Department: Chemistry Dept.

College: Education College

University: Salahaddin University

Subject: Thermodynamic Chemistry

Course Book: *Stage* 2**; First semester**

Lecturer's name: Lecturer Dr. Khozan A. Haji

Academic Year: 2023/2024

Course Book

1. Course name	Thermodynamics
2. Lecturer in charge	Dr.Khozan A. Haji
3. Department/ College	Chemistry/ Education
4. Contact	e-mail:khozan.haji@su.edu.krd
5. Time (in hours) per week	Theory: 4 Practical: 9
6. Office hours	Thursday 10.5am – 12.5 pm or by appointment
7. Course code	
8. Teacher's academic profile	I graduated from the College of Education, Department of Chemistry in 1997 and got a bachelor's degree BSc in chemistry. After that. I then started to study MSc/Analytical Chemistry in 1998 at Salahaddin University. After finishing my MSc study in 2000, I worked in Collage of Education / Chemistry department, as an assistant lecturer. The teaching experience is practical in the analytical Physical, Industrial &Organic Chemistry. Finally, I received my PhD-Physical Chemistry in the same University in 2015. My academic and research program interest focus on Kinetic study; I have more than 4 published articles and going to publish some other articles.
9. Keywords	**Kinetic study, chalcones, spectrophotometry, bromination, rate of reaction.**

10. Course overview:

All matter exists in three states: gas, liquid and solid. A molecular level representation of gaseous, liquid and solid states. A gas consists of molecules separated wide apart in empty space. The molecules are free to move about throughout the container.

In this course we introduce the principles of chemical thermodynamics, in studying and evaluating the flow of energy into or out of a system, it will be useful to consider changes in certain properties of the system. These properties include temperature, pressure, volume and concentration of the system. Measuring the changes in these properties from the initial state to the final state, can provide information concerning changes in energy and related quantities such as heat and work.

11. Course objective:

It tells whether a particular physical or chemical change can occur under a given set of conditions of temperature, pressure and concentration. It also helps in predicting how far a physical or chemical change can proceed, until the equilibrium conditions are established.

12. Student's obligation

The student attendance in class two hours a week, preparation of the home works examinations and participate in the discussion in the classroom.

13. Forms of teaching

Different forms of teaching will be used to reach the objectives of the course: Direct questions, Quizzes, Discussion and conclusions. Power point presentations

14. Assessment scheme

Exams: There will be two closed book exams given throughout the semester.
Each test will be to take 90 minutes. Each exam carry out 7.5 degrees, they considered = 15%.

Final Exam: The Final Exam is Comprehensive in all course outlines. Carry out 50% degrees of the grade.

Theoretical grade = 65%

Practical grade = 35%

15. Student learning outcome:

The student will learn the phase rules, chemical equilibrium, finding the equilibrium constant for different reactions, in addition to learning the colligative properties of a mixtures

16. Course Reading List and References:

1- P.Atkins, and J.DE Paula. " ATKINS Physical Chemistry "6th edition.
2- IRA N. Levine. "Physical Chemistry" 6th edition.
3- A. Bahl, B.S. Bahl, and G.D. Tuli " Essential of physical Chemistry" .
4- R.A. Alberty, and R.J. Silbey."Physical Chemistry" 2nd edition.

17. The Topics:	Lecturer's name
First week General properties of gases, parameters of a gas, gas laws. Second week Van der Waals equation, liquefaction of gases. Third week Thermodynamic terms, types of thermodynamic systems, thermodynamic processes. Fourth week	Dr.Khozan A. Haji **2 hours**

Nature of heat and work, internal energy. Fifth week First law of thermodynamics, enthalpy of a system. Sixth week Joule-Thomson effect, adiabatic expansion of an ideal gas. Seventh week Thermochemistry. Enthalpy of a reaction, exothermic and endothermic reactions. Eighth week Heat of reaction. Ninth week Heat of combustion, heat of solution, heat of neutralization. Tenth week Hess's law of constant heat summation, bond energy. Eleventh week Second law of thermodynamics. Twelfth week Third law of thermodynamics. Thirteenth week	

Carnot cycle. Fourteenth week Entropy change for an ideal gas, entropy change accompanying change of phase. Fifteenth week Gibb's Helmholtz equations. Clausius-Clapeyron equation. Free energy and work functions van't Hoff isotherm. Fugasity and activity.	

19 Exams

Q1 // Calculate the density of HBr in g/L at 733 mmHg and 46°C. Assume ideal-gas behavior.

Q2 // A sample of 255 mg of neon occupies $3 \times 10^{-3} m^3$ at 122 K. Use the ideal gas law to calculate the pressure of the gas.

Q3 //A sample of zinc metal reacts completely with an excess of hydrochloric acid:

$$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

The hydrogen gas produced is collected over water at 25.0°C. The volume of the gas is 7.80 L,

and the pressure is 0.980 atm. Calculate the amount of zinc metal in grams consumed in the

reaction. (Note: Vapor pressure of water at 25°C is 23.8 mmHg).

Exam 2

Q1 // A) The critical temperature and critical pressure of naphthalene are 474.8 K and 40.6 atm, respectively. Calculate the van der Waals constants a and b for naphthalene.

(12M

B) Three moles of an ideal gas are compressed isothermally from 60 L to 20 L using a constant pressure of 5 atm. Calculate q, w, and ΔE.

(13M

Q2 // A) A sample of ammonia NH_3 gas is completely decomposed to nitrogen and hydrogen gases over heated iron wool.($NH_{3(g)} \longrightarrow \frac{1}{2}N_2 + \frac{3}{2}H_2$). If the total pressure is 866 mmHg, calculate the partial pressures of N_2 and H_2.

(12M)

B) If $\left(ds = \frac{dq}{T}\right)$ and $(dE = nC_v dT)$ prove that ($\Delta S = nC_v \ln\frac{T_2}{T_1} + nR\ln\frac{V_2}{V_1}$)

(13M)

Q3// A) Calculate the enthalpy change for the reaction:

(12M)

$$C_2H_{4(g)} + H_{2(g)} \longrightarrow C_2H_{6(g)}$$

Using the following combustion data

$$C_2H_{4(g)} = -1401\ kJ \quad , C_2H_{6(g)} = -1550\ kJ\ , H_{2(g)} = -286\ kJ\ .$$

B) A sample of carbon dioxide of mass 2.45 gat 27.0°C is allowed to expand reversibly and adiabatically from 500 cm^3 to 3.00 drn^3. What is the work done by the gas?

($\gamma = 1.3$)

(13M

Q4// Calculate the change in molar entropy of aluminum that is heated from 600 to 700 C. The melting point of aluminum is 660 ºC, the heat of fusion is 393 J/g , and the heat capacities of the solid and the liquid may be taken as 31.8 and 34.4 J/(K.mol) , respectively.

(25M

Atomic weights (g/mole): C=12, H=1, N=14, O=16, Al=27

20. Extra notes:

21. Peer review