CHEM 102 – ENGINEERING CHEMISTRY II

Course Code	Course Name			Semester	
CHEM 102	ENGINEERING CHEMISTRY II			Fall ☒ Spring ☐ Summer ☐	
Hours				Credit	ECTS
Theory	Practice	Lab		2	3
2	0	0			

Course Details	
Department	Nanotechnology Engineering
Course Language	English
Course Level	Undergraduate ☒ Graduate ☐
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☒ Elective ☐
Course Objectives	The aim of this course is to provide students with a deeper understanding of chemical systems, emphasizing thermodynamics, chemical equilibrium, kinetics, and the chemistry of elements. It will enable students to analyze real-world chemical phenomena, apply quantitative reasoning, and understand the role of chemistry in living systems and industrial applications.
Course Content	This course covers entropy and Gibbs free energy to understand why reactions occur; properties of solutions; chemical equilibrium; acids and bases; acid–base equilibria; solubility and complex-ion equilibria; reaction rates and chemical kinetics; main-group elements in Groups 1, 2, 13, 14, 15, 16, 17, and 18; transition elements; complex ions and coordination compounds; nuclear reactions; and the role of chemistry in living systems.
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☒ Discussion ☒
Prerequisites/ Corequisites	CHEM 101
Work Placement(s)	No

Textbook/References/Materials
Main Textbook: Petrucci, R.H., Herring, F.G., Madura, J.D., Bissonnette, C. (General Chemistry: Principles and Modern Applications), Pearson Education, 12th edition. **Supplementary References:** - Zumdahl, S.S., Zumdahl, S.A. (Chemistry) - Chang, R., Goldsby, K. (Chemistry) - Atkins, P., Jones, L. (Chemical Principles)

Course Category				
Mathematics and Basic Sciences	☒		Education	☐
Engineering	☒		Science	☒
Engineering Design	☐		Health	☐
Social Sciences	☐		Profession	☐

Weekly Schedule

No	Topics	Materials/Notes
1	**Spontaneous Change- Entropy and Gibbs Free Energy:** Entropy, 2nd Law of Thermodynamics, ΔG, spontaneity	Chapter 13
2	**Solutions and Their Physical Properties:** Concentration units, colligative properties, vapor pressure	Chapter 14
3	**Chemical Kinetics I:** Reaction rates, rate laws, experimental data analysis	Chapter 15
4	**Chemical Kinetics II:** Mechanisms, rate-determining steps, Arrhenius equation	Chapter 15
5	**Principles of Chemical Equilibrium:** K_eq, Q, Le Chatelier's Principle, equilibrium calculations	Chapter 16
6	**Acids and Bases:** Strong/weak acids-bases, pH, buffers, titrations	Chapter 17,18
7	**Solubility and Complex-Ion Equilibria:** Ksp, common ion effect, selective precipitation, complex ions	Chapter 19
8	**Midterm Exam**	
9	**Main-Group Elements I – Groups 1, 2, 13, and 14:** Periodic trends, reactivity, oxides, hydrides	Chapter 21
10	**Main-Group Elements II – Groups 15, 16, 17, 18, and Hydrogen:** Oxoacids, halides, allotropes, redox behavior	Chapter 22
11	**Transition Elements:** Properties, Oxidation States, and Applications	Chapter 23
12	**Complex Ions and Coordination Chemistry:** Ligands, geometries, nomenclature, crystal field theory	Chapter 24

13	**Nuclear Chemistry –** Radioactivity, decay types, half-life, nuclear reactions	Chapter 25
14	**Chemistry of Biological Molecules:** Carbohydrates, proteins, nucleic acids, chemical structure	Chapter 28
15	**Review and Exam Preparation**	
16	**Final Exam**	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance		
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize	2	10%
Homework		
Presentation / Seminar		
Project		
Report		
Seminar		
Midterm Exam	1	40%
Final Exam	1	50%
	Total	**100%**
Contribution of Midterm Studies to Success Grade		50%
Contribution of End of Semester Studies to Success Grade		50%
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	14	2	28
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time	14	1	14
Quiz/Studio/Criticize	2	4	8
Homework			
Presentation / Seminar			
Project			
Report			
Midterm Exam and Preparation for Midterm	1	10	10
Final Exam and Preparation for Final Exam	1	15	15

Total Workload	**75**
Total Workload / 25	**75/25**
ECTS Credit	**3**

Course Learning Outcomes	
No	**Outcome**
L1	Explain thermodynamic concepts such as entropy and Gibbs free energy
L2	Analyze chemical equilibria including acid-base, solubility, and complex-ion equilibria
L3	Interpret and predict reaction rates and mechanisms using chemical kinetics
L4	Describe chemical and physical properties of main-group and transition elements
L5	Apply chemical principles to biological systems and nuclear chemistry

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**	**Total**
L1	5	4	1	2	2	1	1	2	1	1	1	
L2	5	5	2	3	4	2	2	2	1	1	2	
L3	5	5	2	3	4	2	2	2	1	1	2	
L4	5	4	2	2	2	2	2	3	1	1	2	
L5	5	4	2	3	3	2	2	3	1	2	4	
											Total	