NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - PHYSICS II

I. GENERAL INFORMATION

CODE : FI-204
SEMESTER : 2
CREDITS : 5
HOURS PER WEEK : 6 (Theory, Practice, Laboratory)
PRERREQUISITES : Physics I
CONDITION : Mandatory
DEPARTAMENT : Basic Sciences
INSTRUCTOR : Luis Mosquera Leiva, Jesús Basurto Pinao, Miguel Melchor Vivanco-Panizo
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II. COURSE DESCRIPTION

Theoretical-experimental course developing within the students the skills for understanding and analyzing the principles of oscillatory motion, simple, damped and forced harmonic motions of discrete systems. The principles of mechanical waves generation and propagation are analyzed and related to seismic motion. Principles governing electromagnetic interactions as well as electromagnetic waves generation and propagation are analyzed. The course is based on Calculus and includes laboratory experience using the scientific method. Application of Physics to civil engineering problems is emphasized.

III. COURSE OUTCOMES

1. Identify oscillatory motions of simple structures.
2. Analyze and calculate amplitude and frequency of oscillations of two-degrees-of-freedom systems.
3. Understand the principles underlying the generation and propagation of mechanical waves.
4. Analyze and calculate the propagation velocity of waves as well as the energy and momentum transferred by mechanical waves.
5. Analyze and calculate the changes in velocity and wavelength related to wave reflection and refraction.
6. Understand the fundamental principles of classic electromagnetism. Calculate the interaction forces between electrical charges, as well as the intensity of electrical and magnetic fields.
7. Understand the electromagnetic induction phenomena and the characteristics and behavior of electromagnetic waves.

IV. LEARNING UNITS

1. OSCILLATIONS / 18 HOURS
Simple harmonic motion: motion description and equations, energy considerations, relationship with uniform circular motion. Combination of harmonic motions: coupled oscillators. Damped harmonic motion. Forced oscillations and resonance. Harmonic motion of simple structures. Stability and chaos.

2. WAVES IN ELASTIC MEANS / 18 HOURS
Pulses. Pulse sequence in elastic means. Mechanical waves: wave equation. Longitudinal and transversal harmonic waves. Waves and barriers: reflection, refraction, diffraction. Wave packets and dispersion. Waves superposition and stationary waves. Two and three dimensional waves. Sound waves. Ultrasound and infrasound waves. Power and energy of ground waves. Doppler effect.

3. ELECTROSTATICS / 12 HOURS
Electric charge. Electrical conductors, isolators and semi-conductors. Interaction between electric charges, Ley de Coulomb. Electric field and Gauss law. Electric potential and electrostatic potential energy. Equipotential surfaces. Electric capacity, dielectric and electrostatic energy. Capacitors.

4. ELECTRIC CURRENT / 6 HOURS
Electric current, resistance and Ohm law. Direct current circuits. Kirchoff laws.

5. MAGNETISM AND ELECTROMAGNETIC INDUCTION / 12 HOURS
Magnetic field. Motion of a charge in a magnetic field. Lorentz forces. Magnetic fields created by mobile charges. Ampere law. Biot-Savart laws. Magnetic flows. Induced electromagnetic forces. Faraday law. Lenz law. Electric motor and generators. Inductance. Energy in inductive circuits. Energy density in magnetic fields.

6. ALTERNATING CURRENT CIRCUITS / 6 HOURS
Alternating current. Serial RLC circuits with constant voltage. Serial RLC circuits with alternating voltage. Phasor. Resonance of RLC circuits. Applications of RLC circuits. Mutual inductance. Electric transformer. Analogy between oscillating mechanical systems and alternatic current circuits.

7. ELECTROMAGNETIC WAVES / 12 HOURS
Electromagnetic waves. Maxwell equations. Energy and momentum of electromagnetic waves. Spectrum of electromagnetic radiation. Radiation of oscillating dipoles. Propagation of electromagnetic waves. Absorption, dispersion, reflection and interference of electromagnetic waves.

V. LABORATORY EXPERIENCES

Laboratory 1: Oscillatory motion: mass-spring system.
Laboratory 2: Oscillatory motion of a rigid body: physical pendulum.
Laboratory 3: Waves in a rope. Steady-state waves.
Laboratory 4: Direct current circuits. Ohm law.
Laboratory 5: Magnetism. Earth magnetic field.
Laboratory 6. Electromagnetic waves. Diffraction.

VI. METHODOLOGY

The course consists of weekly sessions of theory, practice and laboratory. Classroom presentations include demonstrative experiments, applets, videos and simulations of physical phenomena that reinforce the theoretical concepts. Required mathematical tools are reviewed at the beginning of classes. Learning is strengthen by intense problem solving sessions motivating students to develop analytical and critical thinking skills. Laboratory experiments are carried out using a sequential guide. Experiments are related to the topics developed in class.

VII. EVALUATION FORMULA

The final grade PF is calculated as follows:

$$PF = (EP + EF + PP) / 3$$

$$PP = (PC1 + PC2 + PC3 + PL1 + PL2 + PL3 + PL4 + TF) / 8$$

EP: Mid-Term Exam EF: Final Exam PP: Average of quizzes and laboratory reports

PC1, PC2, PC3 : Classroom Practice
PL1, PL2, PL3, PL4 : Laboratory reports TF: Final Report

VIII. BIBLIOGRAPHY

1. **ALONSO M., FINN E.**
   Physics. Vol. I, Vol. II.
   Addison-Wesley Iberoamerican. Seventh edition.

2. **TIPLER MOSCA**
   Physics for Science and Technology
   Oakland University. Reverte Editions. 2005.