NATIONAL UNIVERSITY OF ENGINEERING

COLLEGE OF SCIENCES

PHYSICS PROGRAM

CF401 – THERMODYNAMICS AND STATISTICAL MECHANICS

I. GENERAL INFORMATION

CODE	: CF401 – Thermodynamics and Statistical Mechanics
SEMESTER	: 7
CREDITS	: 08
HOURS PER WEEK	: 10 (Theory – Laboratory)
PREREQUISITES	: CF302 Quantum Mechanics I
CONDITION	: Mandatory

II. COURSE DESCRIPTION

To establish the relations between Thermodynamics and Statistical Mechanics, between thermodynamic properties and partition functions of the different groups. Clarify the difference between classical and quantum statistical treatments and the application limits of the classical treatment. Identify the appropriate collective for a given system. Understand the relationships between the partition functions of the different groups. Discuss the expressions of the partition function and the fundamental thermodynamic properties of various thermodynamic systems. Understand the formalism of quantum statistics and their applications.

III. LEARNING UNITS

1. Introduction to Statistical Methods

Permutations and combinations / Probability notion / Distribution functions: discrete and continuous stochastic variables / Random path and binomial distribution / General study of the random path problem.

2. Statistical Description of the Particle Systems

Statistical formulation of the mechanical problems / Statistical sets / State density / Interaction between macroscopic systems / Thermal interaction. Processes.

3. Statistical Thermodynamics

Equilibrium irreversibility and consequence / Thermal interaction between macroscopic systems / General interaction between macroscopic systems / Summary of the fundamental results.

4. **Macroscopic Parameters and their Measures**

   Work and internal energy. Heat / Absolute temperature / Heat capacity and specific heat / Entropy.

5. **Applications of Macroscopic Thermodynamics**

   Properties of ideal gases / State equation and internal energy / Specific heat / Adiabatic expansion and compression / Entropy. 7 General relations for a homogeneous substance / Expansion and strangulation process / Heat engine and refrigerators.

6. **Basic Methods and Results of Statistical Mechanics**

   Representative sets of situations of physical interest / Isolated systems / Systems in contact with a heat source / Simple applications of canonical distribution / Systems with specified medium energy.

7. **Simple Applications of Mechanics**

   General study method / Partitioning functions / Properties / Ideal monatomic gas / Calculation of thermodynamic magnitudes / Gibbs's paradox / Validity of the classical approximation / The equipartition theorem / Paramagnetism.

8. **Balance between Phases or Chemical Species**

   General equilibrium conditions / Balance between phases / Systems with several components: Chemical equilibrium.

9. **Quantum Statistics of the Ideal Gases**

   Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics / Ideal gas in the classical limit / Blackbody radiation / Conduction electrons in metals.

10. **Interactive Particle Systems**

    Solids / Reticular vibrations and normal modes / Debye's approximation / Non-ideal classical gases / Partition function calculation for low densities / State equation and virial coefficients / Ferromagnetism / Interaction between spins / Approximation of the Weiss molecular field.

IV. BIBLIOGRAPHY

- F. Reif, Fundamentos de Física Estadística y Térmica, McGraw Hill Book Company
- K. Huang, Statistical Mechanics, John Wiley & Sons, 1965.
- L.E. Reichl, A Modern Course in Statistical Physics, University of Texas Press, 1980.
- M. Toda, R. Kubo, N. Saito, Statistical Physics I, 2da. Ed., Springer-Verlag, 1992.

- Feynman et al., Feynman. Física Vol. I., Addison-Wesley Iberoamericana, 1987.

.