Kuwait University
Vice President for Academic Affairs

جامعة الكويت
نائب مدير الجامعة للشئون العلمية

نموذج توصيف مقرر
Course Description Form

Name of College\Faculty : Science — **اسم الكلية:**

Name of Department: Chemistry — **اسم القسم العلمي:**

Course Name	Introduction to Chemical Statistics and Dynamics	**اسم المقرر**
Course No.	0420427	**رقم المقرر**
No. of Credits	3	**عدد الوحدات**
Theoretical Hours	3	**عدد الساعات النظرية**
Practical Hours	0	**عدد الساعات المحلية**
Course topics		**مواضيع المقرر**

1. Kinetic theory of gasses.
2. Basic concepts of statistical thermodynamics.
3. Application of statistical thermodynamics to chemically significant quantities.
4. reaction dynamics.
5. Eyring theory of liquid.

Text book: (Name, Author , Year , Publisher)	**عنوان الكتاب : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)**

Peter Atkins, Physical Chemistry, Oxford University Press, Oxford, Latest Edition.

References: (Name , Author , Year . Publisher)	**عنوان المرجع : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)**

An Introduction to Statistical Thermodynamics by R. Gasser and W. Richards, Latest Edition.

Prerequisites					**متطلبات المقرر**	
	Exams	**50**	**%**		**الاختبارات**	
	Quizzes	**10**	**%**		**امتحانات قصيرة**	
	H.W.	**0**	**%**		**واجبات**	
	Project (field study)	**0**	**%**		**مشاريع (دراسة ميدانية)**	

Grading	**Final**	**40**	**%**		**الاختبار النهائي**	**آلية رصد المقرر**
	100%					

Chapters included:

Chapter	Topic	Page
CH.1	Kinetic theory of gases	11-18
CH.2	Basic concepts of statistical thermodynamics	531-537
CH.3	Application of statistical thermodynamics to chemically significant quantities	538-565
CH.4	Reaction dynamics	779-790, 801-809
CH.5	Theory of liquid	602-622

Course objectives					
No.	**Course Objectives (Learning Outcomes)**	**Example(s) of relevant (Topics and activities)**	**Recommended Level to satisfy the objectives**		
			High	**Medium**	**Low**
1	To introduce basic laws governing Kinetic theory of gasses	1.1 Understand the kinetic model of gases: elastic collision; root mean square of speed; Maxwell distribution of speed ; relative mean speed.	**X**		
2	To introduce the basic concepts of statistical thermodynamics which provides the link between microscopic properties of matter and its bulk properties	2.1 Calculate the distribution of molecular states; Population; principle of equal prior probability. 2.2 Understand and calculate Configuration and weights; Stirling's approximation; Boltzmann distribution; method of undetermined multipliers. 2.3 Define the molecular partition function and thermal wavelength.	**X**		

		2.4 Calculate the internal energy and entropy: q for uniform array; q for translation. 2.5 Calculate the internal energy: U in terms of q. 2.6 Define and calculate the statistical entropy: Boltzmann formula; S in terms of q. 2.7 Define and understand the canonical ensemble: Ensemble; canonical ensemble; thermodynamic limit; canonical distribution; canonical partition function; density of states. 2.8 Obtain the thermodynamic information in the partition function: U in terms of Q; S in terms of Q. 2.9 Define Independent molecules: Distinguishable and indistinguishable molecules and calculate Sackur-Tetrode equation.			
3	To apply the concepts of statistical thermodynamics to the calculation of chemically significant quantities such as heat capacities and chemical equilibrium.	3.1 Define and use the thermodynamics function: Molar partition function. 3.2 Calculate the molecular partition function: Rotational temperature; symmetry. number; rotational subgroup; vibrational temperature. 3.3 Calculate Mean energies: Mean energy of a mode. 3.4 Calculate Heat capacities: heat capacity of a mode; overall heat capacity. 3.5 Define and use equation of state: Configuration integral; Mayer f-function; hard-sphere potential. 3.6 Define and calculate Residual entropies.	**X**		

		3.7 Calculate equilibrium constants: standard molar partition function; equilibrium constant.			
4	To introduce the Activated Complex Theory using the statistical thermodynamics approach to reaction rates. This approach is useful for parameterizing the rates of reaction in solution.	4.1 Explain the Activated complex theory. 4.2 Discuss the reaction coordinate and transition state: Activated complex; transition state. 4.3 Derive and explain the Eyring equation: Transmission coefficient; concentration of activated complex; Eyring equation; collision of structureless particles; kinetic isotope effect; femtochemistry. 4.4 Calculate the dynamics of molecular collision: Reactive collisions; potential energy surfaces;	**X**		
5	To introduce basic concepts of theory of liquids	5.1 explain the structures of liquids : Radial distribution function; long-range and short- range order; Virial; Monte Carlo method; molecular dynamics; mesophase; liquid crystal; smectic, nematic and cholesteric phases.	**X**		
Fields	Physical Chemistry				
Skills					
Coordinator (Name and Rank) :		Physical Chemistry Coordinator			
Signature and stamp :					
Date:		**10/11/2025**			