CHE 565
Nonlinear Dynamics in Chemical & Biochemical Systems
First Semester 2013 – 2014 (Term 131)

Instructor:
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Office Hours: UT: 3:00-4:00 PM

Objective: Study elementary concepts of the dynamics of chemical and biochemical systems. Understand steady-state multiplicity as well as chaotic and periodic behaviors observed in chemistry as well as chemical and biochemical engineering processes.

Case studies:
- population dynamics: Logistic equation, Lotka-Volterra predator-prey mechanism,
- Oscillating Chemical Reactions: Brusselator and Oregonator,
- Lorenz and Rössler attractors,
- adiabatic and nonadiabatic CSTRs,
- fermenters,
- enhanced distillation (reactive and extractive distillation columns, residue curve maps) …

Prerequisites: Graduate Standing
Syllabus CHE 565 Fall 2013

Outcomes:
Upon successful completion of this course, students will be able to:

1) Solve analytically and numerically linear and nonlinear systems of ODEs related to Chemical and Biochemical systems.

2) Find multiple steady-states and discuss their stability.

3) Use concepts and tools of nonlinear dynamics such Hopf bifurcation, limit cycle, bifurcation diagrams, power spectrum, phase-plane plots, period doubling, time-series plots, Lyapunov exponents and Lyapunov functions, linearization and Jacobian matrices…

4) Master computer algebra such as Matlab® and Mathematica© to solve linear and nonlinear systems of algebraic and differential equations, to compute eigenvalues of Jacobian Matrices…

Textbook:


Part II: Hand out: A selection of papers and documents from the scientific literature.

Course Outline:

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<thead>
<tr>
<th>Course Outline</th>
<th>Number of Lectures</th>
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<tr>
<td>Introduction to Nonlinear Dynamics (Part I)</td>
<td>10</td>
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<tr>
<td>Solution of special problems related to chemistry, Biology, Chemical Engineering, Biochemical Engineering using Matlab® and Mathematica© (Part II)</td>
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Mid Term: To be announced

Grading System:

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<tr>
<td>HW Assignments</td>
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<td>Mid Term</td>
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