MTH 480: Systems of Ordinary Differential Equations
Mathematical Models in Ecology
Spring 2010

Professor: Dr. Vrushali Bokil
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Office Hours: MWF 2:00 pm - 2:50 pm, W 4:00-4:50 pm or by Appt.

Class Time and Room: MWF: 3:00 - 3:50 pm, BAT 250

Class Details: CRN: 53624, Section 001

Website: http://www.math.oregonstate.edu/~bokilv/MTH480S10


Prerequisites: MTH 341 and MTH 256. Please contact me to discuss your background if you do not have the necessary prerequisites.

Course Description:
Mathematical methods are increasingly becoming important in the study of ecological systems. This course will introduce mathematical models for applications in ecology. We will study how differential equations are used to model various ecological phenomenon including population growth, spread of infectious diseases, competition between species and predator prey relationships, among others.

We will mainly focus on systems of two first-order ordinary differential equations. The qualitative analysis of these systems will include the study of phase portraits, linearization and the stability of equilibria, conservative systems, bifurcations, periodic solutions and limit cycles and the Poincaré-Bendixson theorem. ODE software written in MATLAB will be used to demonstrate specific examples.

Syllabus: (Tentative) We will cover material from Chapters 1, 4, 5 and 7 of the class textbook.

- **Week 1**: Single Species Population Models: Exponential and Logistic growth, Qualitative Analysis of Differential Equations.
- **Week 2**: Qualitative Analysis of Differential Equations (cont), Models for Harvesting and Bifurcations, HW1 assigned.
- **Week 3**: Models for Interacting Species, Kolmogorov models and classification into Predator-Prey, Competition and Mutualistic models. Notions of equilibria, stability, nullclines, Lyapunov functions and bifurcations.
- **Week 4**: Linearization and the Qualitative behavior of solutions of Linear Systems, HW1 due, HW2 assigned.
• **Week 5**: Qualitative behavior of solutions of Linear Systems (cont), classification of equilibria in the Trace-determinant plane, and the Hartman-Grobman theorem. HW2 due.

• **Week 6**: Predator-prey models, Midterm.

• **Week 7**: Bendixson and Bendixon-Dulac Negative Criteria, limit cycles and Hopf bifurcations. HW3 assigned.

• **Week 8**: Hopf Bifurcation Theorem, more predator prey models and the Poincare-Bendixson theorem. HW3 due, HW4 assigned.

• **Week 9**: Poincare-Bendixon Trichotomy, Competition models. HW4 due.

• **Week 10**: Basic ideas of Mathematical Epidemiology. Review for final.

• **Finals Week**: Final Exam.

**Assignments and Grading**: The grade for this class will be based on four homework assignments, a midterm and a final exam.

**Course Grading:**

- **HW Assignments**: 40%
- **Midterm Exam**: 25%
- **Final Exam**: 35%

**Midterm**: Friday, May 7, 2010, in BAT 250 at 3:00 pm

**Final**: Friday, June 11, 2010, in BAT 250 at 9:30 am

**Course Grade Scale**: Each letter grade below corresponds to grades scored between the lower limit (including) and less than the upper limit (excluding).

- A: 90 % - 100%
- A-: 87 - 90%
- B+: 84 - 87%
- B: 80 - 84%
- B-: 77 - 80%
- C+: 74 - 77%
- C: 70 - 74%
- C-: 67 - 70%
- D+: 64 - 67%
- D: 60 - 64%
- D-: 57 - 60%
• F: below 57%

**Special arrangements:** For students with Disabilities, make-up exams and other special arrangements, please contact Professor Bokil. For all types of special arrangements appropriate documentation will be required. Course drop/add information is at [http://oregonstate.edu/registrar/](http://oregonstate.edu/registrar/).

Check the class website (given above) for general information and other policies regarding the class.