NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF SCIENCES

PHYSICS PROGRAM

CF371 – THEORETICAL MECHANICS I

I. GENERAL INFORMATION

CODE	: CF371 – Theoretical Mechanics I
SEMESTER	: 5
CREDITS	: 08
HOURS PER WEEK	: 10 (Theory – Laboratory)
PREREQUISITES	: CF121 Physics I CF252 Mathematical Methods for Physicists I
CONDITION	: Mandatory

II. COURSE DESCRIPTION

Study the physical phenomena related to dynamics. Understand conservation laws and develop the Lagrangian and Hamiltonian formulations of classical mechanics as well as understand variational principles.

III. LEARNING UNITS

1. Classical Mechanics

Reference systems / Newton's laws / One, two and three-dimensional movement in gravitational and electric fields / Conservation laws: linear momentum, angular momentum and energy. Movement in resistive medium.

2. Oscillatory Movement

Restorative force / Simple harmonic, damped and forced movement / Resonance / Pendulum / Non-linear oscillations.

3. D'alembert and Hamilton Principles

Boundaries. Generalized coordinates. Displacement and virtual work. D'Alembert principle and Lagrange equations / Variational calculus / Hamilton principle / Its application to non-conservative and non-holonomic systems.

4. Central Forces

Electric and gravitational forces / Potential / Conservation of angular momentum and Kepler's second law / Orbits. Periods / Kepler's First and Third Law / Planetary and satellite movement / Dispersion. Effective section.

5. **Two Particle Collisions**

   Center of mass. Linear momentum / Angular momentum. Energy of a particle system / Reduced mass. Frontal and oblique shocks / Laboratory systems and center of mass / Movement of a variable-mass body.

6. **Movement in a non-inertial system**

   Translation and rotation of a reference system / Fictitious forces: Coriolis, centrifugal and transversal / Earth’s rotation effects / Focault pendulum.

7. **Rigid Bodies’ Dynamics**

   Rotation regarding an axis and a point / Inertia tensor and moment of inertia / Eigenvalues and principal axes / Euler's equations / Free rotation. Rotation in a gravitational field / Gyroscope and spin.

8. **Coupled oscillations. Vibrating strings. Fluids**

   Normal modes / Normal coordinates / Many-particles’ system vibration / Vibrating string / Wave equation.

9. **Wave Equation**

   Phase speed / Overlay / Wave pack / Dispersion / Attenuation / Reflection / Refraction.

IV. BIBLIOGRAPHY

- K.R. Symon, Mechanics, Addison Wesley, 1960.
- W. Hauser, Introduction to the Principles of Mechanics, Regional Technical Assistance Center, Mexico, 1969.
- J.B. Marion, Classical Dynamics of Particles and Systems, Academic Press, 1967.
- R.B. Becker, Introduction to Theoretical Mechanics, McGraw-Hill, 1954.

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