MATH-36600 Spring 2022

Course: ORDINARY DIFFERENTIAL EQUATIONS
CRN: 43105, 15974
Time: Section 021 TuTh 9:00 am - 10:15 am, Jan 10, 2022 - Apr 30, 2022
Section 193 TuTh 07:30 am - 08:45 am, Jan 10, 2022 - Apr 30, 2022
Location: University Hall 119
Instructional Modality: Face to Face

Instructor: Yuan GAO
Office hour: TuTh 10:30am-12:30pm (in office + zoom room available) or by Email appointment
Office Location: Math 736
Email: gao662@purdue.edu
Office Phone number: 765-496-0056
MA366 lab: https://www.projectrhea.org/rhea/index.php/MA366_Lab

Description:
Credit Hours: 4.00. An introduction to ordinary differential equations with emphasis on problem solving and applications. The one-hour computer lab will give students an opportunity for hands-on experience with both the theory and applications of the subject.

Texts:
1. Elementary Differential Equations and Boundary Value Problems – 11th Edition, William E. Boyce and Richard C. DiPrima. (This is the textbook the course will follow.)
https://www.lib.purdue.edu/holdings?isbn=9781119443766&course=202220-MA-36600
2. Notes taken in class or posted on Brightspace.
3. Additional resources: https://www.jirka.org/diffyqs/diffyqs.pdf
https://tutorial.math.lamar.edu/Classes/DE/DE.aspx

Important prerequisites:
An essential prerequisite of the course is a thorough understanding of the concepts of linearity, linear combination, linear independence, span, basis, dimension, eigenvectors and eigenvalues, as well as the ability to use them in argument and in calculation.
Ordinary Differential Equations (ODE) cover Ch1-Ch9 will be taught the course. Notes and additional topics will be posted in Brightspace. **Homework problems will be assigned from the textbook.**

There may be deviations from the schedule below, depending on class progress.

Approximated Schedule (subject to changes)**:**
Chapter sections refer to the textbook.
1. Week of Jan. 11, § 1.1-1.3, 2.1-2.2;
2. Week of Jan. 18, § 2.3,2,5,2.6;
3. Week of Jan. 25, § 2.4,2.8; 3.1-3.2;
4. Week of Feb. 01, § 3.3-3.6;
5. Week of Feb. 08, § 3.7-3.8;
6. Week of Feb. 15, § Midterm 1;
7. Week of Feb. 22, § 4.1-4.2;
8. Week of Mar. 01, § 7.1-7.3;

9. Week of Mar. 08, §7.4-7.6;
10. Week of Mar. 15; Spring Break, no class;
11. Week of Mar. 22, § 7.7-7.9
12. Week of Mar. 29, § 9.1-9.2
13. Week of Apr. 05, § Midterm 2
14. Week of Apr. 12, § 9.3-9.4
15. Week of Apr. 19, § 9.4-9.5
16. Week of Apr. 26, Review or optional topics

Final Exam: TBA

Key dates for Spring 2022 from the Purdue 2021-2022 Academic Calendar
Classes begin, Monday, Jan. 10, 2022
Martin Lurther King Jr. Day No classes, Jan. 17
Spring Break, Mar. 14-19
Classes end, Sat., Apr. 30
Final Exams, Mar. 2-7
Grades due by 5 p.m. Tues., May. 10

Course outlines:
Chapter 1. Introduction
1.1. What is a differential equation? Importance. Some Basic Models; Direction Fields
1.2. Solutions of Some Simple Differential Equations
1.3. Classification of Differential Equations
Chapter 2. First Order ODEs
2.1. Linear Equations; Integrating Factors
2.2. Separable Equations, including homogeneous ones
2.3. Modeling with First Order Equations
2.4. Differences Between Linear and Nonlinear Equations
2.5. Autonomous Equations and Population Dynamics
2.6 Exact Equations
2.7. Numerical Approximations: Euler's Method
2.8. The Existence and Uniqueness Theorem
Chapter 3. Second Order Linear Equations
3.1. Homogeneous Equations with Constant Coefficients; Real Roots of the Characteristic Equation
3.2. Solutions of Linear Homogeneous Equations (with variable coefficients), the Wronskian.
3.3. Complex Roots of the Characteristic Equation
3.4. Repeated Roots; Reduction of Order
3.5. Non-homogeneous Equations; Method of Undetermined Coefficients
3.6. Variation of Parameters
3.7. Mechanical and Electrical Vibrations
3.8. Forced Vibrations
Chapter 4. Higher Order Linear Equations
4.1. General Theory of n-th Order Linear Equations
4.2. Homogeneous Equations with Constant Coefficients
Chapter 5 Series Solutions of Second Order Linear Equations (optional)
Chapter 7. Systems of First Order ODEs
7.1. Introduction; Why study systems?
7.2. Review of Matrices (Brief)
7.3. Linear Independence, Eigenvalues, Eigenvectors
7.4. Basic Theory of Systems of First Order Linear Equations
7.5. Homogeneous Linear Systems with Constant Coefficients; distinct eigenvalues

7.6. Complex Eigenvalues; Real Valued Solutions
7.8. Repeated Eigenvalues
7.7. Fundamental Matrices
7.9. Non-homogeneous Linear Systems

Chapter 9. Nonlinear Differential Equations and Stability

9.1. The Phase Plane: Linear Systems
9.2. Autonomous Systems and Stability
9.3. Locally Linear Systems
9.4. Competing Species
9.5. Predator-Prey Equations
9.6 Liapunov's Second Method (optional)
9.7 Periodic Solutions and Limit Cycles (optional)

Grading System:

1. Homework and Reading 15%
-Weekly assignments based on lectures and encouraged readings. A component of your final grade.

- A weekly assignment from the homework problem list will usually be due on the first day the class meets each week (to be handed in via Gradescope to the TA). The assignment will be posted on Gradescope per week, with a specific due time. Missing homework counts as 0; see policy below.
- Additional practice problems are available on Brightspace, together with other course material; they are **optional** but encouraged.
- Only 5 Problems in each homework will be graded per week. Each written homework will be graded on a scale of 0-10.

2. Lab section 15%
-Your scores from Math 366 Lab will be scaled as to 15% of your final grade.
Labs are posted here and must be submitted to your lab TA.

3. Midterms 20%+20%
-Two, full-period, closed-book in-class exams. A very significant portion of your final grade.
- To be taken in or close to the week indicated in the schedule.

4. Final Exam 30%
-A final exam (TBA). A very significant portion of your final grade.

Exam and HW Policies:

•EXAMS will be taken individually. No calculators or electronic devices are allowed. Any form of cheating in HWs and exams will automatically lead to an F grade

- A formula sheet will be available for use in all exams. It can be downloaded from the Resources in the Brightspce.
- Please resolve any error in the grading (hws and tests) WINTHIN ONE WEEK after the return of each homework and exam.
- Working in groups on HOMEWORK and to study is encouraged! Mathematics can be a wonderfully collaborative endeavor. However, please submit individual work, in your own words.

•Missed course work is officially accommodated in the following three circumstances:
1. Illness or other extraordinary personal circumstance
2. Religious observance
3. Varsity athletic participation
Late work for any other reason will not be accepted.

This policy may change if Purdue switches to online teaching.

Grades policy
Students who get at least 97% of the total points in this course are guaranteed an A+,

93% an A
90% an A-
87% a B+
83% a B
80% a B-
77% a C+
73% a C
70% a C-
67% a D+
63% a D
and 60% a D-

Above is departmental policy for the grade cut-offs. For each of these grades, it's possible that at the end of the semester a lower percentage will be enough to get that grade. A specific cut-off will be announced after the final exam.

Expectations:
• This is an advanced course with high expectations. Your submitted work should reflect your best effort. Solutions should be complete, legible, and easily understood. Complete sentences expressing well-developed ideas should be used whenever appropriate.
• The goal of the course is to not only learn those classical method in the textbook but also learn the way of thinking. These fundamental ideas will (hopefully) influence the way you think and the way you solve problems. Thus, our goal is to not only teach you the content outlined in the course synopsis, but to also more broadly impact the way you think about problems in your chosen discipline.
• Checking of the notes while working out the solutions means that they do not yet have the needed stand-alone knowledge. Taking each homework as the opportunity to build it.
• During reading and working out HWs, it is highly encouraged to explain concept, hear it from others in some different angles, and to answer other people's doubts, which will solidify one's own understanding.

Academic Integrity

Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494- 8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Direct copying from (or too close to) other works or online materials is not allowed. Any form of cheating in exams will automatically lead to an F grade.

All materials, including exams and HWs posted on the Brightspace of this course subject to my copyright and cannot be bartered.

Attendance Policy during COVID-19
Students are expected to attend all classes in-person unless they are ill or otherwise unable to attend class. If they feel ill, have any symptoms associated with COVID-19, or suspect they have been

exposed to the virus, students should stay home and contact the Protect Purdue Health Center (496-INFO).
In the current context of COVID-19, in-person attendance cannot be a factor in the final grades. However, timely completion of alternative assessments can certainly be part of the final grade. Students need to inform the instructor of any conflict that can be anticipated and will affect the timely submission of an assignment or the ability to take an exam. Classroom engagement is extremely important and associated with your overall success in the course. Some questions on learned concepts/quick calculations will be asked during class meetings. Everyone is encouraged to answer them or propose some ideas. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester.
Only the instructor can excuse a student from a course requirement or responsibility. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747.

Academic Guidance in the Event a Student is Quarantined/Isolated
If you must quarantine or isolate at any point in time during the semester, contact the Protect Purdue Health Center at 765-496-4636. Please also reach out to me via email so that we can communicate about how you can continue to learn remotely. Work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmq@purdue.edu. Importantly, if you find yourself too sick for an extended period of time to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation.

Classroom Guidance Regarding Protect Purdue

Please refer to the Protect Purdue Plan including the Protect Purdue Pledge, for campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines.

Please refer to the latest Protect Purdue Pledge and Classroom Expectation below.
https://www.purdue.edu/odos/protect/overview.html

https://www.purdue.edu/odos/osrr/resources/documents/managing_classroom_behavior.html

Lack of compliance
Students who are not engaging in behaviors established in the standard operating procedures (e.g., properly wearing a mask when required) will be asked to comply and offered any assistance they need in order to comply. If non-compliance continues, possible results include instructors asking students to leave the class, potentially followed by instructors dismissing the whole class. Students who do not comply with the required health and Protect Purdue Pledge behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office, with sanctions ranging from educational requirements to dismissal from the university. For additional guidance, please see the Dean of Students guidance on Managing Classroom Behavior and Expectations.

Student rights
Any student who has substantial reason to believe that another person in the room is threatening

class safety by not wearing a face covering or following other safety guidelines for public health considerations may leave the class without consequence. The student is encouraged to report the observed behavior to the course instructor or to the Office of Student Rights and Responsibilities (OSRR), as well as discuss next steps with the instructor.

Accommodations for Students with Disabilities and Academic Adjustment:

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone at 765-494-1247.

If you have been certified by the Disability Resource Center (DRC) as eligible for accommodations, you should contact me to discuss your accommodations as soon as possible. Click here for instructions for sending your Course Accessibility Letter to me.

Nondiscrimination Statement:

This class, as part of Purdue University's educational endeavor, is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential.

Mental Health/Wellness Statement

Help-seeking is a life skill rather than an indication of weakness.

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one- on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis. A link to Purdue's Emergency Preparedness resources (also located on the Brightspace shell under University Policies) https://www.purdue.edu/ehps/emergency_preparedness/