INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITD&M) KANCHEEPURAM

INTRODUCTION OF NEW COURSE

Course Title	Statistical Mechanics	Course No *(will be assigned)*				
Specialization	Physics	Structure (LTPC)	3	0	0	3
Offered for	PG/Ph.D	Status	Core ☐		Elective ■	
Faculty	Dr. Tapas Sil	Type	New ■		Modification ☐	
Pre-requisite	Basic Thermodynamics and basic quantum mechanics	To take effect from	January 2013			
Submission date	October 2012	Date of approval by AAC				
Objectives	To get knowledge of physical properties of matter “in bulk” on the basis of the dynamical behavior of its microscopic constituents.					
Contents of the course *(With approximate break up of hours)*	1.Introduction (7hrs): Objective of statistical mechanics. Macrostates, microstates, phase space and ensembles. Ergodic hypothesis, postulate of equal a priori probability and equality of ensemble average and time average. Boltzmann's postulate of entropy. Counting the number of microstates in phase space. Entropy of ideal gas: Sackur-Tetrode equation and Gibbs' paradox. Liouville's Theorem. 2. Canonical Ensemble (5hrs): System in contact with a heat reservoir, expression of entropy, canonical partition function, Helmholtz free energy, fluctuation of internal energy. 3. Grand Canonical Ensemble (3hrs): System in contact with a particle reservoir, chemical potential, grand canonical partition function and grand potential, fluctuation of particle number. Chemical potential of ideal gas. 4. Classical non-ideal gas (5hrs): Mean field theory and Van der Wall's equation of state; Cluster integrals and Mayer-Ursell expansion. 5. Quantum statistical mechanics (6hrs): Density Matrix; Quantum Liouville theorem; Density matrices for microcanonical, canonical and grand canonical systems; Simple examples of density matrices; one electron in a magnetic field, particle in a box; Identical particles, B-E and F-D distributions. 6. Ideal Bose and Fermi gas (7hrs): Equation of state; Bose condensation; Equation of state of ideal Fermi gas; Fermi gas at finite T. 7. Special topics (9hrs): Ising model: partition function for one dimensional case; Chemical equilibrium and Saha ionization formula. Phase transitions: first order and continuous, critical exponents and scaling relations.					
Textbook	1. R.K. Pathria and Paul D. Beale: Statistical Mechanics, Elsevier, 3rd Edition, 2011.					
References	1. F. Reif: Fundamentals of Statistical and Thermal Physics,Mc Graw Hill 2. K. Huang: Statistical Mechanics, John Wiley and Sons. 3. L. D. Landau and E. M. Lifshiiz: Statistical Physics, Third Edition, Part 1: Volume 5 (Course of Theoretical Physics, Volume 5), Butterworth-Heinemann					