MATH-53-01: ODE'S WITH LINEAR ALGEBRA

Instructor:
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Office hours:
Tuesdays 3:05-5:05 pm, Thursdays 3:05-4:05 pm.
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Course Assistant:
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Office hours: Mondays 3:40-5:40pm. Education 313.

Meeting times:
Monday, Tuesday, Wednesday, Thursday, Friday 2:15 pm to 3:05 pm
Room 380 W

Textbook:
The textbook is Differential Equations : an Introduction to Modern Methods and Applications by James R. Brannan and William E. Boyce. I follow this textbook in the lectures and use it for some of the assignments.

Assignments:
There will be 5 assignments. The lowest score will be dropped from the average. Homework are due on Wednesdays at the beginning of class. No late HW.

Course grade:
Homework: 20%
Midterm 1: 25%
Midterm 2: 25%
Final: 30%

Prerequisite:
MATH 51 (or equivalent).
You should be familiar with differentiation of functions. You should also know the standard tricks for computing integrals of functions of a single variable (integration by parts, substitution, etc), and be able to use them in practice. You should be familiar with vectors, matrices, systems of linear equations, determinants, and inverses of matrices.

Syllabus:
Linear ordinary differential equations, applications to oscillations, matrix methods including determinants, eigenvalues and eigenvectors, matrix exponentials, systems of linear differential equations with constant coefficients, stability of non-linear systems and phase plane analysis, numerical methods, Laplace transforms.
Here is a tentative schedule:

June 24: Introduction to ODEs, Classification of ODE (1.4).
June 25: Direction Fields (1.1), Numerical approximation: Euler's method (1.3)
June 26: Numerical approximation: Euler's method (1.3), Solving (some) differential equations (1.2)
June 27: Solving (some) differential equations, method of integrating factors (1.2) (continued)
June 28: (continued)

July 1: Separable equations (Section 2.1)
July 2: General theory of differential equations (existence/uniqueness) 2.3
July 3: General theory of differential equations (existence/uniqueness) Interval of existence (2.3) HW1 due
July 5: (2.3) continued.

July 8: Autonomous equations (2.5)
July 9: Autonomous equations
July 10: Systems of first order linear equations (3.2). Linear algebra review. HW2 due
July 11: Complex numbers (Appendix B)
July 12: Real eigenvalues (3.3).

July 15: Phase diagrams (textbook has bits in 3.3, 3.4, 3.5)
July 16: Phase diagrams.
July 17: Phase diagrams. Midterm exam.
July 18: Complex eigenvalues(3.4).
July 19: Complex eigenvalues(3.4)

July 22: Repeated eigenvalues.
July 23: Repeated eigenvalues, generalized eigenvectors (3.5). More on phase portraits.
July 25: General theory of first order linear systems
July 26: General theory of first order linear systems

July 29: General theory of first order linear systems (continued)
July 30: (continued)
August 1: Laplace transform: definition and basic properties; a formula for the Laplace transform of the derivative of a function (5.1, 5.2), the inverse Laplace transform (5.3) Solving first order systems and higher order ODE-s using Laplace transform (5.4).
August 2: Non homogenous systems.

August 5: Non homogenous systems.
August 6: Variation of parameters: example. Superposition principle for nonhomogeneous equations (Theorem 4.5.1).
August 7: Method of undetermined coefficients (4.5). HW4 due
August 8: Nonlinear systems (Chapter 7), existence and uniqueness theory (3.6)
August 9: Nonlinear systems (Chapter 7)

August 12: Nonlinear systems (continued)
August 13: Nonlinear Systems (continued) We cover 7.1, 7.2, 7.3, 7.4. **HW5 due.**
August 14: Review
August 15: Review. Last day of classes.

August 17: Final exam 12:15-3-15 pm.