



**NATIONAL UNIVERSITY OF ENGINEERING**  
**COLLEGE OF ENVIRONMENTAL ENGINEERING**  
**ENVIRONMENTAL ENGINEERING PROGRAM**

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**AA224 – PHYSICS I**

**I. GENERAL INFORMATION**

<b>CODE</b>	: AA224 Physics I
<b>SEMESTER</b>	: 2
<b>CREDITS</b>	: 4
<b>HOURS PER WEEK</b>	: 6 (Theory – Practice - Laboratory)
<b>CONDITION</b>	: Compulsory

**II. COURSE DESCRIPTION**

The course prepares students in the understanding and application of the fundamentals laws of classical mechanics that models the surrounding physical world. Students apply Newton Laws for analyzing the motion of a particle and a system of particles, as well as the related work and energy and their mechanical transformations. Linear and rotational motions are analyzed and diverse problems related to engineering are solved. Laboratories experiences are carried out to verify the validity and applicability of physics laws.

**III. COURSE OUTCOMES**

1. Analyze the concepts of vector algebra applied to mechanics.
2. Design static equilibrium and apply to specific cases.
3. Specify the equations of motion to specific cases of particles using the differential and integral calculus.
4. Model the motion of particles relating it to the laws of dynamics.
5. Analyze the concepts of work – energy and energy conservation into conservative and non conservative areas to specific cases.
6. Select the concepts of kinematics and dynamics applied to a particle system related to the conservation of the linear momentum and kinetic energy.
7. Specify Newton's laws and conservation laws of energy applied to rotation and translation of rigid bodies.

**IV. COURSE CONTENTS**

**1. VECTOR ANALYSIS**

Course general description / Scalar and vector magnitudes / Coordinate System and unit vectors, addition and vector difference / Graphic and analytical methods / Scalar and vector product / Examples.

**2. STATIC EQUILIBRIUM**

Concepts of force / Concurrent force systems / Equilibrium of a particle / Non-concurrent force systems / Torque or moment of force: applications / Center of gravity / Equilibrium of a rigid body / Concepts of static friction: applications.

**3. PARTICLE KINEMATICS**

Differentiation and integrals / Rectilinear and curvilinear motion of a particle: average and instantaneous velocity / Average and instantaneous acceleration / Rectilinear uniform motion / Uniformly varied motion / Varied motion: applications / Projectile motion / Free fall and parabolic motion / Trajectory equation: applications / Circular motion: angular velocity and angular acceleration / Uniform circular motion / Uniformly varied circular motion / Tangential and normal components of acceleration: applications.

**4. PARTICLE DYNAMICS**

Concepts of force / Friction force / Coefficient of friction: static and dynamic / Applications / Newton's laws / Internal and external forces / Inertial mass / Force and linear momentum: applications.

### **5. WORK AND ENERGY**

Concept of work / Work of constant and variables forces / Kinetic energy / Theorem of work and kinetic energy / Potential energy: applications / Conservative forces / Elastic and gravitational force / Gravitational and elastic potential energy / Mechanical energy / Power: applications / Principle of energy conservation / Conservative and non-conservative systems / Particle system and its relation to the case of a particle: applications.

### **6. PARTICLE SYSTEMS**

Dynamics of a particle system / Center of mass (CM) / CM movement / Velocity and acceleration / Linear momentum of a particle system: applications / Conservation of the linear momentum / Kinetic and potential energy of a particle system / Elastic and inelastic collisions / One-dimensional and two-dimensional collision: applications.

### **7. ROTATIONAL DYNAMICS OF SOLID**

Rotational motion of a particle system / Conservation of angular momentum / Moment of inertia of a particle system and a rigid body / Torque and angular momentum / Torque and moment of inertia: applications / Kinetic energy of a rigid body / Kinetic energy of rotation and translation / Energy conservation / Kinetic energy and moment of inertia / Mechanical energy of a rigid body: applications.

## **V. PRACTICE AND LABORATORY EXPERIENCES**

Laboratory 1: Measurements and curve fitting

Laboratory 2: Instantaneous velocity and acceleration

Laboratory 3: Relative motion

Laboratory 4: Two dimensional motion and collision

Laboratory 5: Work and energy

Laboratory 6: Gravitational and elastic potential energy

## **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.

## **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. Sears-Zemansky-Young-Freedman  
University Physics Vol. 1, 2010, 12th Ed. Pearson Education.
2. Resnick-Halliday-Krane  
Physics, Vol. 1. 2011, 5th Ed. CECSA.