DE LA SALLE UNIVERSITY – MANILA
COLLEGE OF SCIENCE
Mathematics Department

SYLLABUS

COURSE CODE	MTH673M/D
COURSE TITLE	Mathematics of Chemical Reaction Network
CLASS DAY & TIME	
ROOM	
NAME OF FACULTY	
COURSE CREDIT	3 Units
CONTACT NO. (DEPT)	(02) 536-0270, (02) 524-4611 loc. 420/413
TERM/SCHOOL YEAR	

COURSE DESCRIPTION

The mathematical theory of chemical reaction networks is unique in several ways: it has had good coverage in high impact science journals such as PNAS, Nature and Science, was pioneered and sustained by chemists and chemical engineers over decades until mathematicians started applying it to biological systems over a decade ago and is now emerging as a valuable contribution to Synthetic Biology. Most recently, the application of the "reaction kinetics" paradigm to ecology, epidemiology and the social sciences (via evolutionary game theory) has been proposed. The field has experienced tremendous growth in the last five years, with over 200 research papers in journals in mathematics, biology, chemistry and chemical engineering, physics and computer science.

The entirely new course intends to provide a comprehensive introduction to both the "classical" results (mainly developed by chemical engineers 1972 – 2000) and new developments in the field (since its application to biology in 2001). Important network properties such as multistationarity (existence and number of equilibria), persistence (non-extinction of species) and robustness have been successfully studied using a combination of methods from linear algebra/matrix theory, graph theory, ordinary differential equations/dynamical systems and most recently, algebraic geometry.

PREREQUISITES: Lecturer's consent to be based on the student's knowledge of linear algebra/matrix theory, fundamentals of graph theory and ordinary differential equations. Topological concepts needed, will be covered in short tutorials within the course.

COURSE OBJECTIVES

The students will:

1. Appreciate the"classical"results (mainly developed by chemical engineers 1972 – 2000) and new developments in the field (since its application to biology in 2001).
2. Identify network properties such as multistationarity (existence and number of equilibria), persistence (non-extinction of species) and robustness.
3. Apply mathematical concepts to biological/ecological systems.
4. Seek opportunities for research with mathematical, computational or biological application focus.
5. Exhibit values like:
    - cooperation through group study;
    - honesty by claiming credit only for the work he has done;
    - zeal and seriousness of intent to learn by participating actively in class discussion, doing his homework

COURSE REQUIREMENTS

- Oral Report 20%
- Written Report 10%
- Problem Set 70%

SOURCES

- Feinberg M., *Co p e ncing in Gener inetic Syste s*. Arch. Rat. Mewch. Anal. 49 (1972) 187-194.
- Feinberg M, Horn FJM. *Che ic ech nis structure nd the coincidence of the stoichio etric nd inetic su sp ces*. Arch. Rational Mech. Anal. 66 (1977): 83-97
- Feinberg M, Horn FJM. *Dyn ics of open che ic syste s nd the ge r ic structure of the under ying re ction net or* . Chemical Engineering Science 29 (1977): 775-787.
- Feinberg M. *M the tic spects of ss ction inetics Che ic Re ctor Theory A Re ie* (L. Lapidus, N. Amundson, Eds. Prentice Hall 1977, pp 1-78.
- Feinberg M. *Lectures on Che ic Re ction Net or s* Univesity of Wisconsin 1979.
- Feinberg M. *Che ic osci tions u tip e equi i ri nd re ction net or structure*. In Warren E. Stewart, W. Harmon Ray, and Charles C. Conley, editors, *Dyn ics nd Mode ing of Re cti e Syste s*, pages 59–130. Academic Press, New York, 1980.
- Feinberg M. *Che ic re ction net or structure nd the st i ity of co p e isother re ctors I The deficiency zero nd deficiency one theore s*. Chemical Engineering Science 42 (1987) 2229-2268.
- Feinberg M. *Necess ry nd sufficient conditions for det i ed ncing in ss ction syste s of r itr ry co p e ity*. Chemical Engineering Science 44 (1989): 819-1827.
- Feinberg M. *So e recent resu ts in che ic re ction net or theory In P tterns nd Dyn ics in Re cti e Medi* (eds. R. Aris, D.G. Aronson and H. Swinney). IMA Volumes in Mathematics and its Applications, V. 37, 43-70, Springer Verlag, Berlin 1991.
- Feinberg M. *The e istence nd uniqueness of ste dy st tes for c ss of che ic re ction net or s*." Archive for Rational Mechanics and Analysis 132 (1995): 311-370.
- Feinberg M.

Chair, Mathematics Department

DR. JOSE SANTOS R. CARANDANG VI
Dean, College of Science