NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES
PHYSICS PROGRAM

CF222 – PHYSICS IV

I. GENERAL INFORMATION

CODE	**:**	CF222 Physics IV
SEMESTER	**:**	4
CREDITS	**:**	5
HOURS PER WEEK	**:**	7 (Theory – Practice)
PREREQUISITES	**:**	CF221 Physics III, CM211 Advanced Differential and Integral Calculus
CONDITION	**:**	Compulsory

II. COURSE DESCRIPTION

The course prepares students in the understanding and explaining the physical phenomena related to electromagnetic theory in the field of optics, geometrical optics, waved optics and quantum optics (light absorption, light scattering). 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. Understand the concepts and principles of electromagnetic waves, their generation, propagation in vacuum, dielectric and metals.
2. Understand the process of image formation trough geometrical optics.
3. Properly use optical instruments and materials in laboratory experiences.
4. Understand and interpret the electromagnetic theory of light reflection and refraction.
5. Understand the optical properties of materials.
6. Understand the undulating behavior of light wave behavior and complete experimental analysis of the theory.
7. Understand the principles of quantum optics.

IV. COURSE CONTENTS

1. ELECTROMAGNETIC WAVES

Wave equation / Flat electromagnetic wave in vacuum / Polarization states / Energy and intensity / Poynting vector / Momentum / Generation of electromagnetic waves / Electromagnetic spectrum / Flat waves in dielectric and metals.

2. GEOMETRICAL OPTICS

Geometrical optics / Wave optics / Quantum optics / Ray / Reflection and refraction / Fermat principle / Huygens principle and Malus theorem / Reversibility principle / Reflection and refraction in flat surfaces of a parallel beam and divergent beam / Refection and refraction in spherical surfaces / Mirrors and lens.

3. THEORY ELECTROMAGNETIC OF REFLECTION AND REFRACTION

Reflection and refraction in dielectric interfaces / Border conditions / Reflection and refraction laws / Fresnel equations / Brewster angle / Total reflection / Critic angle / Reflection on conductors: wave guides and cavities.

4. MATTER OPTICAL PROPERTIES

Transmission in non-isotropic dielectrics / Double refraction / Dicroism / Optical activity.

5. WAVE OPTICS

Optical interference by two sources and several sources / Interference by multiple reflections: thin films / Diffraction / Huygens principle and diffraction / Fraunhofer diffraction of a linear, rectangular and circular slits / Diffraction slit: dispersion and resolution / Fresnel diffraction produced by a slit and by circular obstacles / X ray diffraction.

6. QUANTUM OPTICS

Refraction index / Microscopic explanation of the reflection and refraction of an electromagnetic wave / Light dispersion / Light absorption / Light scattering by linked electrons / Scattering by free electrons: Compton effect.

V. LABORATORY AND PRACTICE

Laboratory 1: Electromagnetic waves
Laboratory 2: Geometrical optics
Laboratory 3: Reflection and refraction
Laboratory 4: Double refraction
Laboratory 5: Wave optics

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. Born and Wold
   Principle of Optics, Mc Graw-Hill Interamerican, 2005
2. Jenkins and White
   Fundamental of Optics, Pearson Education, 2010