

STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI
COURSE PLAN June - November 2024

Department : Physics
Name/s of the Faculty : Dr. C. Stella
Course Title : Statistical Mechanics
Course Code : 23PH/PC/SM14
Shift : II

COURSE OUTCOMES (COs)		
COs	Description	CL
CO1	Recall and relate statistical methods to ideal gas, actual gas and harmonic oscillator in the field of thermodynamics.	K1
CO2	Provide a description of the relevant parameters, thermodynamic ensembles, and potentials that are employed to describe macroscopic systems.	K2
CO3	Compute thermodynamic probability and apply probability theory to the distribution of particles in multiple systems.	K3
CO4	Distinguish the characteristics of quantum systems including phonon gas, photon gas and electron gas using statistical methods.	K4
CO5	Develop analytical skills for problem solving in statistical mechanics	K5

Week	Unit No.	Content	Cognitive Level	Teaching Hours	COs	Teaching Learning Methodology	Assessment Methods
Jun 24 – 26, 2024 (Day Order 4 - 6)	I	Ensemble theory Foundation of statistical Mechanics	K1-K3	2	1-3	Lecture and Power point presentation	Questioning and discussion
Jun 27 – July 4, 2024 (Day Order 1 - 6)	I	Connection between statistical mechanics and thermodynamics – classical ideal gas – Gibb's paradox - Phase space	K1-K5	5	1-5	Power point presentation and Group discussion	Questioning and discussion
July 5 – 12, 2024 (Day Order 1 - 6)	I	Liouville's theorem. Microcanonical ensemble – classical gas in microcanonical ensemble- linear harmonic oscillator – coarse graining of phase space	K1-K5	5	1-5	Lecture and Problem solving	Questioning and problem solving
July 15 – 23, 2024 (Day Order 1 - 6)	II	Unit II: Canonical Ensembles Classical Canonical ensembles - Partition function – connection with thermodynamics – energy fluctuation - classical ideal gas in canonical ensembles	K1-K5	5	1-5	Lecture and Power point presentation	Questioning and discussion

July 24 – 31, 2024 (Day Order 1 - 6)	II	Calculation of statistical quantities - Equipartition theorem – classical harmonic oscillator – two level system – concept of negative temperature – particle in a box	K1-K5	5	1-5	Lecture and Power point presentation	Questioning and discussion
Aug 1 – 5, 2024 (Day Order 1 - 3)	II	Linear harmonic oscillator - System with internal degrees of freedom – rigid rotator – Einstein’s theory of specific heat capacity	K1-K5	3	1-5	Lecture and Problem solving	Component test and Problem solving
Aug 6 – 10, 2024	C.A. Test - I						
Aug 12 – 14, 2024 (Day Order 4-6)	III	Unit III: Grand Canonical ensemble: Particle reservoir – grand partition function – connection with thermodynamics –	K1-K4	2	1-4	Lecture and Power point presentation	Questioning and Discussion
Aug 16 – 23, 2024 (Day Order 1-6)	III	Classical gas in grand canonical ensemble - symmetry aspect of many particle wave function – photons – number fluctuation – Parametric equation of states – virial expansion – critical fluctuation Pair production	K1-K5	5	1-5	Lecture and Group discussion	Questioning and problem solving

Aug 27 – Sep 3, 2024 (Day Order 1-6)	III	Elements of quantum statistics - Density matrix – pure and mixed states – properties of density matrix– density operators for quantum statistics	K3-K5	5	3-5	Lecture and Power point presentation	Questioning and problem solving
Sep 4 – 11, 2024 (Day Order 1-6)	IV	Unit IV: Bose-Einstein Statistics Ideal Bose gas – its thermal properties - statistics of ensembles	K1-K4	5	1-4	Lecture and Power point presentation	Questioning and problem solving
Sep 12 - 20, 2024 (Day Order 1-6)	IV	Black body radiation – phonons Debye’s theory of specific heat	K1-K5	5	1-5	Lecture and problem solving	Component problem test
Sep 23 - 26, 2024 (Day Order 1-4)	IV	BE condensation – Liquid helium –super fluidity	K3-K5	4	3-5	Lecture	Questioning and discussion
C.A. Test - II							
Sep 27 – Oct 3, 2024							
Oct 4 – 5, 2024 (Day 5 & 6)	V	Unit V: Ideal Fermi gas Ideal Fermi gas – Fermi Dirac distribution	K1-K4	1	1-4	Lecture	Component seminar and discussion
Oct 7 - 15, 2024 (Day Order 1 to 6)	V	Thermodynamic properties of Fermi gas - Electrons in metals – electronic heat capacity – paramagnetic susceptibility	K3-K5	5	3-5	Lecture and problem solving	Component seminar and discussion
Oct 16 - 22, 2024 (Day Order 1 to 6)	V	White dwarf – Chandrasekhar limit – nuclear matter	K3-K5	5	3-5	Lecture and power point presentations	Questioning and problem solving

Oct 23 - 24, 2024
(Day Order 1 to 2)

REVISION