ETG 2831 Nature: Intersections of Science, Engineering and the Humanities

Credits: 3 credits

Textbook, title, author, and year: Peter Corning, Nature's Magic: Synergy in Evolution and the Fate of Mankind, Cambridge University Press, 2003 (List: $50)
Melanie Mitchell, Complexity: A Guided Tour, Oxford University Press, 2009 (List $30)

Reference materials:

Daniel Botkin, *Discordant Harmonies: A New Ecology for the 21st Century*, Oxford University Press, 1990. (List: $26, Library: QH75 .B67 1990) *
Nickolas Rose, *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*, Princeton University Press, 2006. (List: $28, Library: R725.5 .R676 2007)
William Eamon, *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture*, Princeton University Press, 1996. (List: $42)
Brian Swimme , Sid Liebes & Elisabet Sahtouris, *A Walk Through Time: From Stardust to Us--The Evolution of Life on Earth*, Wiley, 1999. (List: $30, Library: QH367 .L525 1998) *

Specific course information

Catalog description: This course will focus on the influences of **science** in its endeavor to understand **nature**, engineering, (in its attempts to harness nature), and the humanities, in their role as the shapers of values, through an exciting combination of philosophical readings, penetrating discussions, and computer models and tools. The course enhances students' understanding of human experience through the study of literature, and the use of modern technologies and tools, piques their intellectual curiosity in the complex world in which we live, and helps to guide them in matching their interests to their academic pursuits.

Prerequisites: No prerequisites

Specific goals for the course:

At the completion of this course, each student will be able to
Better understand scientific, engineering, and philosophical views of natural processes from the Big Bang to the 21st Century, including recent theories of complexity in nature and human society.
Articulate theories, challenges, and prospects for nature and human society.
Understand and create models of natural phenomena including population dynamics, predator-prey ecosystems, evolution, social behavior, etc. understanding different models such as deterministic, probabilistic, and cellular automata models.
Compare and contrast the strengths and weaknesses of various models and perspectives.
Consider and reflect upon the ethical and philosophical consequences of the various models.
Consider and reflect upon the implications of the various models, specifically focusing on resultant responsibilities, if any.
Name 10 different kinds of explanation found in science, engineering, business, literature, and law.
Utilize modern software packages to simulate and visualize rather complex systems, relationships, social interdependencies, etc.
Improve teamwork and oral and written communication skills

Brief list of topics to be covered:

We seek to develop in students the ability to formulate simple models in a wide spectrum of natural phenomena by building upon classical modeling techniques. We believe that students who take this course will be better humanists, artists, scientists, nurses, engineers, business men and women, and citizens.

In the first several weeks of this course, students will gain confidence in the use of MATLAB® as a software tool. The MATLAB® tools are widely used for modeling complex systems in business, engineering, economics, biology, health, and many other fields. We will be using the tools for simple exercises in population dynamics. No prior computer experience is assumed. Very detailed step-by-step instructions are provided for every assignment involving the use of software.

Topics covered will include

- Basics of MATLAB programming and use – by example.
- Basic use of a spreadsheet to model relationships and produce a graph – by example.
- Plotting, symbolic number, and lists
- 2-D and 3-D lists and graphics
- Using year-by-year and generation-to-generation differences to show changes over time.

Following the initial tutorials, we will focus on the approaches that have been used and that are presently being used to model natural phenomena, including

- Deterministic analytical models: Malthusian, Verhulst, and Lotka-Volterra
- Probablistic simulation models: Genetic drift.
- Cellular Automata models: game of life.
- Chaos and complexity: Butterfly effect.

A simple homework project is assigned for each of the modeling approaches. Each student will work independently on the homework lab projects to establish their competence with using the computer and the course material on modeling natural phenomena. The goal of the homework labs is to create familiarity and a level of comfort with the use of computers to help make decisions in the real world.

All technical assignments come with complete instructions and can be done at home or in the Lab with the assistance of the instructor.