PHY7106: STATISTICAL MECHANICS 3(3-0)

1. Course Name: Statistical Mechanics

2. Course Code: PHY7104

3. Credit Units: 3

4. Course Description:

This course starts with applications in equilibrium statistical mechanics from the imperfect gas treatment. The cooperative and critical phenomena are then introduced, leading to the group theory. Finally, the non-equilibrium statistical mechanics is introduced.

5. Course Objectives:

At the end of the course, the students should be able to:

- Use applications in equilibrium statistical mechanics.
- Apply the cooperative phenomena in ferromagnetism.
- Use the critical phenomena in group theory.
- Distinguish between equilibrium and non-equilibrium statistical mechanics.

6. Course Outline:

Content	Hours
Applications of Equilibrium Statistical Mechanics: Imperfect gas: Interaction potentials and virial coefficients; radial wave function; Bose-Einstein condensation.	10
Cooperative Phenomena: Ising-Model (1D & 2D) Mean field approximation; Order-Disorder Phase changes; Structural Phase Changes; Ferromagnetism-Weiss Theory	10
Critical Phenomena: hermodynamics of Phase Transitions; Critical Exponents; Scaling Hypothesis; Introduction to Group Theory of Critical Phenomena	15

(Wilson's renormalization)	
Non-equilibrium Statistical Mechanics: Fluctuation and noise; Brownian Motion: Correlation, Spectral density and autocorrelation functions, Nyquist theorem, Linear response theory, Kramers – Kronig relations, Fluctuation Dissipation Theorems; Onsager's theory and applications; The Boltzmann transport equation: Relaxation time equation, Perturbation approach, Ritz-Rayleigh method, Method of Invariants; The statistical Density Operator: Time evolution of the statistical operator, Canonical density operator, Grand canonical density operator, Application to the ID harmonic oscillator, The Green-Kubo formulation.	10
Total	**45**

7. Mode of Delivery:

This course will consist mainly of lecture sessions.

8. References:

1. Reif, Frederick: Fundamentals of Statistical and Thermal Physics.
2. F. Mandl, Statistical Physics, John Wiley(1972)
3. Bipin K. Agarwal and Melvin Eisner ,Statistical Mechanics, John Wiley(1988)