School of Chemistry
Faculty of Science
University of the Punjab, Lahore
Course Outline

BS Chemistry Semester-II					
Programme	**BS Chemistry**	**Course Code**	**Chem-103**	**Credit Hours**	**3**
Course Title	**Physical Chemistry – II Thermodynamics**		**Course Type**	**Major**	

Course Introduction

This course is developed to impart a scientific understanding of thermodynamic parameters and to use their knowledge in understanding the practical applications of thermodynamics. Here is a brief description of course outlines:

Brief introduction of second law of thermodynamics, concept of entropy, entropy change in reversible and irreversible process, entropy change for an ideal gas, entropy change due to mixing of ideal gases, effect of temperature and pressure on entropy, concept of free energy, effect of temperature and pressure on free energy, relationship between standard free energy and equilibrium constants. Clausius inequality, Nernst heat theorem and its applications, Nernst approximation, Maxwell’s Relations, third law of thermodynamics, Experimental verification of third law of thermodynamics. Entropy change in solid/liquid and ideal gas, Adiabatic demagnetization. Vant’s Hoff equation and Clausius-Calyepron equation. Fugacity and Activity, Adiabatic demagnetization.

Sterling’s approximation, Concept of microstate and determination of most probable microstate, partition function (Q), its derivation and physical significance, Energy of system in terms of partition function, expression of thermodynamic functions (energy, enthalpy, entropy, heat capacity at constant pressure and volume and free energies) in terms of translational partition function (Qt), rotational partition function (Qr), vibrational partition function (Qv) and electronic partition function (Qe), Separation of partition functions, expression of free energy and equilibrium constant of reversible chemical reaction in terms of partition function. Entropy and probability.

Learning Outcomes

1. This course aims to deepen the understanding of thermodynamic principles, covering both classical and statistical thermodynamics.
2. The course will emphasize applying these principles to practical and emerging technologies.

	Course Content	Assignments/Readings
Week 1	**Unit-Classical thermodynamics** Brief introduction of second law of thermodynamics	
	Concept of entropy, Entropy change in reversible and irreversible process	
Week 2	Entropy change for an ideal gas Entropy change due to mixing of ideal gases	
	Concept of free energy Effect of temperature and pressure on free energy	

Week 3	relationship between standard Gibbs energy and equilibrium constants	
	Clausius inequality	
Week 4	Nernst heat theorem and its applications	
	Nernst approximation	
Week 5	Maxwell's Relations Third law of thermodynamics	
	Experimental verification of third law of thermodynamics	
Week 6	Entropy change in solid/liquid and ideal gas	
	Adiabatic demagnetization	
Week 7	Van 't Hoff equation and Clausius–Clapeyron equation	
	Fugacity and Activity	
Week 8	**Mid Term Examinations**	
Week 9	**Unit-II Statistical Thermodynamics** Sterling's approximation	
	Concept of microstate and determination of most probable microstate	
Week 10	Partition function (Q), its derivation and physical significance	
	Energy of system in terms of partition function	
Week 11	Expression of thermodynamic functions (energy, enthalpy, entropy, heat capacity at constant pressure and volume and free energies) in terms of translational partition function (Q_t), rotational partition function (Q_r), vibrational partition function (Qv) and electronic partition function (Qe)	
	Continued	
Week 12	Continued	
	Continued	
Week 13	Continued	
	Separation of partition functions	
Week 14	expression of free energy and equilibrium constant of reversible chemical reaction in terms of partition function	
	Continued	
Week 15	Continued	
	Entropy and probability.	
Week 16	**Final Term Examinations**	

Textbooks and Reading Material
1. Nash, L.K., Elements of classical and statistical thermodynamics, Addison Wesley Co. Ltd., 1979. 2. Bhatti, H. N. and Farooqi, Z. H., Modern Physical Chemistry, Revised ed., Caravan Book House, Lahore, 2014. 3. Alberty, R. A. and Silbey, R. J. Physical Chemistry, 3rd ed., John Wiley & Sons, Inc., New York, 2001. 4. Atkins, P. W., Physical Chemistry, 7th ed., W. H. Freeman and Company, New York, 2002. 5. Chang, R., Physical Chemistry the Chemical and Biological Sciences, 3rd ed., University Science Books, Sausalito, CA, 2000. 6. Laidler, K. J., Meiser, J. H., and Sanctuary, B. C., Physical Chemistry, 4th ed., Houghton Mifflin Company, Boston, 2002. 7. Levine, I. N., Physical Chemistry, 5th ed., McGraw-Hill, Inc., New York, 2002. 8. Winn, J. S., Physical Chemistry, Harper Collins College Publishers, New York, 1995. 9. Noggle, J. H., Physical Chemistry, Harper Collins College Publishers, New York, 1996. 10. Engel, T. and Ried, P., Physical Chemistry, 1st ed., Pearson education, Inc. 2006. 11. Maron S.H. and Prutton C.F., Principles of Physical Chemistry, Macmillan and Co. Ltd., 1965. 12. Glasstone, S. Physical Chemistry, Macmillan and Co. Ltd., London, 195. 13. Physical…?
Teaching Learning Strategies
1. Lectures 2. Group Discussion 3. Laboratory work 4. Seminar/ Workshop
Assignments: Types and Number with Calendar
1. Numerical problem sets relevant to topic will be given as assignments from week 1 to week 16. 2. Literature review based assignment relevant to the course will also be given during the course.

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.