

Core-Course title: CLASSICAL AND STATISTICAL MECHANICS

Course Code*	082PY1M01	Category	Part III Core/ Theory	
Credits	4	Semester	I	
Hours / Cycle	6	Year of Implementation	From the academic year 2023-'24 onwards	
Course Structure	Theory	Tutorial	Practical	Total Hours
	90 hours			90 hours

* To be allotted by Examinations Office after the Approval of Academic Council

SYLLABUS: Classical and Statistical Mechanics

Unit	Content	Hours	COs	Bloom's Taxonomy Level
1	LAGRANGIAN FORMULATION: Generalised coordinates – Constraints – D'Alembert's principle – Lagrange's equations of motion – Hamilton's variational principle and Lagrange's equation – Non-holonomic and non-conservative systems – Scattering in lab and centre of mass systems – Rutherford Scattering. Hamilton's Theory: Hamilton's equations – Cyclic variables – Principle of least action	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5
2	CANONICAL TRANSFORMATIONSEquation of CT – Lagrange and Poisson brackets – Invariance – Equation of motion in Poisson bracket's notation – ICT.Hamilton Jacobi Theory: H-J equation for Hamilton's principle function – Hamilton's characteristic equation – Separation of variables in H-J equation – Action angle variables.	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5
3	RIGID BODY DYNAMICSMoments and products of inertia – Euler's equations of motion – Euler's angles – uniformly rotating frames – Foucault's pendulum – Top motion.Small Oscillations:Theory – Normal coordinates – Normal modes – Linear triatomic molecules.	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5
4	STATISTICAL MECHANICSClassical Statistics: Phase space – Ensembles – Liouville's theorem – M.B. distribution – Doppler broadening – Equipartition theorem – Entropy and probability.	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5
5	PARTITION FUNCTIONPartition function – Calculation of thermodynamic quantities – Rotational, vibrational and translational partition functions – Diatomic ideal gas	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5
6	QUANTUM STATISTICSSState function - Symmetry principles - Density matrix-B.E. distribution – Black body radiation – Planck's law – B.E. condensation – Degeneracy – F.D. distribution – Electron theory of metals – Qualitative comparison between classical and quantum statisticsChandrasekhar limit – Pauli's spin paramagnetism – Debye's theory of specific heats of solids.	15	1, 2, 3, 4, &5	K1, K2, K3, K4, K5

Prescribed Books/Text Books

1. H. Goldstein, Classical Mechanics 2nd edition, Narosa Publishing Co., (2001).
2. B. K. Agarwal and Melvin Eisner, Statistical Mechanics, 2nd edition New Age International Pvt. limited, Publishers (1989) New Delhi.
3. S.K. Sinha, Statistical Mechanics Theory and Application, TMH Publishing Co., (1990).

Reference Books

1. B. B. Laud , *Fundamentals of statistical mechanics*, New Age International pvt. Limited, Publishers (1998).
2. Federick Reif, *Fundamentals of statistical and thermal physics*, 20th printing, McGraw Hill Publishing Co.,(1988) New York.

Suggested Reading

1. S. Lokanathan & R. S. Gambhir, Statistical and Thermal Physics, Printice-Hall India, New Delhi.

Web Resources: