1. **Course number and name - CHBE 2100 – Chemical Process Principles** ***(required)***

2. **Credits and contact hours** – 3 Credit hours, 3 Lecture hours

3. **Instructor's or course coordinator's name -** Dr. Christian Cuba-Torres

4. **Textbook, title, author, and year**
   Elementary Principles of Chemical Processes; Felder, Rousseau and Bullard; 4th ed.; John Wiley & Sons; 2016.

5. **Specific course information**
   a. **Catalog Description -** Material and energy balances for single-phase and multiphase process common to chemical engineering. Phase equilibrium and analysis of reacting systems.
   b. **Prerequisites or co-requisites** – CHEM 1310 or CHEM 1211K General Chemistry; MATH 1551 (minimum grade "C")
   c. **Required, elective, or selected elective course** (as per Table 5-1) – Required

6. **Specific goals for the course**
   a. **Specific outcomes of instruction**:
   By the end of this course, a student should be able to:
      1) Identify and understand the unit operations involved in a process, draw flowcharts, and develop relationships between process variables.
      2) Perform simple degree-of-freedom analysis to identify the number of unknowns relating to mass, mass flow rate, composition and energy, and develop the linearly independent mass and energy balances needed to determine unknown quantities.
      3) Solve for the unknown variables using fundamental laws, empirical relationships, and available data.
      4) Write simple phase equilibrium relationships (e.g. Raoult's and Henry's Laws) and use phase diagrams.
      5) Extract data for pure compounds and mixtures from tables, charts, graphs, or phase diagrams and estimate these through theoretical or empirical equations.
      6) Apply ideal gas rule and equations of state for real gases.
      7) Use solubility data, miscibility charts, and phase relationships to calculate equilibrium composition of multiphase multi-component systems.
      8) Apply the First Law of Thermodynamics to perform energy balances on steady-state non-reactive and reactive processes.
      9) Determine enthalpy and internal energy changes associated with changes in temperature, pressure, mixing, phase change, and chemical reaction from appropriate heat capacities, heats of solution, latent heats, and heats of formation or combustion.
      10) Solve materials and energy balances simultaneously on chemical process systems.
      11) Extract thermodynamic information from Steam Tables.
      12) Illustrate application of mass and energy balances to biological system.

b. Connection with Student Outcomes

CHBE 2100							
	Student Outcomes						
Course Outcomes	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Course Outcome 1	**X**						
Course Outcome 2	**X**						
Course Outcome 3	**X**	**X**					
Course Outcome 4	**X**					**X**	
Course Outcome 5	**X**					**X**	
Course Outcome 6	**X**						
Course Outcome 7	**X**					**X**	
Course Outcome 8	**X**						
Course Outcome 9	**X**					**X**	
Course Outcome 10	**X**	**X**				**X**	
Course Outcome 11	**X**					**X**	
Course Outcome 12	**X**	**X**					

Student Outcomes

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

(3) an ability to communicate effectively with a range of audiences

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

7. **Brief list of topics to be covered**
   a. Introduction to Engineering Calculations: Units and dimensions, Numerical calculations and estimations, Process data representation
   b. Process and Process Variables
   c. Fundamentals of Material Balances: Process classification, General balance equation, Reactive processes
   d. Single Phase System: Ideal gases, Equation of state for non-ideal gases
   e. Multiphase Systems: Phase equilibrium, Gas-liquid systems, Solid-liquid systems, Liquid-liquid systems
   f. Energy Balances: Closed and open systems, Energy balance equations, Tables of thermodynamic data
   g. Energy Balance on Nonreactive Processes: Change in pressure and temperature, Phase change
   h. Energy Balance on Reactive Processes: Heats of mixing and solution, Heats of reaction, Heats of formation
   i. Transient Material and Energy Balances