NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF CIVIL ENGINEERING

CIVIL ENGINEERING PROGRAM

SYLLABUS - PHYSICS I

I. GENERAL INFORMATION

CODE : CB-105
SEMESTER : 1
CREDITS : 5
HOURS PER WEEK : 6 (Theory, Practice, Laboratory)
PRERREQUISITES : None
CONDITION : Mandatory
DEPARTAMENT : Basic Sciences
INSTRUCTOR : Armando Baltazar Franco , Jesús Basurto Pinao , Fredy Loayza Cordero.

II. COURSE DESCRIPTION

The course provides to students a high level of understanding and comprehension of physical phenomena and concepts and develops within the student the skills for applying physical principles and laws related to solid mechanics, fluid mechanics, fluid transport phenomena as well as an introduction to thermodynamics. 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. Analyze the motion of particles and bodies using different coordinates systems.
2. Specify the equations of motion of particles using differential and integral calculus.
3. Understand and solve problems about the dynamics of a system of particles as well as the dynamics of a rigid body and related them to civil engineering problems.
4. Apply Newton's laws and energy conservation laws applied to rotational and translational motion of rigid bodies.
5. Analyze and solve problems related to elasticity and linear body deformation.
6. Understand and apply the concepts and principles of hydrostatics and fluid mechanics.
7. Interpret the basic principles of thermodynamic systems.
8. Solve engineering problems using Physic models.

IV. LEARNING UNITS

1. MECHANICS / 16 HOURS

Introduction. Motion of a particle with position dependent acceleration and velocity dependent acceleration. Cartesian coordinates and transformations to polar, spherical, cylindrical coordinates, as well as normal and tangential coordinates. Curvilinear motion. Relative motion. Newton laws and representation in different coordinate systems. Linear and angular momentum. Impulse. Non-inertial reference systems and fictitious forces. Motion integrals. Work developed by constant forces and variable forces. Kinetic energy and Work-Energy theorem. Potential energy: gravitational and elastic. Energy conservation. Conservative and non-conservative systems. Orbital motion and central forces.

2. DYNAMICS OF A SYSTEM OF PARTICLES / 16 HOURS

Center of mass. Motion of center of mass. Linear momentum of a particle and a system of particles. Internal and external forces. Linear momentum conservation. Variable mass systems. Potential and kinetic energy of a system of particles. Elastic and inelastic collision. Rigid body: moment of inertia, angular momentum, translational and rotational motion. Work, energy, power and momentum of a rigid body. Energy conservation

3. EQUILIBRIUM AND ELASTICITY / 8 HOURS

Composition of concurrent and non-concurrent forces. Friction forces and friction cone. Center of gravity. Equilibrium of rigid body. Elasticity, stress and deformation. Hooke law, elasticity module, Poisson coefficient and Young module.

4. FLUID MECHANICS / 8 HOURS

Hydrostatic general law. Archimedes principle. Forces on immersed bodies. Pressure center. Concepts and principles of fluids mechanics. Continuity equation. Bernoulli theorem. Torricelli theorem. Dynamical lifting forces.

5. FLUIDS TRANSPORT PHENOMENA / 8 HOURS

Molecular diffusion. Thermal conduction. Viscosity. Poiseuille theorem. Stokes theorem. Reynolds number.

6. THERMODYNAMICS / 8 HOURS

Temperature. Heat. First Thermodynamics law. Entropy and Second Thermodynamics law. Applications.

V. LABORATORY EXPERIENCES

Laboratory 1: Kinematics
Laboratory 2: Dynamics
Laboratory 3: Work and Energy
Laboratory 4: Rotational dynamics
Laboratory 5: Hydro-Dynamics

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. BURBANO S., BURBANO E.
General Physics
Wordpress. 32nd edition.