

# Syllabus & Course Policies

## Time & Location:

Lectures: MWF 10:00-10:50 AM, CB 343.

## Instructor:

Lecturer: **David Murrugarra**, POT 771, (859) 257-4734, murrugarra@uky.edu.  
Office hours: MW 3-4 PM, Tuesdays 11 AM-12 PM, and by appointment.

## Course Overview:

This course will be an introduction to mathematical modeling with a particular focus on mathematical biology. We will sample from a variety of problems and modeling techniques throughout the class. Unlike most math classes, the scope of this class will be more about breadth than depth. We will begin with some classical models such as the logistic and predator-prey models for population growth and the SIR model in epidemiology. The second half of the class will be spent learning about a relatively new but widely popular trend of discrete modeling. In particular, the field of mathematical biology has been transformed over the past 15 years by researchers using novel tools from discrete mathematics and computational algebra to tackle old and new problems. These ideas have impacted a wide range of topics such as systems biology, RNA folding, genomics, infectious disease modeling, phylogenetics, and ecology networks and food-webs. In some cases they have even spawned completely new research areas. This approach is arguably more accessible and appealing to many scientists and engineers, encouraging cross-disciplinary communication and collaborations.

## Student Learning Outcomes:

After completing this course, students will be able to:

1. Understand how models are constructed and analyzed, in a way that contributes biological understanding of the process being studied.
2. Gain expertise with the mathematical tools used in the construction and analysis of these models.
3. Apply the different modeling methods in new contexts to solve unfamiliar problems.

**Course Outline:**

**1. Part I: Continuous Dynamical Systems**

Phase space, attractors, repellors, limit cycles.

Stability analysis.

Bifurcation theory.

Software tutorial: Matlab and XPPAUT.

Applications: p53 network and biochemical reaction networks.

**2. Part II: Boolean Networks**

Wiring diagrams.

Attractors.

Polynomial representation.

Reverse engineering

Network reduction techniques

Software tutorial:

Applications: T-LGL model

**3. Part III: Markov Chains**

The Markov property.

Stationary distributions.

The Perron-Frobenius Theorem

Applications:

**4. Part IV: Probabilistic Boolean Networks**

State transition probabilities.

Steady-state distributions.

Introduction to network control approaches

Applications:

### 5. Part V: Other Applications

RNA secondary structure modeling.

the NNTM model.

#### Grading:

You will be able to obtain a maximum of 500 points in this class, divided as follows:

	<b>Points</b>	<b>Percentage of final grade</b>
<b>Homework</b>	100 points	50%
<b>Class Participation</b>	20 points	10%
<b>Final Presentation</b>	80 points	40%

Your final grade for the course will be based on the total points you have earned as follows:

	<b>Points</b>	<b>Percentage</b>
<b>A</b>	180 - 200 points	90 - 100 %
<b>B</b>	160 - 179 points	80 - 89.9 %
<b>C</b>	140 - 159 points	70 - 79.9 %
<b>D</b>	120 - 139 points	60 - 69.9 %
<b>E</b>	0 - 119 points	0 - 59.9 %

The grading scale might be adjusted at the end of the semester. You will be guaranteed the above letter grade if your score falls within the given range, but the minimum score for each letter grade might be lowered.

*Mid-term grades* will be posted in myUK by the deadline established in the [Academic Calendar](#).

#### Policies:

*Attendance* in MA 320-001 is mandatory. Be on time and remain until dismissed. Do not leave in the middle of class. Whenever possible, please notify your instructor of absences prior to class.

S.R. 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

You may be asked to verify absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request *appropriate verification* when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

If you anticipate an absence for a major religious holiday please notify your instructor (in writing) of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Two weeks prior to the absence is reasonable, but should not be given any later. Information regarding major religious holidays may be obtained through the Ombud (859) 257-3737, [http://www.uky.edu/Ombud/ForStudents\\_ExcusedAbsences.php](http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

**Classroom behavior:**

Electronic devices such as mobile phones, laptops and tablets should be put away or used only as part of class activities during lectures and recitations. Mobile phones, laptops, and computers may not be used during exams.

**Make-up policies:**

Per Senate Rule 5.2.4.2, if you are missing any graded work due to an excused absence you are responsible for informing the Instructor about your excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The instructor will give you an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred. In particular, if you have university excused absences or have university-scheduled class conflicts with uniform examinations you may arrange with their instructor to take the exam at an alternate time. Generally these make-up exams will be scheduled on the day of or on the day after the regularly scheduled exam. Work-related conflicts are neither university excused absences nor university-scheduled absences.

**Students needing accommodations:**

If you have a documented disability that requires academic accommodations, please see your instructor as soon as possible. In order to receive accommodations in this course, you must provide your instructor with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC is located at Suite 407 of the Multidisciplinary Science Building, 725 Rose Street, 0082). Contact David T. Beach, dtbeac1@uky.edu for coordination of campus disability services.

**Accommodations for victims of violence:**

By federal law, any student who is a victim of dating violence, domestic/intimate partner violence, sexual assault, or stalking (whether on or off campus) is entitled to appropriate accommodations for his or her coursework. To get help getting accommodations and other support, students who are assaulted can do any of the following:

1. Tell your instructor who can assist you in accessing resources appropriate to your situation;
2. Call the UK VIP Center (Violence Intervention and Prevention Center) at 257-3574 or vipcenter@uky.edu or [http://www.uky.edu/StudentAffairs/VIPCenter/about\\_contact.php](http://www.uky.edu/StudentAffairs/VIPCenter/about_contact.php); or walk in to the Center in Frazee Hall, lower level, between 8:30 and 5:00;
3. Call the University Counseling Center at 257-8701; 2nd floor, Frazee Hall;
4. Call Ms. Patty Bender from the UK Institutional Equity and Equal Opportunity at 257-8927 or patty.bender@uky.edu;
5. In the case of an emergency, contact the UK Police Department at 911.
6. Students may also contact community resources 24-hours a day, including:
  - a. Bluegrass Rape Crisis Center at 800.656.4673 or <http://bluegrassrapecrisis.org/>.
  - b. Greenhouse17 (formerly Bluegrass Domestic Violence Program) at 800.544.2022 or <http://greenhouse17.org/>.

**Academic Honesty:**

Cheating or plagiarism is a serious offense and will not be tolerated. It will be thoroughly investigated, and might lead to failure in the course or even to expulsion from the university. See

<http://www.uky.edu/StudentAffairs/Code/part2.html>

(Sections 6.3.1 and 6.3.2) for information on cheating, plagiarism, and penalties.

A summary of recent changes to rules on cheating can be found at the Academic Ombud website:

<http://www.uky.edu/Ombud>