Statistical Physics II

Module Code: Phys-M3092;	EtCTS of Course: 5 ;	Course Status:	Compulsory
Course Title :	Statistical Physics II		
Course Code:	Phys3092;	Credits Hours:	3
Mode of delivery:	Full Semester;	Weeks required:	16
Prerequisite(s):		Co-requisite(s):	
Academic Year:	20_____/_____ ;	Year/Semester:	III/ II
Students' College/Faculty:	_____;	Department:	Physics
Program:	Undergraduate	Enrollment:	_____
Instructor's Name (Coordinator)	_____		
Address: Email: _____	Block No._____;	Rm. No. _____	
Class Hours:	_____		

Course Rationale

This course is designed to introduce basically quantum statistics. Emphasis is also given to study systems with many particles using statistical approaches. The designed procedures aided in investigating and interpreting results associated with macroscopic systems.

Learning Outcomes

Upon completion of this course students should be able to:

- identify simple application of classical and quantum statistics,
- apply statistical approaches in studying different properties of a system,
- derive and apply equi-partition theorem,
- explain the applications of laws of thermodynamics,
- employ Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics in describing a given system,
- explain magnetic properties of substances at low temperature,
- discuss about different properties of substances related with their movement by using kinetic theory of transport process,
- understand the ways of incorporating the interaction term while studying dynamics of interacting particles.

Course Description

Review of the Laws of Thermodynamics, Thermodynamic Potentials, Conditions for Equilibrium and Stability, Legendre Transformations, Maxwell's Relations, Maxwell's distribution, Phase Transitions, Simple Application of Statistical Mechanics, Quantum and Classical Statistics, Fermi-Dirac and Bose-Einstein System of Interacting Particles, Kinetic Theory of Transport Processes

Course Outline: EtCTS (5)

No	Topic	Lecture (hrs)	Tutor (hrs)	Home (hrs)	T.Load (hrs)
1)	**Review of Thermodynamics**	7	2	11	20
2)	**Simple Applications of Statistical**	13	4	23	40
3)	**Quantum Statistics of Ideal Gases**	13	5	23	41
4)	**System of Interaction Particles**	6	2	9	17
5)	**Kinetic Theory of Transport**	6	2	9	17
	Total	45	15	75	135

Method of Teaching

Presentation of the course is through lecture, tutorial and problem solving. Online learning resources can also be employed.

Tentative Time Breakdown of Lecture Topics

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 1	**Review of Thermodynamics** • State of variable and equation of state • Laws of thermodynamics • Thermodynamic potential • Gibbs-Duhems and Maxwells relations	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
Week 2	• Response functions • Condition for equilibrium • Thermodynamics of phase transitions			
	Assignment I			
Week 3	**Simple Applications of Statistical** • Partition function and their properties ideal monatomic gas • Calculations of thermodynamic quantities • Gibbs paradox	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
Week 4	• Validity of the classical approximation • Proof of equipartition • Simple applications			
	Test I			

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 5 Week 6	• Specific heat of solids • General calculation of magnetism • Maxwells velocity distribution • Related velocity distribution • Number of molecule striking a surface • Effusions • Pressure and momentum	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
	Assignment II			
Week 7 Week 8	**Quantum Statistics of Ideal Gases** • Isolated systems: micro canonical ensembles • System at mixed temperature • Grand canonical ensembles • Identical particles and symmetry requirement • Formulation of statistical problems • The quantum distribution functions	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
Week 9 Week 10	•Maxwell-Boltzmann statistics • Photon statistics • Bose-Einstein statistics • Fermi-Dirac statistics • Quantum statistics in the classical limit • Evaluation of the partition function	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
	Test II			
Week 11 Week 12	**System of Interaction Particles** • Lattice vibration and normal mode • Debye approximation • Calculation of the partition function for low densities • Equation of state and virial coefficients • Alternative derivation of the van Der waals equation	Gapped Lecture, Group discussion, Questioning and answering,	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
	Assignment III			

Date	Topics	Pedagogical Approaches	Teachers' Tasks/Activities	Students' Tasks/Activities
Week 14	**Kinetic Theory of Transport** • Collision time • Collision time and scattering cross section • Viscosity	Gapped Lecture, Group discussion, Questioning and answering	Giving home work, reading assignments and feedback	Listen to a lesson take short notes, asking and answering questions, Doing home work
Week 15	• Thermal conductivity • Self diffusion • Electrical conductivity			
	Final Exam			

Students should read the relevant sections in the textbook and/or reference materials and do the assignments on time. Practice with solved problems and come to office hours to get concepts clarified. Review and extra problems will be given through worksheets. Students are also expected to have worked through the problems in the worksheets before the tutorial sessions. Attendance at lectures and tutorials is expected for all students. Attendance records will be taken at all times. It is the students chance to ask questions, solve problems and work in team.

Assessment

No	Type of Assessment	Time	Weight
1	Test I	Week 4	5%
	Test II	Week 10	10%
2	Assignment I	Week 2	5%
	Assignment II	Week 6	10%
	Assignment III	Week 12	10%
3	Class activity and home work	All weeks	10%
4	Final exam	Final week	50%
		Total	100%

Recommended References

Course Textbook

F. Reif, *Fundamentals of Statistical and Thermal Physics*, Wave Land Price, 2008.

References

1. B. B Laud, *Fundamentals of Statistical Mechanics*, India, 2009.
2. C. Kittel, *Elementary statistical Physics*, Rieger Pub Co., 1988.
3. Michel D. Sturge, *Statistical and Thermal Physics: Fundamentals and Applications*, 2003.