THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE

Department of Chemistry

CHE 205 – Physical Chemistry I

COURSE PARTICULARS

Course Code: CHE 205
Course Title: Physical Chemistry I
No. of Units: 2
Course Duration: Two hours of theory and three hours of practical per week for 15 weeks.
Status: Compulsory
Course Email Address: che504@futa.edu.ng
Course Webpage: http://www.che.futa.edu.ng/courseschedule.php?coursecode=CHE%20504
Prerequisite: CHE 101

COURSE INSTRUCTORS

Dr. A. F. Aiyesanmi
Room 3, CHE Lab II,
Dept. of Chemistry,
Federal University of Technology, Akure, Nigeria.
Phone: +2348033501293
Email: afaiyesanmi@futa.edu.ng

Dr. A. O. Adetuyi
Room 15, SOS Adamu Office Complex,
Dept. of Chemistry,
Federal University of Technology, Akure, Nigeria.
Phone: +2348033801359
Email: *aoadetuyi@futa.edu.ng*

Dr. A. E. Okoronkwo
Chemistry Laboratory I
Dept. of Chemistry,
The Federal University of Technology, Akure
Phone: +2348034047318
E-Mail: aeokoronkwo@futa.edu.ng

Dr. E. F. Olasehinde,
Obakekere Laboratory Office,
Department of Chemistry,
The University of Technology, Akure.
Phone: +2348162003356.
E-Mail: efolasehinde@futa.edu.ng

Mr. W. B. Tomori,
School of Sciences Building,
The Ground Floor Offices,
Department of Chemistry,
The Federal University of Technology, Akure.
Phone: +2348036710443
Email: *wbtomori@futa.edu.ng*

COURSE DESCRIPTION

This course provides opportunity for students of Chemistry, biochemistry, microbiology, engineering, food science and technology and geology to collect the appropriate data required to define the properties of gases, liquids, solids and colloidal dispersions, to systematize them into laws, and give them a theoretical foundation. The course is also useful in establishing the energy relations obtaining in physical and chemical transformations, in ascertaining the extent and speed with which they take place, and in defining quantitatively the controlling factors. Topics to be covered include Kinetic theory of gases; behaviour of real gases; critical constants and liquefaction of gases; heat capacities of gases; principle of equipartition of energy; first and second laws of thermodynamics; enthalpy, entropy and free energy; reaction and phase equilibria; reaction rates; rate laws; zero, first and second order kinetics; experimental determination of reaction orders; mechanism and theory of elementary processes; photochemical reactions; basic electrochemistry.

COURSE OBJECTIVES

The objectives of this course are to:

- introduce students to the theory and laws guiding the behaviour of gases and the deviation of real gases from ideal gases;
- teach students on the application of physical changes to liquefaction of gases;
- introduce students to the concept of the first and second laws of thermodynamics and their applications;
- introduce students to reaction kinetics and rate laws;
- introduce students to phase equilibria and provide them with opportunities to appreciate the existence of phase equilibria in their surrounding and develop basic skills in separating/ handling them.
- introduce students to basic electrochemistry, which involves the identification of different electrochemical cells, mode of reactions and interaction of different cells.
- provide students with opportunities to understand the set-up and arrangement of electrochemical and electrolytic cells

COURSE LEARNING OUTCOMES / COMPETENCIES

Upon successful completion of this course, the student will be able to:
(Knowledge based)

- know the theory and laws guiding the behaviour of gases;

- understand the reasons and conditions for deviation of real gases from ideal behaviour;
- explain the process of liquefaction of gases;
- understand thermodynamic principles and heat energy calculation in chemical systems;
- Explain reaction kinetics, order of a reaction and application of reaction rate laws;
- Understand the importance of phase equilibria in nature;
- Explain some natural phenomenon based on phase diagram;
- Identification of different types of electrochemical/electrolytic cells;
- Explain how to set-up different types of cell, for specific purpose, with necessary component to be put in place;

(Skills)

- solve mathematical problems involving gas behaviour:
- solve mathematical problems in thermodynamics and reaction kinetics
- separate/purify liquids-in –liquids;
- calculate the potential difference of cells;

GRADING SYSTEM FOR THE COURSE

This course will be graded as follows:

Practical	20%
Assignments	10%
Test(s)	10%
Final Examination	60%
TOTAL	**100%**

GENERAL INSTRUCTIONS

Attendance: It is expected that every student will be in class not latter than 15 minutes after commencement of lectures. Attendance records will be kept and used to determine each person's qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible, indicating the reason for the absence.

Academic Integrity: Violations of academic integrity, including dishonesty in assignments, examinations, or other academic performances are prohibited. You are not allowed to make copies of another person's work and submit it as your own; that is plagiarism. All cases of academic dishonesty will be reported to the University Management for appropriate sanctions in accordance with the guidelines for handling students' misconduct as spelt out in the Students' Handbook.

Practical and Assignments: Students are expected to submit practical notes and assignments as scheduled. Failure to submit an as at when due will earn you zero for that assignment.

Code of Conduct in Lecture Rooms and Examination Hall: Students should turn off their cell phones or at most put on silence during lectures. They should not be brought into the examination hall. Food and drinks are not permitted in the laboratories.

READING LIST

[4]Mortimer R.G. (2008). Physical Chemistry, 3rd Ed., Elsevier Inc. USA, 1402p.

[1]Gilbert W. C (1980) Physical Chemistry Textbook, 3rd Ed. Addison Wiley Publishing Company

[1]Maron, S.M. and Lando, J.B. (1974). Fundamental of Physical Chemistry Macmillan Publishing Co. New York, 853p

Legend
1- Available in the University Library
2- Available in Departmental/School Libraries
3- Available on the Internet.
4- Available as Personal Collection
5- Available in local bookshops.

COURSE OUTLINE

Week	Topic	Remarks
1	Review of gas laws; Kinetic theory of gases and quantitative treatment of the kinetic theory of gases; Deductions from the kinetic theory	Laws governing the behaviour of gases (Boyle's, Charles; Avogadro's etc) will be reviewed. Also to be treated is the kinetic theory postulates, quantitative treatment and deduction of molecular velocity of gases. During practical class, students will be introduced to good laboratory practices and data treatment.
2	Deviation of real gases from ideal behaviour: Modification of the the ideal gas equation-Van der Waals' equation of state The critical constants	Reasons and conditions for deviation of gases from ideal behaviour will be discussed; Modification of the ideal gas equation to real situation will be carried out. Practical class will involve laboratory experiments in physical chemistry
3	Liquefaction of gases; Heat capacities of gases; Principle of equipatition of energy	Student will be taught on the conditions and how gases could be liquefied. Heat capacities at constant pressure and volume will be taught. Calculations involving equipartition of energy will also be treated. Practical
4	First Law of Thermodynamics • Thermodynamic terms; Energy and Conservation of Energy; P-V work; Heat Content; Heat Capacities • Heat Capacity Temperature-Relationship; Joule Experiment; • Isothermal & Adiabatic processes, Joule-Thomson Effect	Exercises based on the topics will be solved in the class. Students will be encouraged to actively participate in the class discussion. Practical
5	Second law of Thermodynamics Mathematical statement of the second law: Entropy Free Energy Functions • Properties of Helmholtz and Gibbs Free Energy; • Maxwell Relations; Clausius and Clausius-Clapeyron Equations	Lectures will involve illustrations drawn from day to day activities. Exercises based on the topics will be solved. Practical

6	Introduction to chemical kinetics: • Reaction rate; • Measurement of reaction rate; • Factors affecting reaction rate; • Order and molecularity of a reaction	Students will be introduced to reaction kinetics, reaction rate and their measurement Practical
7	Rate laws; • Zero order reaction and half life; • First order reaction and half life; • Second order reaction and half life • Determination of order of reaction • Dependence of rate of reaction on temperature	Different orders of reaction and half life will be discussed. Application of half life concept to naturally occurring processes will be highlighted. The concept of activation energy in chemical reaction will also be discussed Practical
8	Definition of Phase equilibria and other terms-Phases, components, phase diagrams of some elements, etc.	Students will be introduced to the definition of phase equilibria and phase diagram of some system like water, sulphur etc.
		MID-SEMESTER TEST
9	Multi components mixtures, Ideal and non-ideal solutions & their applications	Students will be taught the practical applications of multi-components mixtures. Practical
10	Introduction of electrochemistry, • types of electrochemical cells(conc. Cell, interference, non interference) • primary cell, secondary cell, fuel cell • electrolytic cells • standard cells(calomel, SHE) • Cell reactions	Differences and their similarities between cll types will be discussed Writing of chemical reactions, identification of different group of cells.) When setting up an electrochemical cell, emphasis will be put on the denotation and connotation pertaining to each cells. Assignment will be giving to the students. Practical
11 -12	Determination of standard electrode potential of a cell. Calculation and principles of solving problems in: • electrochemical cells • Electrolytic cells: • the electrode potential of different cells • Overall potential difference • Energy used by the cells • Nernst equation	The student will be taught the implications and Functions of different principles associated to each type of cell, calculations and solving problems. Class work will be done. Practical

	• Relationship with ΔG, ΔH, ΔS, ΔT, • Fuel cell	
13	Meaning of photochemistry / photochemical Reactions. Laws of photochemistry: • Grotthurs-Draper law • Stark- Einstein law	Student will be introduction to photochemistry, photochemical reactions and laws that governs them. Practical
14	• Criteria for photochemical reactions and Frank-Condon principle. • Jablonski Diagram • Importance of photochemical reactions • Examples of photochemical reactions ➢ Photo addition ➢ Photosynthesis ➢ Photocleavage ➢ photoreduction	The students should be able to taught the importance of photochemistry and some examples of photochemical reactions. Practical
15	Revision	This is the week preceding the final examination. At this time, evaluation will be done to assess how far the students' expectations for the course have been met.