MATH 2420 Differential Equations with Applications

Summer 2025 Syllabus

Class Information

Class Section	Class Room	Instructor	Days/ Time
MATH 2420.0U1	SCI 2.225	Dr. Oleg Makarenkov	TR 10:00am - 12:15pm
MATH 2420.0U2	SCI 3.270	Dr. Saikat Biswas	TR 10:00am - 12:15pm

Instructor Information

Instructor: Dr. Oleg Makarenkov **Email:** makarenkov@utdallas.edu
Office: FO 2.610C **Phone:** 972-883-4617
Office Hours: TR 12:30 pm-13.30 pm & by appt.

Instructor: Dr. Saikat Biswas **Email:** saikat.biswas@utdallas.edu
Office: FO 2.104 **Phone:** 972-883-6531
Office Hours: TR 1:30 pm-2.30 pm

Course Description: (4 semester credit hours) This is an introductory course to the theory of ordinary differential equations (ODEs). Topics to be covered include: first order differential equations, second order linear equations, Laplace transform techniques, power series solutions, systems of first order linear equations, nonlinear systems.

Pre-requisites: Not all MATH/STAT courses may be counted toward various degree plans. Please consult your degree plan to determine the appropriate MATH/STAT course requirements. Prerequisites: A grade of at least C- in either MATH 2415 or in MATH 2419 or equivalent and a grade of at least C- in MATH 2418 or equivalent.

Problem Section and Teaching Assistant Information: Students are required to enroll in and attend to the problem section below. Your teaching assistant will inform you about the structure of the problem section.

Section	Day/Time/Location	TA	E-mail
MATH2420.8U1	Tuesday/3.00-5.45pm/ SCI 3.270	Bennet Luke	luke.bennett@utdallas.edu
		Babu Ivin	ivin.babu@utdallas.edu
MATH2420.8U2	Tuesday/3.00-5.45pm/ SCI 2.225	Daniel David Olutunde	david.daniel2@utdallas.edu
		Crane Casey	casey.crane@utdallas.edu

Textbook: William E. Boyce and Richard C. DiPrima, *Elementary differential equations and boundary value problems*, John Wiley & Sons, Inc. **Any** edition.

eLearning: Important announcements, course materials including lecture notes, homework assignments and solutions will be posted in the elearning of MATH 2420.701. A grade book for quizzes and tests will be maintained in the eLearning of MATH 2420.701.

Student Learning Objectives:

1. Students will be able to identify different methods of solving differential equations and apply them to obtain solutions for various classes of differential equations.
2. Students will be able to apply their knowledge of differential equations to construct and analyze models arising in applications in mathematics, physics, engineering, population dynamics.
3. Students will be able to perform quantitative and qualitative analysis of problems described by differential equations.

Course Policy & Grading Scheme:

Assignments: Weekly assignments will be uploaded to the eLearning course homepage of MATH 2420.701 in the beginning of each week. Assignments are not for grade. Solutions will be posted towards the end of the week.

Quizzes: There will be a weekly quiz organized and marked by the teaching assistant.

Exams: There will be three examinations. Textbooks, notes, calculators or other electronic devices won't be allowed during examinations.

	Date	**Time**	**Location**
Exam I	Tuesday, 06/24	10:00am–12:15pm	Your lecture room
Exam II	Thursday, 07/17	10:00am–12:15pm	Your lecture room
Exam III	Tuesday, 08/12	3.00pm-5.45pm	Your problem section room

For further info see also UTD Course Book: https://coursebook.utdallas.edu/

Grading scheme:

Quiz Average	Exam I	Exam II	Exam III
30%	20%	25%	25%

Notes: There is no make-up for late or missed quizzes/exams, unless in extreme circumstances with proper documentation accepted by the instructor.

Important Dates

Monday, June 2, 2025: Classes begin
Tuesday, June 17, 2025: Census Day
Tuesday, June 17, 2025: Last Day to drop a class without a "W"
Tuesday, June 24, 2025: Exam I
Thursday, July 17, 2025: Exam II
Tuesday, August 12, 2025: Exam III
Tuesday, August 12, 2025: Last Day of classes

Further important dates:
http://www.utdallas.edu/academiccalendar/

Detailed Course Description:

1. Introduction: Some basic examples of models, classification of differential equation, standard forms, initial value problems. Few remarks on applications. First order ordinary differential equations (ODEs): existence and uniqueness results. Higher order ODEs.

2. Separable equations, homogeneous equations: techniques of obtaining solutions. (Review of techniques of integration is recommended).

3. First order linear ODEs and Bernoulli's equation. Exact equations and equations which can be made exact using integrating factors. (Review of gradient vector fields recommended).

4. Second order linear ODEs: general theory, homogeneous and non-homogeneous equations, Wronskian and linear independence of solutions. (Review of linear algebra: linear independence and basis recommended).

5. Reduction of order for second order linear ODEs (homogeneous and non-homogeneous).

6. Second order linear homogeneous ODEs with constant coefficients: characteristic equation, real characteristic roots, complex characteristic roots, repeated root. Remarks about higher order linear ODEs with constant coefficients. (Review of complex numbers and complex exponential function recommended).

7. Euler equation.

8. Second order linear nonhomogeneous ODEs: methods of undetermined coefficients and variation of parameters.

9. Laplace transform: definition and its properties, derivation of table of Laplace transforms. Laplace transforms of discontinue functions and impulse functions. Solving linear nonhomogeneous ODEs (with constant coefficients) using Laplace transforms. Examples. (Review of improper integrals and criteria for their convergence recommended).

10. Review of power series: analytic functions, domains of convergence, tests for convergence, basic analytic functions and their power series. Second order linear ODEs with non-constant coefficients: power series solutions. (Review of calculus related to infinite series recommended).

11. Second order systems of linear ODEs: Classification of singular points, phase portrait. (Review of linear algebra, eigenvalues and eigenvectors recommended).

12. Introduction to nonlinear systems: Equilibrium solutions, linearization, examples from mechanics, electricity and population dynamics.

COVID-19 Guidelines and Resources: The information contained in the following link lists the University's COVID-19 resources for students and instructors of record:

http://go.utdallas.edu/syllabus-policies

Comet Creed: This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same: **"As a Comet, I pledge honesty, integrity, and service in all that I do."**

UT Dallas Syllabus Policies and Procedures: The information at

http://go.utdallas.edu/syllabus-policies

constitutes university's syllabus policies and procedures segment of this syllabus. Please review the catalog sections regarding the credit/no credit or pass/fail grading option and withdrawal from class. Please go to the above link for these policies.

Detailed Timelines:

Week	Days	Lecture Section	Textbook	PS
1	Jun 3, 5	Separable, linear, Bernoulli, Homogeneous, Exact	Ch 2.1, Ch 2.2, Ch. 2.6	
2	Jun 10, 12	Exact, Integrating factor, Wronskian, order reduction, 3 cases	Ch. 2.6	Quiz 1
3	Jun 17, ~~19~~	Undetermined coefficients, Review, graded Quiz 2 returned to students	Ch 3.1-3.4, Ch. 3.5	Quiz 2
4	**Jun 24**, 26	**Exam I** (topics of quizzes 1-2) Euler equation, Parameter variation, Laplace transform, Inverse Laplace transform		No quiz
5	Jul 1, 3	Continuous Initial value problem (IVP), Step functions, Discontinuous IVP		Quiz 3
6	Jul 8, 10	Delta function, Impulsive IVP, Mechanical oscillator		Quiz 4
7	Jul 15, **17**	Linear systems: solving and sketching, affine systems, Review, **Exam II** (topics of quizzes 3-4)		No quiz
8	Jul 22, 24	Nonlinear Systems: linearization and sketching Competing species model, Prey-predator model		Quiz 5
9	Jul 29, 31	Power series solutions, Review		Quiz 6
10	Aug 5, 7	Advanced topics, Review, Quiz 7 returned		Quiz 7
11	Aug 12	Advanced topics		Exam III (topics of quizzes 5-7)

These descriptions and timelines are subject to change at the discretion of the Professor.