

ABE 6986: Applied Mathematics in Agriculture & Life Sciences

Spring 2021

Credits: 3

Catalog Description:

Mathematical methods, including regression analysis, graphical techniques, and analytical and numerical solution of ordinary and partial differential equations, relevant to engineering in agriculture and the related sciences.

Pre-requisites/Co-requisites:

MAP2302: *Elementary Differential Equations or equivalent.*

Course Objectives:

- Increase competence with applied math as a tool of science and engineering.
- Discuss complementary structure (physics & math) of theories and models.
- Enhance capability with analytical and numerical procedures.
- Develop appreciation for conceptual foundations for math models.
- Broaden professional ability as Agricultural and Biological Engineers.

Instructor:

Richard V. Scholtz, III

Office location: 107 Rogers Hall

Telephone: 352-294-6704

E-mail address: rscholtz@ufl.edu

Office Hours: MWF 3:00-4:00 PM

Class Materials Required:

Textbook: No official text.

Lecture notes and other handout materials will be provided, as it becomes available, via e-learning at <http://elearning.ufl.edu>, look under ABE6986 in Canvas.

Material Fees: None.

Class Materials Suggested:

Books: Abramowitz, M. and I. A. Stegun. 1965. *Handbook of Mathematical Functions*. Dover Publications, New York. ISBN-10: 0486612724

Riley, K. F., M. P. Hobson, and S. J. Bence. 1997. *Mathematical Methods for Physics and Engineering*. Cambridge University Press, New York. ISBN-10: 0521890675

Spiegel, M. R. 1965. *Laplace Transforms*. Schaum Publishing Co., New York. ISBN-10: 007060231X

Spiegel, M. R. 1968. *Mathematical Handbook of Formulas and Tables*. Schaum Publishing Co., New York. ISBN-10: 0071795375

CoVID-19 Pandemic Statement:

This course for Spring 2021 and the near future will be conducted on-line asynchronously (previously recorded) for lecture periods and synchronously (live) for discussion and laboratory periods.

Recording Statement:

Live class sessions may be audio visually recorded for students in the class to replay and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Illness Statement:

Ill students will be provided with alternative assignments and will be afforded the opportunity of taking an incomplete, both as needed. No failing/non-passing grades will be awarded, unless based on evaluation of the student's accumulative effort from the submission of all required deliverables. Find more information in the university attendance policies.

An effort will be made to provide all lectures via video. If the instructor takes ill prior to the recording of all lectures, all PowerPoint slides will be stored, along with assignment deliverables on a designated storage device remaining in the on-campus office. At which point other faculty will be designated to complete courses.

Students are discouraged from coming to the department unless absolutely necessary. Any student who must visit the department, must review the department's safety protocols, and the EH&S safety protocol video prior to the visit.

Course Outline:

Format:

Basic material highlighted in these notes will be covered in lectures along with additional information. Discussions and questions during class are encouraged.

Supplemental readings will be assigned from time to time. Which are designed to enrich knowledge of and appreciation for applied math and physics.

Extensive homework assignments will be assigned, but not graded. As a graduate level math course, it is incumbent of each student to determine how to achieve mastery of each assigned problem.

There will be three equally weighted examinations, worth 30% each. The problems on the examinations will stem from those assigned as homework. Expect 5 to 8 multiple part problems. Each will be turned in electronically on Canvas by scan or high definition photo.

A computer is an excellent tool, but its operation will not be tested during examinations. As a helpful hint: think first, set up a problem to be solved, then and only then, compute.

The final 10% shall come from a 5-page applied math white paper prepared and the peer reviews conducted by each student.

Timeline:

Lecture	Topics
1	Syllabus, Goals and Objectives – <i>Student Questionnaire</i>
2	Project Description
3	§ 1: Introduction
4	§ 2: Interpretation of Data - § 2.5: Regression Analysis
5	§ 2.5.1: Linear Model - § 2.5.3: Quadratic Model
6	§ 2.5.4 Exponential Model - § 2.5.6: Double Exponential Model
7	§ 2.5.7: Power Law Model - § 2.5.10: Generalized Treatment
8	§ 2.5.11: Standard Error - § 2.5.15: Maximum Likelihood Method
9	§ 2.6: Examples - § 2.6.2: Solute Transport
10	§ 2.6.3: Briggs Haldane Model - § 3.1: Malthus Model
11	§ 3.2: Verhulst-Pearl Model - § 3.3: Lotka-Volterra Model
12	§ 3.3.1: Phase Relationship - § 3.4: Matrix Models <i>*End of First Exam Material</i>
13	§ 4: Mathematics of Heat Transfer - § 4.4: Steady State
14	§ 4.5: Transient Solution - § 4.5.3: Cylindrical Coordinates
15	§ 4.6: Application
16	§ 5: Integral Transforms - § 5.7.1: Continuous Stirred Reactor
17	§ 5.7.2: Series Continuous Stirred Reactors - § 5.7.5: Spring and Damper with Step Input
18	§ 5.7.6: Spring and Damper with a Temporary Force - § 5.7.9: Free Damped Motion
19	§ 5.7.10: Simultaneous Ordinary Differential Equations - § 5.9.2: Convective Transport with Chemical Reaction

20	§ 5.9.3: Chemical Transport with Dispersion, Convection, and Reaction - § 5.9.4: Chemical Transport with Heterogeneous Kinetics
21	§ 5.9.5: Process Analysis of Overland Flow Treatment of Wastewater - § 5.9.7: Chemical Transport Across a Porous Membrane
22	§ 5.9.8: Heat Conduction in a Semi-infinite Conductor - § 5.9.10: Heat Conduction in a Cylinder <i>*End of Second Exam Material</i>
23	§ 5.10: Fourier Transforms - § 5.13: Inverse Laplace Transforms by Integration in a Complex Plane
24	§ 5.14: Applications: Part 4 - § 5.14.1: Overland Flow Treatment of Wastewater
25	§ 5.14.2: Short Hand Procedure for Convective Diffusion - § 5.14.3: Heat Transfer with Insulation and Convection Boundary Conditions
26	§ 5.14.4: Heat Transfer with Insulation and Flux Boundary Conditions
27	§ 5.14.5: Cross Flow Heat Exchanger - § 5.14.6: Electrical Circuit
28	§ 6: Numerical Solutions of Ordinary Differential Equations - § 6.3: Taylor Series Method
29	§ 6.4: Runge-Kutta Method - § 6.6: Simultaneous Equations
30	§ 8.1: Stability and the Method of Singular Perturbation
31	§ 6.6: Application
32	§ 7: Numerical Solutions of Partial Differential Equations - § 7.1: Explicit Method <i>*End of Third Exam Material</i>
33	§ 7.2: Implicit Method - § 7.3.1: Heat Transfer Along a Uniform Conductor
34	§ 7.3.2: Langmuir-Hinshelwood Kinetics - § 7.3.3: Heat Transfer through a Cylinder
35	§ 8.2: Matrix Inversion by the Thomas Algorithm & § 7.3.4: Heat Transfer through a Cylinder with Offset Internal Insulation

Announcement Policy: Students will be held responsible for *all* announcements made in class, which includes *any and all* changes to this syllabus and the course lecture schedule. Students are expected to attend all lectures and any guest speakers scheduled.

Expectations: Attendance is expected. Be professional and show the appropriate courtesy that should represent all University of Florida graduate students. Paying attention, reading the required material, and mastering the problem sets should result in a successful outcome. The student will get out of this course, what they put into it.

Grading:

Grading Policy:

A:	92-100%
A-:	90-91%
B+:	88-89%
B:	82-87%
B-:	80-81%
C+:	78-79%
C:	72-77%
C-:	70-71%
D+:	68-69%

D:	62-677%
D-:	60-61%
E:	< 60%

Make-up Policy: To make-up an unavoidable class period with prior notification the student will be required to attend one additional seminar. Tardiness will be treated similarly. To make up a missing class without prior notification, or excessive tardiness the student will be required to attend three addition seminars (at least one must be outside the department)

Student Course Evaluations:

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

Academic Honesty:

Students will be *strictly held* to the University of Florida's policy on Academic Honesty. Any act of cheating, plagiarism, or any other dishonest act will be prosecuted to the fullest extent. Students should also strive to think and act as professionals. Students should extend all guests professional and common courtesy.

In the process of enrolling and registering for classes at the University of Florida, every student has signed and presumably understands the following statement: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment to academic honesty and understand that failure to comply with this commitment may result in disciplinary action up to and including expulsion from the University." The following information will be placed on examinations. On my honor, I have neither given nor received unauthorized aid on this examination.

Use of Library, Personal References, PC Programs and Electronic Databases:

These items are university property and should be utilized with other users in mind. Never remove, mark, modify nor deface resources that do not belong to you. If you're in the habit of underlining text, do it only on your personal copy. It is inconsiderate, costly to others, and dishonest to use common references otherwise.

Software Use:

All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.

UF Counseling Services:

Resources are available on-campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. These resources include:

1. University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling;
2. Student Mental Health, Student Health Care Center, 392-1171, personal counseling;
3. Center for Sexual Assault/Abuse Recovery and Education (CARE), Student Health Care Center, 392-1161, sexual assault counseling;
4. Career Resource Center, Reitz Union, 392-1601, career development assistance and counseling.

Commitment to a Safe and Inclusive Learning Environment:

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination.

It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind please contact your instructor or any of the following:

Your academic advisor or Graduate Program Coordinator

- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@ufl.edu

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu
