1. **Course Number and Name:** CHBE 440 - Chemical Engineering Kinetics

2. **Credits and Contact Hours:** 3 Credits

3. **Instructor's Name:** Srinivasa R. Raghavan

4. Textbook and Other Materials

Elements of Chemical Reaction Engineering, 5th edition (Recommended)
by H. Scott Fogler, Prentice Hall, 2016.

All lectures given on Powerpoint

5. Specific Course Information

Catalog Data

Fundamentals of chemical reaction kinetics and their application to the design and operation of chemical reactors. Isothermal and non-isothermal reactor operation. Bioreactors for cell growth. Kinetics of gas-phase catalysis by solid particles and enzyme-mediated catalysis. Kinetics of thin film deposition by CVD. Mass transfer limitations on kinetics.

Class Schedule

MWF.....2:00 pm - 2:50 pm (Lecture)
W.....1:00 pm -1:50 pm (Discussion)

6. Specific Goals for the Course

Course Objectives

1. To provide students a fundamental understanding of chemical kinetics and rate laws.
2. To develop the fundamental skills in students to design isothermal chemical reactors.
3. To introduce students to the design of non-isothermal chemical reactors.
4. To introduce students to catalysis and to the effects of mass transfer on reaction kinetics and reactor design.

Contribution of the Course to Meeting Professional Component

Every chemical engineer must acquire a sufficient knowledge of chemical kinetics and must be able to use this knowledge to design chemical reactors and process units. From an industrial

standpoint, the kinetics course is the most critical to process design. In the process of learning reactor design, students also clearly see the strong connection between engineering principles, process economics, and safety considerations.

Relationship of Course to Program Objectives

This course teaches the students some of the most important fundamentals in chemical engineering and the use of these fundamentals in the step-by-step design of engineered systems and processes. The ABET objectives most relevant to this course are a, c, and e.

7. List of Topics Covered

1. Basics of chemical kinetics, rate laws, rate constant, Arrhenius theory
2. Kinetic mechanisms in terms of elementary reactions and their corresponding rate laws
3. Design equations for batch, continuous stirred tank (CSTR) and plug flow (PFR) reactors
4. Design of reactors in series
5. Reactor design for variable density reactions
6. Unsteady state operation of continuous reactors, semi-batch reactors
7. Design of bioreactors for cell growth
8. Design of reactors for multiple reactions in series or parallel
9. Non-isothermal reactor design for batch, CSTR, PFR
10. Adiabatic reactors and the adiabatic temperature rise
11. Multiple steady states in non-isothermal CSTRs
12. Basics of catalysis and heterogeneous gas-solid reactions
13. External mass transfer limitations on reaction kinetics for nonporous catalysts
14. Pore diffusion limitations on reaction kinetics for porous catalysts
15. Design of catalytic converter, packed bed reactor in mass transfer-limited regimes
16. Mass transfer effects on the kinetics of thin film deposition by CVD processes
17. Basics of enzyme catalysis and Michaelis-Menten kinetics

Prepared by: Srinivasa R. Raghavan **Last revised:** September 1, 2016