1. **Course number and name - CHBE 4300 – Kinetics and Reactor Design *(required)***

2. **Credits and contact hours** - 3 credit hours, 3 lecture hours (3-0-0-3)

3. **Instructor's or course coordinator's name -** Dr. Michael Filler

4. **Textbook, title, author, and year**
   Fogler, "Elements of Chemical Reaction Engineering," 5th Ed. Prentice Hall, 2016

5. **Specific course information**
   a. **Catalog Description –** Reacting systems are analyzed in terms of reaction mechanisms, kinetics, and reactor design. Both homogeneous and heterogeneous reactions are considered.
   b. **Prerequisites or co-requisites** –CHBE 3130 Chemical Engineering Thermo II (grade "C" or better); CHBE 3200 Transport Phenomena I (grade "C" or better); CHBE 3210 Transport Phenomena II (pre-requisite with concurrency).
   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) Analyze reaction mechanisms for homogeneous & heterogeneous reactions and develop kinetic rate expressions for the reactions.
      2) Develop microscopic and macroscopic mass and energy balances for various reactor types and identify the initial and boundary conditions
      3) Discern reaction kinetics by analyzing data from a variety of reactor types
      4) Design ideal isothermal reactors
      5) Design non-isothermal reactors by accounting for the heat effects (endothermic or exothermic reactions) as well as non-adiabatic reactor configurations
      6) Analyze RTD (residence time distribution) data to identify non-idealities in reactor configurations and utilize this information to predict reactor performance
      7) Analyze for the role of transport effects in isothermal heterogeneous reactions.

   b. **Connection with Student Outcomes**

CHBE 4300							
	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**	**X**				**X**	
Course Outcome 7	**X**	**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. Reaction Thermodynamics
      1) Heat of reaction effects
      2) Reaction free energy and equilibrium constant
      3) Effect of pressure and temperature on equilibrium conversion
   b. Theories and Mechanisms of Homogeneous Reactions
      1) Bimolecular collision theory and Transition state theory
      2) Reaction intermediates and Bodenstein steady-state approximation
      3) Chain and non-chain reactions
      4) Kinetic rate expressions derived from reaction mechanisms
      5) Michaelis-Menten kinetics
   c. Definitions of Rate and Design Equations in Different Reactor Types
      1) Mass balances around ideal homogeneous reactors
      2) Fractional conversion as a design variable in single reactions
      3) Integration of kinetics into the reactor design equation
      4) Graphical interpretation of reactor design equations
   d. Multiple Reactions in Homogeneous Reactors
      1) Series vs. parallel reactions
      2) Yield and selectivity in multiple reactions
      3) Reactor design considerations
   e. Non-isothermal Homogeneous Reactor Design
      1) Energy balances around non-adiabatic reactors
      2) Numerical vs. graphical approach to reactor design
      3) Multiple reactions in a non-isothermal reactor
   f. Non-idealities in Homogeneous Reactors
      1) Residence time distribution (RTD)
      2) Segregated flow model
      3) Axial dispersion model
      4) CSTR's in series model
   g. Heterogeneous Reactions
      1) Reaction mechanisms
      2) Langmuir-Hinshelwood kinetics
      3) Catalyst structure and transport
      4) Single pore diffusion model
      5) Thiele modulus and catalyst effectiveness factor