / Relation between field and potential / Equipotential curve / Electrostatic properties of conductors / Electric dipole / Capacitor and dielectric / Capacitance / Parallel plate capacitor / Series and parallel capacitor / Energy stored / Dielectric capacitor.

2. CONTINUOUS CURRENT CIRCUITS

Electric current / Introduction / Electric current intensity / Current density / Ohm's law, conductivity, resistivity and resistance / Power / Joule effect / Continuous current circuits / Resistance in series and parallel / Continuous current circuits / Electromotive force / Ammeter,

voltmeter, ohmmeter / Kirchhoff's laws / RC circuit / Charge and discharge of a capacitor graph / Current and voltage relation with time.

3. ELECTROMAGNETISM

Magnetic field / Introduction / Magnetic induction, definition / Field lines / Force on a charge in motion / Force on a conductor wire / Magnetic momentum / Application: DC motor / Currents as sources of magnetic fields / Bio–Savart and Ampere's law / Field produced by straight cables and circular loops / Filed inside a coil / Magnetism / Experimental study on magnetic induction / Magnetic force on charges in motion / Magnetic force on a conductor with current / electromagnetic induction / Magnetic flux / Electromotive force and inductive current / Faraday and Lenz law / Transformer.

4. ALTERNATING CURRENT CIRCUITS

Alternating current (AC) / Introduction / Parameters of a sinusoidal current: amplitude, frequency, period, phase angle / Effective values / Dephase / Series RLC circuit / Parallel RLC circuit / Wave representations / Phasor representations / Impedances, reactances and inductances / Dephase of signals / Resonance / AC circuit / Analysis of alternating current circuits / Phasorial calculus of impedances, voltages and currents / Power factor.

5. MAXWELL EQUATIONS

Ampere-Maxwell law / Differential form / Electromagnetic waves / Maxwell equations.

V. LABORATORY AND PRACTICE

Laboratory 1: Electrostatics
Laboratory 2: Equipotential curves
Laboratory 3: Electric field
Laboratory 4: Magnetic field
Laboratory 5: Charge and discharge of a capacitor. Use of oscilloscope
Laboratory 6: Alternating current circuits

VI. METHODOLOGY

The course consists of theory, practice and laboratory sessions. The instructor presents the concepts and physical laws using applets, videos and formulating equations using differential and integral expressions. Problems related to engineering are solved with active student participation. Laboratory experiences are carried out using specialized equipment and software simulation. For every experience, students work in group and present a report summarizing main results, analysis and conclusions. Student active participation is promoted.

VII. GRADING SYSTEM

The Final Grade (FG) is calculated with the following formula:

FG = (EP + EF + PP) / 3

EP: Mid-term exam EF: Final exam PP: Average of quizzes and laboratories

VIII. BIBLIOGRAPHY

1. R. A. Serway
   Physics, Vol. 2, Mc Graw-Hill Interamerican, 2005
2. Sears-Zemansky-Young-Freedman
   University Physics Vol. 2, 2010, 12th Ed. Pearson Education.