Course Syllabus

Department: Science & Technology
Date: Fall 2014

I. Course Prefix and Number: SCI 137

Course Name: CHAOS: The Self-Organizing Universe

Credit Hours and Contact Hours: 4 credit hours - 5 contact hours

Catalog Description including pre- and co-requisites: *supporting data required for grade prerequisite of 'C' or higher.* An innovative introduction to Chaos which brings the new scientific paradigm to the undergraduate curriculum. Starting from geometric fractals describing trees, leaves, and snowflakes the quantitative understanding of fractals is achieved through laboratory exercises including modeling on computers. Relevance of the Chaos theory is explored across scientific disciplines, and extended to non-science areas such as communications, economics, and arts. This course fulfills a science elective course requirement for students whose primary area of study is other than the sciences; however, interested science/mathematics students can take this course as an elective. Prerequisite: High School algebra (Course I) or MAT 097.

Relationship to Academic Programs and Curriculum including SUNY Gen Ed designation if applicable: The primary audience for this course are students pursuing A.A. and A.S. degree in Liberal Arts and Sciences. This course fulfills mathematics/science course requirement for many A.A.S. degrees. A student should verify the appropriateness of this course for her/his program with her/his advisor.

II. Course Student Learning Outcomes: *State the student learning outcome(s) for the course (e.g. Student will be able to identify…)*

Upon completion of the course the student will be able to :

1. Describe the main concepts related to Fractals, Chaos and Self-Organization.
2. Quantify Fractal dimensionality of structures and processes encountered in natural and artificial environments.
3. Evaluate applicability of the theoretical framework across the sciences.
4. Articulate the science of the 'whole' -- in contrast to the reductionist approach wherein objects and processes are broken down in to elemental parts and claim is made that the understanding of the smallest parts is tantamount to the understanding the whole.
5. Demonstrate an ability to relate mathematics to physical reality and vice versa.
6. Assess the limitations of what they know, and be able to seek further knowledge pertinent to the subject matter.
7. Explore and describe the use of these new paradigms in the social sciences, arts and humanities.

College Learning Outcomes Addressed by the Course: *(check each College Learning Outcome addressed by the Student Learning Outcomes)*

x☐ writing	x☐ computer literacy
☐ oral communications	☐ ethics/values

☐ reading ☐ citizenship
x☐ mathematics ☐ global concerns
x☐ critical thinking ☐ information resources

III. Assessment Measures (Summarize how the college and student learning outcomes will be assessed): *For each identified outcome checked, please provide the specific assessment measure.*

List identified College Learning Outcomes(s)	Specific assessment measure(s)
Writing	Student will complete a research paper
Mathematics	Student will complete assignment using mathematical models for fractals and chaos.
Critical Thinking	Student will complete a complex problem solving activity, such as modeling and assessing disaster recovery.
Computer Literacy	Student will use spreadsheet and other software tools to complete assignments.

IV. Instructional Materials and Methods

Types of Course Materials:

1. Books assigned for Book Review & Supplementary Reading
2. Word processor (MS Word) & Spreadsheet program (MS Excel).
3. Supplementary Material: As specified by Instructor.

Methods of Instruction (e.g. Lecture, Lab, Seminar …):

Lecture/Demonstrations, Discussions, Team Activities, Experiments, and Use of Computers.

V. General Outline of Topics Covered:

The course is divided into learning activity units organized as follows:
Drawing, Tabulating and Graphing
Self-Similarity, Fractals, and Chaos
Numerical Iterations
Deterministic Chaos
Control of Chaos *(Advanced Topic)*
The Fractal Dimension
The Mandelbrot Set
Basic Physics
Chaos in Physics
Cellular Automata
Self-Organized Criticality & Complexity
Chaos in Chemistry, Weather, and Geophysics
Relation to Bio Sciences
Bridges to the Social Sciences
Bridges to the Humanities & Arts
Student Research Project: Proposal, Article Reviews, Outline, and Paper

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