Continuous Mathematical Modeling
MATH 5000/6000

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Office Hours: tentatively via zoom immediately after class and by appointment.

Text: Elementary Differential Equations and Boundary Value Problems, expanded 11th edition, Boyce, Diprima, Meade; the edition with 11 chapters.

A comment about appropriate response to COVID: The COVID-19 pandemic is far from over; Lee County, according to analysis from the Mayo Clinic is now a "Hot Spot." See

https://www.mayoclinic.org/coronavirus-covid-19/map/alabama

The Provost's Office further tells us that, "Given the efficacy of vaccinations, we know they are the most important protection against COVID-19, and all members of our campus community are strongly encouraged to get vaccinated."

The CDC (https://covid.cdc.gov/covid-data-tracker/#county-view?list_select_state=Alabama&data-type=CommunityLevels&list_select_county=1081) tells us:

> Stay up to date with COVID-19 vaccines. Get tested if you have symptoms. Wear a mask if you have symptoms, a positive test, or exposure to someone with COVID-19. Wear a mask on public transportation. You may choose to wear a mask at any time as an additional precaution to protect yourself and others. If you are at high risk for severe illness, consider wearing a mask indoors in public and taking additional precautions.

I plan to wear a mask in class, and I respect students' desire to wear one also. Students who feel that they may have been exposed to illness should wear a mask. I insist that all students maintain social distancing in the classroom, keeping 6 feet between you and your neighbor. I will discuss exceptions to this in class. If at any time during one of the class meetings, you feel an illness coming on, you must put on a mask; if you feel very ill you should leave the classroom. No penalty will be given to any student who needs to leave the classroom for this reason. Students who are feverish or unwell should not attend class but should be tested and follow the advice of their physicians regarding interacting with others and returning to campus. If a student is contagious, the student should contact me immediately, and we will

discuss ways to make up classwork during their quarantine period (assuming that the student is well enough to do so).

Textbook sections: Review sections from chapters 1-3; selected sections from chapters 7, 9 and 10. Topics:

Chapters 1 and 2 and 3 review:
- Modeling with First Order Equations
- Autonomous Equations and Population Dynamics.
- Mechanical and Electrical Vibrations
- Forced Vibrations.

Chapter 7
- Basic Theory of Systems of First Order Linear Equations
- Homogeneous Linear Systems with Constant Coefficients
- Complex Eigenvalues
- Fundamental Matrices

Chapter 9
- The Phase Plane: Linear Systems
- Autonomous Systems and Stability
- Locally Linear Systems
- Competing Species
- Predator--Prey Equations
- Liapunov's Second Method
- Periodic Solutions and Limit Cycles
- Chaos and Strange Attractors: The Lorenz Equations (if time permits)

Chapter 10 (first five topics and selected topics from the remaining three as time permits)
- Two-Point Boundary Value Problems
- Fourier Series.
- The Fourier Convergence Theorem
- Even and Odd Functions.
- Separation of Variables; Heat Conduction in a Rod
- Other Heat Conduction Problems
- The Wave Equation: Vibrations of an Elastic String
- Laplace's Equation (if time permits).

Class Participation and Working in Groups

Students will be expected to present solutions to problems and homework exercises on the blackboard. An integral part of the learning process for any mathematics course is solving mathematics problems. You will be challenged to solve problems and do exercises that you have not seen; my purpose is to develop analytical problem-solving techniques that can be applied to a broad range of real-world problems. Though idealized, the problems assigned for the course mirror problems encountered in science and engineering disciplines. The techniques of mathematics are retained much more firmly if students can discover their own solutions to problems. Students will be

expected to critique other student presentations for understanding and correctness; this is to be done respectfully. Alternate methods of solving problems also add to one's repertoire of problem solving techniques; I encourage students to offer presentations of different techniques for problem-solving. Working in groups is not discouraged (and in fact is often encouraged); students are expected to present their own work on the blackboard and to give credit to other students (or any other outside resource) who (that) have contributed to the solution of the problem they are presenting.

Parameters for Working in Groups

It is unethical to use someone else's work as your own. In working together, each person should start working on a problem or exercise themselves; if you get stuck at some point you might ask "did anyone figure this out?" and accept someone's help (and not a completed solution) in getting over a difficulty. Typically, a new type of problem often needs a "trick" (or more correctly, a new technique) for solution and not everyone will figure out what's needed at the same time. To those who figure out the "trick" - I encourage you to offer hints (this is my own method of helping students) at first rather than offer a complete solution. If one has figured out most of the underlying work then the new technique - whatever gets us over the hurdle - is more firmly remembered. Finally, as mathematicians do, one should properly give credit to one's collaborators for their contributions. When presenting a collaborative solution, credit for the discovery of a new technique should be given to the individual who figured it out. When term projects are handed in, include the names of members of the study group and, where possible, give credit to those who figured out critical techniques and steps.

Grade Calculation

Item		Total Points
Participation grade (includes attendance, blackboard presentations and homework)	20%	U
Short Projects	10 pts each	V
Long Projects	20 pts each	W
Quizzes	10 pts each	X
Tests	20 pts each	Y
Final Exam	50 pts	Z

The standard 10 percentage point scale will be used: 90 to 100 =A; 80 to <90 = B; 70 to < 80 =C; 60 to <70 = D; <60=F.

Calculation of the final grade:

$$G = U * 20\% + ((V+W+X+Y+Z) \div (\text{Total Points possible}))*80\%$$

ACCADEMIC HONESTY: Plagiarism (work presented as your own that is not your own) and giving or receiving aid on exams in whatever form will result in action by the University Honesty Committee. Refer to the Tiger Cub for more specific details.

ABSENCE FROM EXAMS: Refer to the Tiger Cub for a list of acceptable reasons for being absent from an exam, quiz or class. Any absence from the final exam must be cleared with your Dean's office.

Accommodations for Disabilities: Students who require such considerations should make an appointment with me during the first week of classes. Please bring your memo from the Office of Accessibility. If you do not have a memo, it is recommended that you make an appointment with a member of the professional staff in the Office of Accessibility, 1244 Haley Center (844-2096).

Attendance Requirement. Attendance and class participation are a critical part of this course. Students are permitted one unexcused absence. More than one unexcused absence (an excused absence is any University excused absence) will result in percentage points taken off the final grade as follows:

1 missed class results in a total of zero points subtracted,
2 missed classes results in a total of 2 point subtracted,
3 missed classes results in a total of 5 points subtracted,
4 missed classes results in a total of 10 points subtracted,
More than 4 missed classes will result in a grade of "F" assigned for the class.