NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

Department of Chemistry

COURSE PLAN			
Course Title	Statistical Thermodynamics, Photochemistry and Surface Chemistry		
Course Code	CH 617	No. of Credits	3 (Theory)
Department	Chemistry	Faculty	Dr. S. ANANDAN
Pre-requisites Course Code	NIL		
Lab Course Coordinator(s) (if, applicable)	-----		
E-mail	sanand@nitt.edu	Mobile No.	+91-9444052074
Course Type	☑ Core course	☐ Elective course	

COURSE OVERVIEW

This is a three credit course offered to II year M.Sc. Chemistry students. Three theory classes will be conducted per week. This course provides a thorough understanding of the subject through lectures, tutorials, course work and demonstrations.

COURSE OBJECTIVE

To introduce Statistical Thermodynamics concepts,such as Maxwel's law of distribution, microstates for distinguishable and indistinguishable particles, Maxwell Boltzmann distribution law, Expressions for thermodynamic quantities in terms of partition functions, Einstein and Debye models - Bose Einstein statistics and Fermi Dirac statistics; and concepts of photochemistry,such as, Franck Condon principle decay of electronically excited states, fluorescence and phosphorescence, Theory of energy transfer, laser and masers, Chemi and thermoluminescence; Surface chemistry aspects, such as Gibbs adsorption isotherm, physisorption and chemisorption, Freundlich, derivation of Langmuir and BET isotherms, spectroscopic surface characterization methods to the students.

COURSE OUTCOMES (CO)

Students will learn about fundamental and advanced concepts of Statistical Thermodynamics, Photochemistry, and Surface Chemistry

COURSE TEACHING AND LEARNING ACTIVITIES

S.No.	Week	Topic	Mode of Delivery
1	I week of August	A brief introduction about the course and syllabus will be discussed. **Unit I- Statistical thermodynamics I:** Maxwel's law of distribution of molecular speeds, graphical representation, experimental verification - derivation of expressions for average, most probable and root mean square velocity.	C&T, PPT
2	II week of August	Concept of velocity space and phase space - perturbution and combination - laws of probability	C&T, PPT

		- microstates for distinguishable and indistinguishable particles. Derivation of Maxwell Boltzmann distribution law	
3	III week of August	Partition functions and their calculation. Expressions for thermodynamic quantities in terms of partition functions - translational, rotational, vibrational and electronic contributions to the thermodynamic properties of perfect gases, Intermolecular forces in imperfect gases.	C&T, PPT
4	III & IV week of August	**Unit II- Statistical thermodynamics II:** Statistical interpretation of laws of thermodynamics, third law of thermodynamics and apparent expression to it.	C&T, PPT
5	IV week of August	Quantum statistics: Limitation of classical statistics - quantum statistics and classical statistics, comparison - heat capacities of gases in general and hydrogen in particular	C&T, PPT
6	I week of September	Heat capacities of solids. Einstein and Debye models - Bose Einstein statistics and Fermi Dirac statistics and corresponding distribution functions	C&T, PPT
7	II week of September	Applications of quantum statistics to liquid helium, electrons in metal and Planck's radiation law.	C&T, PPT
8	IV week of September	**Unit-III- Photochemistry:** Absorption and emission of radiation, Franck Condon principle decay of electronically excited states, radiative and non-radiative processes, fluorescence and phosphorescence	C&T, PPT
9	I week of October	spin-forbidden radiative transitions, inter conversion and intersystem crossing. Theory of energy transfer - resonance and exchange mechanism, triplet-triplet annihilation, photosensitization and quenching.	C&T, PPT
10	II week of October	Spontaneous and induced emissions. Einstein transition probability - inversion of population - laser and masers. Flash photolysis: Chemi and thermoluminescence.	C&T, PPT
11	III week of October	**Unit IV- Surface chemistry I:** Surface Phenomena, Gibbs adsorption isotherm, types of adsorption isotherms, solid-liquid interfaces, contact angle and wetting, solid-gas interface, physisorption and chemisorption,	C&T, PPT
12	IV week of October	Freundlich, derivation of Langmuir and BET isotherms, surface area determination. Kinetics of surface reactions involving adsorbed species, Langmuir-Hinshelwood mechanism, Langmuir-Rideal mechanism, Rideal-Eley mechanism.	C&T, PPT
13	I week of November	**Unit V-Surface chemistry II:** Surface Films, Langmuir-Blodgett films, self-assembled mono	C&T, PPT

		layers, collapse pressure, surface area and mechanism of heterogeneous catalysis, phase transfer catalysis.	
14	III week of November	Chemical analysis of surfaces: Surface preparations - spectroscopic surface characterization methods, electron spectroscopy, ion scattering spectrometry, secondary ion scattering microscopy (SIMS)	C&T, PPT
15	IV week of November	Auger electron spectroscopy - instrumentation and application. Electron stimulated micro analysis, scanning probe microscopes.	C&T, PPT

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
Theory				
1	Group Task (Quiz/working model)/Assignment/Surprise test	III week of August	One week	5
2	Test I	II week of September	1.5 hr	30
3	Group Task (Quiz/working model)/Assignment/Surprise test	I week of October	One week	5
4	Test II	II week of November	1.5 hr	30
5	End semester	I week of December	3 hours	30
Total (100)				

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

1. P. W. Atkins, Physical Chemistry, 6th Edn., Oxford University Press, 1998.
2. D. McQuarie, and J. D. Simmen, Physical Chemistry, 1st Edn., University Science, 1998.
3. S. Glasstone, Thermodynamics for Chemists, Affiliated East West Press, 1965.
4. B. C. McClelland, Statistical Thermodynamics, Chapman and Hall, 1973.
5. L. K. Nash, Elements of Classical and Statistical Thermodynamics, Addison-Wesley, 1970.
6. K. K. Rohatgi - Mukkerjee, Fundamentals of Photochemistry, Wiley 1992.
7. P. K. Ghosh, Introduction to Photoelectron Spectroscopy, Wiley Interscience, 1983.

COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)

1. Feedback from students during class committee meetings.
2. Anonymous feedback through questionnaire at the end of the semester.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

1. Test I and II will be conducted during assessment period respectively.
2. Retest will be conducted for students who do not appear for the test I & II due to ill health or any other genuine reasons.
3. 75% attendance is compulsory for writing the end semester exam.
4. No formative assessment only Redo if students are absent for final examination.

ADDITIONAL COURSE INFORMATION

The faculty will be available for consultation at times as per the intimation by the faculty. Students can get prior permission either through email: sanand@nitt.edu or mobile no.: +91-9444052074

Faculty-in-charge Dr. S. ANANDAN **CC-Chairperson** **HOD**