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Graduate Program in Physics
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Statistical Mechanics I

Course code: FSC410131

Credit hours: 6

Duration: 18 weeks

DESCRIPTION: Microcanonical, canonical and grand canonical ensembles. Ideal quantum gases. Phase transitions. Mean field approximation. Scaling. Kinetic theory. Langevin equation. Fokker-Planck equation.

COURSE CONTENT:

1. Ensemble theory: Microcanonical, canonical and grand canonical ensembles. Partition function. Thermodynamical properties. Fluctuations. Statistics of quantum systems. Density matrix. Ideal quantum gases. Bose-Einstein and Fermi-Dirac statistics and its applications.

2. Interacting systems and phase transitions: Phase transition thermodynamics. Critical exponents. Virial expansion. Van der Waals model of real gases. Liquid-gas phase transition. Ising model. Mean field theory and its applications. Landau theory. Order and symmetry. Scaling.

3. Out of equilibrium systems: Kinetic theory. Boltzmann equation. H theorem. Transport phenomena. Brownian motion and the Langevin equation. Fokker-Planck equation. Fluctuation-dissipation theorem.

BIBLIOGRAPHY:

1. Statistical Mechanics. R.K. Pathria and P. D. Beale, Third Edition, Academic Press (2011).
2. Statistical Mechanics. Huang Kerson, Second Edition, John Wiley and Sons (1987).
3. A Modern Course in Statistical Physics. Linda Reichl, Fourth Edition, Wiley-VCH (2016).
4. Statistical Physics of Particles. Mehran Kardar, First edition, Cambridge University Press (2007).
5. Statistical Physics of Fields. Mehran Kardar, First edition, Cambridge University Press (2007).