SCHOOL OF PHARMACY AND HEALTH SCIENCES

SEMESTER:	Spring
COURSE:	CHE 2307: Physical Chemistry
LECTURER :	Dr Naumih Noah
CLASS DAYS/TIME:	M/W 9.00 – 10.40AM, 11.00 – 12.40
CLASS VENUE:	PM
CREDIT UNIT:	SC 5 & 6
OFFICE HOURS :	T/R 8.00 – 9.00 AM or on Appointment
CONTACT :	mnoah@usiu.ac.ke

COURSE DESCRIPTION:

The main objective of the course is to teach the student modern theories and techniques in physical chemistry that are applied to many areas of pharmaceutical research and development.

Link to University Mission and Program Learning Outcomes:

1. **1. High order thinking:** The ability to collect, analyze and evaluate information and formulate conclusions. Students develop and demonstrate the ability to think critically, analytically and creatively.
2. **Literacy:** Competence in oral, written, quantitative, and technological skills. Students develop and demonstrate competency in oral and written communication as well as demonstrate scientific, quantitative and technological literacy.
3. **Global understanding and multicultural perspective:** Awareness, knowledge and appreciation of both the diversity and commodity of cultures. Students acquire these perspectives through formal study of languages, history, literature and the arts and through working, studying and living cooperatively in a radically, ethnically, and culturally diverse environment. Further, students acquire an understanding of economic, historical, political, geographic and environmental relationships on a global basis.

4. **Preparedness for career:** Mastery of a field of knowledge and its multi-cultural and multinational application. Such mastery is accomplished through both formal study and various experienced forms of learning such as internships and field experiences.
5. **Community service and development***:* A sense of being part of a community and a desire to be of service to it. Students are given opportunities to participate in community service, citizenship, or social action projects or activities.
6. **Leadership and ethics***:* As part of their growth and development, students formulate and articulate the ethical standards which will guide their professional and personal lives. This is accomplished through formal courses in discipline areas and active engagement of students in leadership roles both inside and outside the classroom.

Program Learning Outcomes

By the end of their training the graduates should be able to:

1. Plan, organize and control the manufacturing, compounding, packaging and quality of pharmaceutical products.
2. Plan, organize and manage the procurement, storage and distribution of pharmaceutical materials and products.
3. Interpret and uphold the laws, regulations and ethics that govern the practice of pharmacy.
4. Provide pharmacist-initiated care to patients and ensure the rational use of medicines.
5. Provide information, advice and education on disease, health, community health and medicines-related issues.
6. Participate in pharmaceutical and medical research and evaluate critically new therapies and current advances in formulation and modes of drug action to ensure the optimal selection and use of medicines.

Course Learning Outcomes:

Upon completion of this course, students should be able to:

1. Describe the procedures and instrumental methods applied in analytical and practical tasks of physical chemistry;
2. Discuss the rates of reactions
3. Describe the chemical and physical equilibrium;
4. Explain redox reaction and electrochemical principles as used in physical chemistry,

5. Use the knowledge of physical chemistry in solving some chemical problems in pharmaceutical formulations;
6. State the role of physical chemistry in the chemical and pharmaceutical sciences;
7. Explain the professional and safety measures to be taken when working with physical systems;

COURSE CONTENT

WEEK	TOPIC	Activity	Learning outcomes	READING

Week 1	• Role of chemistry to pharmacy
	• Physical properties of drug molecules
	• States of matter
	  • Liquids
	  • Solid
	  • Gases
	• Gaseous state
	  • The gas laws
	  • The pressure-volume relationship (Boyles law)
	  • The temperature –volume relationship (Charles's law)
	  • The quantity-volume relationship (Avogadros Law)
	  • The equation of state and the ideal gas equation (Gas constant R)
		Lectures and Class Discussion and class exercise	1,5	Ebbing and Gammon Pages 175 – 209
				Atkins Pages 3-28

Week 2	• Gaseous state
	  • The quantity-volume relationship (Avogadros Law)
	  • The equation of state and the ideal gas equation (Gas constant R)
	  • Mixture of gases: Dalton's law of partial pressure.
	  • The kinetic molecular of theory of ideal gases
	  • Application to pharmacy
		Lectures, Discussion and Class Exercise	1,2,5	Ebbing and Gammon Pages 175 – 209
				Atkins pages 3-28

Week 3	• Rates of Reactions • **Individual Assignment 1** • **Practical 1: Physical and Chemical Changes**		1,2,4	Ebbing and Gammon Chapter 13

Week 4	• Chemical Equilibrium
	  o Introduction
	  o The concept of equilibrium
	  o The magnitude of equilibrium constants
		Lecturers, Class Discussion	1,2,5,6,7	Ebbing and Gammon Pages 582-591
				Atkins pages

	○ The direction of the chemical equation • **Quiz 1** • **Practical 2: Determination of the Value of K_c and the Reaction of Ethanol with ethanoic acid**			3-28 Daniel C Harris pages 119 - 144
Week 5	• Chemical Equilibrium • Relationship between K_c and K_p • Approach to equilibrium • Heterogeneous equilibrium • Factors influencing equilibrium concentration • **Practical 3: Solubility Curve of a salt**	Lecturers, Class Discussion	1,2,5,6,7	Ebbing and Gammon Pages 594-609 Atkins pages 3-28 Daniel C Harris pages 119 - 144
Week 6	• **Chemical Equilibrium** ○ Acid base equilibrium • **Group Assignment 1** • **Practical 4: Determination of the Effect of Various Influences on the Position of Equilibrium** •	Lectures, Class Discussion and	1,2,3,5,6	Ebbing and Gammon Pages 653-682 Atkins pages 3-28 Daniel C Harris pages 161 - 211
Week 7	**Mid Semester Exam**			
Week 8	• **Physical Equilibrium** • Introduction • Liquid-vapor equilibria • Raoult's law • Positive deviation • **Practical 5: The Triple point of water**	Lectures, Class Discussion	1,2,3,5	Ebbing and Gammon Pages 175 – 209 Atkins pages 3-28
Week 9	• **Physical Equilibrium** • Immiscibility • Partition of solutes between two immiscible solvents **Make up Practical**	Lectures, Class Discussion	1,2,3,5,7	Ebbing and Gammon Pages 175 – 209 Atkins pages 174-191
Week 10	• **Thermodynamics** • Energy and Its Units • Heat of Reaction • Enthalpy and Enthalpy Changes • Thermochemical Equations • Applying Stoichiometry to Heats of Reaction • **Practical 6: Hess Law of Constant**	Lectures, Class Discussion and	1,2,3,5	Ebbing and Gammon Pages 731-741 Atkins pages 174 -191

	Heat Summation • **Individual assignment 2**			

Week 11	• **Thermodynamics**
	  • Measuring heats of reaction
	  • Hess's Law
	  • Standard Enthalpies of Formation
	  • Kirchoff's law**:** spontaneous changes, Clapeyron, Clausius-Clapeyron and van't Hoff equations,
	• **Practical 7: Redox titration**
	• **Individual Assignment 1 Due**
	• **Group Assignment 2**
		Lectures, Class Discussion and	1,2,3,5,7	Ebbing and Gammon Pages 745 - 755
				Atkins pages 28-56

Week 12	• Redox reactions and electrochemistry • **Quiz 2** **Group 2 Assignment Due**	Lectures, Class Discussion,	1,3,5,7	Ebbing and Gammon Pages 144-151 , 771-780 Daniel C Harris pages 306 - 338 Atkins pages 216-224
Week 13	**Final Semester Exam**			
Week 14	**Practical Exam**			

TEACHING METHODOLOGY:

1. Lectures, using power point presentations and class discussions.
2. Lectures will be given in class to explain to students various topics in basic inorganic chemistry.
3. Lectures will take a participatory approach where the instructor will involve students by frequently asking them questions that are meant to keep them alert and trigger class discussions.
4. **Laboratory learning and Experiments:** The lecturer, together with the laboratory technical staff, will take the students through practical sessions, beginning with **demonstrations**. The students will thereafter be expected to use pre formulated laboratory manuals to carry out various practical exercises then write out their findings in their laboratory workbooks.

5. **Video demonstrations and/or CD-Roms** on Physical Chemistry when available, after the relevant topic has been covered.
6. **Assignment criteria:** Students will be given several individual or group research assignments on topics relevant to the course. These could include lectures, discovery learning, problem-based learning, experimental learning, group-based learning, independent studies and e-learning.
7. The instructor will also be free to answer questions from students in the course of the lectures.

COURSE EVALUATION

Class attendance	10%
Individual assignments	10%
Practical Reports	10%
Weekly Tests	5 %
Practical Exam	10%
Quizzes	10%
Mid-Semester Exam	20%
Final Exam	25%
Total	100%

Note: **seven absences** from class will result to an automatic **grade F.**
Assignments must be handed in on the due dates shown.

REFERENCE BOOKS
Course Text
General Chemistry by Darell Ebbing and Steven Gammon, 9th or 10th Edition.
(ebook)
Quantitative Chemical Analysis by Daniel C Harris
Physical Chemistry by Atkins

GRADING

A	90-100
A-	87-89
B+	84-86
B	80-83
B-	77-79
C+	74-76
C	70-73
C-	67-69
D+	64-66
D	62-63
D-	60-61

F	0-59