Math 4381/6378
Symmetry Analysis of Differential Equations

Semester: Spring 2021 CRN 33277/31474
Meeting times: MW 3:00–4:15 pm
Room: MCS 220
Instructor: Dr. Danny Arrigo
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Office location: MCS 201
Office telephone No.: 450–5668
Office hours: MTWR 1-2pm (unless I have a meeting)
Textbook: Symmetry Analysis of Differential Equations - An Introduction
by Daniel Arrigo, publisher Wiley and Sons

Use of cell phones (including texting), MP3 players, web browsers, ear buds/plugs is **NOT ALLOWED during class time**. **Cell phones must be turned off.** Instructor may also disallow use of any other technology not relevant to the instruction. Use of any type of laptop during class time requires consent of the instructor.

Prerequisites
The prerequisite for this course Math 3331 (ODEs) and Math 4315 (PDEs).

Introductory Remarks
The method of symmetry analysis could be possibly viewed as the most powerful method in solving nonlinear differential equations. In the case of ordinary differential equations (ODEs) symmetries can lead to a simplification of the equation (*i.e.* a reduction of the order of the equation) and often leads to the general solution. In fact, all the "special" techniques introduced for solving first order ODEs can be unified by the method symmetry analysis. In the case of partial differential equations (PDEs), symmetry analysis can provide a method for obtaining exact solutions of the given equation. This is particularly important since most physical phenomena modeled by PDEs are typically modeled using nonlinear PDEs in which there are only a handful of techniques for obtaining their exact solutions.

Course Outline
0) Review of first order ODEs and PDEs.
1) Introduction to symmetries, infinitesimal transformations,
2) Symmetries of first order ODEs, standard integration techniques,
3) Finite Lie groups and the infinitesimal operator,
4) Higher order ODEs, systems of ODEs,
5) First order PDEs,
6) Second order PDEs and the heat, wave and Laplace's equation,

7) Nonlinear PDEs (Burgers and Potential Burgers equation),
8) Systems of PDEs (if time permits).

Grades
Your grade for this course will be determined by homework, a test, preliminary research, and a final project. The homework will count 70% of your final grade. There will be one take-home test that will be given around mid-term and will be 20% of your final grade. The remaining 10% of your grade is determined from a final seminar. The objective is to find, understand, and present the results from a research article in the literature. Your group may have no more than two people.

Grade		Grade Scale	
Homework:	70%	90% - 100%	A
Test:	20%	80% - 89%	B
Seminar:	10%	70% - 79%	C
	100%	60% - 69%	D
		0% - 59%	F.

The Project
The project should be chosen based on the student's interest and their possible future research plans. For example, if a student plans on graduate work in acoustics then maybe the topic of the reduced wave equation can be chosen for the project since this equation is commonly used to model sound wave propagation in oceans and atmospheres. Graduate student may use this opportunity to find a possible thesis topic.

Attendance
Attendance is highly recommended. If you are absent for approximately 10% without a valid excuse, where appropriate, you will be dropped from the course. It is a good idea to form small groups to work together in doing homework problems. You will learn from each other and your progress will be more rapid. However, joint work (or copying) during tests and exams is forbidden – the University has an academic dishonesty policy that you can find in the student handbook. Severe penalties apply.

University policy on Academic Integrity and Academic Misconduct
The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the *Student Handbook*. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

Plagiarism
Plagiarism can be defined as the use of someone else's words without proper acknowledgement of that use. If you use someone else's words or the written words of the instructor in the assignment, you must put them in quotations and provide a reference for the source. Paraphrasing the words of others by only changing a few words is also considered plagiarism. For more information about plagiarism, please see UCA's statement on plagiarism at http://uca.edu/academicaffairs/files/2012/08/Plagiarism.pdf. Plagiarism is academic misconduct and will result in appropriate disciplinary action.

The Americans with Disabilities Act statement
The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the UCA Disability Resource Center, 450-3613. If the instructor of this class needs to be informed of your disability in order to assist with any appropriate accommodations, please contact the instructor during the first week of classes.

Building Emergency Plan statement
An Emergency Procedures Summary (EPS) for the building, in which this class is held, will be discussed during the first week of this course. EPS documents for most buildings on campus are available at http://uca.edu/mysafety/bep. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.

The Title IX disclosure
If a student discloses an act of sexual harassment, discrimination, assault, or other sexual misconduct to a faculty member (as it relates to "student-on-student" or "employee-on-student"), the faculty member cannot maintain complete confidentiality and is required to report the act and may be required to reveal the names of the parties involved. Any allegations made by a student may or may not trigger an investigation. Each situation differs and the obligation to conduct an investigation will depend on those specific set of circumstances. The determination to conduct an investigation will be made by the Title IX Coordinator. For further information, please visit: https://uca.edu/titleix. **Disclosure of sexual misconduct by a third party who is not a student and/or employee is also required if the misconduct occurs when the third party is a participant in a university-sponsored program, event, or activity.*

Departmental Policy
Use of cell phones (including texting), MP3 players, web browsers, ear buds/plugs is NOT ALLOWED during class time. Cell phones must be set to silent/vibrant mode while in class. Instructors may also disallow use of any other technology not relevant to the instruction. Use of any type of laptop during class time requires consent of the instructor.

Other Policies
Students should familiarize themselves with all policies listed in the UCA *Student Handbook*, such as the Sexual Harassment Policy and Academic Policies.