American University of Central Asia
Applied Mathematics and Informatics Department
Fall 2015
Syllabus - Ordinary Differential Equations, MAT 332, ID 3700

Instructor		**Email**	**Office Hours**	**Phone**	**Office**
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Course ID	**Course Credits**	**Semester**	**Day and Time**	**Room**	**Lang.**
3700	6	Fall	Tu:8.00-9.15 Th:8.00-9.15	G34	English

I. Course Description

This is a one-term introduction to ordinary differential equations with applications. Topics include classification of, and what is meant by the solution of a differential equation, first-order equations for which exact solutions are obtainable, explicit methods of solving higher-order linear differential equations, an introduction to systems of differential equations, and the Laplace transform. Applications of first-order linear differential equations and second-order linear differential equations with constant coefficients will be studied.

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. It is often the case that these mathematical models are formulated in terms of equations involving functions as well as their derivatives. Such equations are called differential equations. The course will demonstrate the usefulness of ordinary differential equations for modeling physical and other phenomena. Complementary mathematical approaches for their solution will be presented, including analytical methods and graphical analysis.

II. Students Learning Objectives:

1. The student will learn to formulate ordinary differential equations (ODEs) and seek understanding of their solutions, either obtained exactly or approximately by analytic or numerical methods.
2. Students should understand the concept of a solution to an initial value problem, and the guarantee of its existence and uniqueness under specific conditions.
3. The student will recognize basic types of differential equations which are solvable, and will understand the features of linear equations in particular.
4. Students will learn to use different approaches to investigate equations, which are not easily solvable. In particular, the student will be familiar with phase plane analysis.
5. Students will become proficient with the notions of linearization, equilibrium, stability. They will learn to use the eigenvalue method for autonomous systems on the plane.

Upon successful completion students should be able to:

1. Analyze real world scenarios to recognize when ordinary differential equations (ODEs) or systems of ODEs are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
2. Appreciate ODE and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.
3. Work with ODEs and systems of ODEs in various situations and use correct mathematical terminology, notation, and symbolic processes in order to engage in work, study, and conversation on topics involving ODEs and systems of ODEs with colleagues in the field of mathematics, science or engineering.

4. Enjoy a life enriched by exposure to Calculus.

The purpose of this course is to introduce the student not only to the theoretical aspects of differential equations, including the establishment of existence of solutions, but also to techniques for obtaining solutions for the various types of ordinary differential equations.

III. Course Policies

a. Students are expected to BE ON TIME for classes. If instructor marked the student absent in case that the student is late for the class, he is considered to be absent for the whole class, unless excused by instructor.

b. ATTENDANCE. Class attendance is required. If the student misses the class with an excuse, he shall provide necessary documents to prove it within a week after he/she missed a class. If the requirements mentioned above are not observed, student's absence is considered to be unexcused.
If a student missed over 15 classes, he/she will not be attested for the course.

c. WRITTEN ASSIGNMENTS must be submitted to instructor by the deadline. The student may submit assignment late: at the latest by the next day after the deadline before 5 pm, in that case 1 point will be deducted from the final grade for the work (e.g., if your grade is "A" for the work, after deduction, your grade will be "B"). ***This rule applies to any student who was aware or should have been aware of an assignment and the deadline no matter whether he was sick or had any other excuse on the date of a deadline***.

d. The student has to follow ACADEMIC HONESTY code. All types of cheating (plagiarism etc) **are strictly prohibited**. If a student fails to observe this requirement, instructor may give from an "F" for the work up to an "F" for the whole course depending on the type of assignment and other circumstances.

IV. Assessment

a. Grading will be based on following components:

Grades will be based on a total of 100 points, coming from**:**

Quiz 1	The lecturer sets day and time	10 points
Midterm Exam	October, xx, 2015 (The lecturer sets day and time)	30 points
Quiz 2	The lecturer sets day and time	10 points
Final Exam	December, xx, 2015 (The lecturer sets day and time)	40 points
Home works/ Activity	Every class	10 points

b. Grading scale:

The total grade of the student is as follows:

$0 \le F \le 40 < D \le 45 < C- \le 50 < C \le 60 < C+ \le 65 < B- \le 70 < B \le 80 < B+ \le 85 < A- \le 90 < A \le 100$

Make-up Exams and Quizzes

- If the reason for missing the midterm exam is valid, the student's final exam will be worth up to 60 points.
- If the reason for missing a quiz is valid, the quiz can be taken at another time and will be worth 5 points.
- If the reason for missing the Final Exam is valid, the student can apply for the grade of "I".
- If a student misses both exams, he/she will not be attested for the course.

- If the reason for missing any exam or quiz is not valid, then the grade 0 will be given for the missing exam or quiz.

Calculators and cellphones

Using graphic calculators and cell phones during quizzes and exams prohibited.

V. Miscellaneous (as needed or desired)

Prerequisites: Linear Algebra and Analytic Geometry, Mathematical Analysis I

VI. Textbooks and References

a. Core Text

1. Kreyszig E. Advanced Engineering Mathematics. - John Wiley & Sons, 2006.
2. Greenberg M. Ordinary Differential Equations. - John Wiley & Sons, 2012.
3. Boyce W., DiPrima R. *Elementary Differential Equations with Boundary Value Problems*. - John Wiley & Sons, 2005.

b. Supplementary Texts

4. Trench W. Elementary Differential Equations with Boundary Value Problems. - Free Edition, 2013.
5. Weiglhofer W., Lindsay K. Ordinary Differential Equations and Applications. - Woodhead Publishing, 2011.

VII. Tentative Academic Calendar

Week 1-4. First-Order Differential Equations (ODEs)

Basic Concepts. Modeling. Geometric Meaning of $y' = f(x, y)$. Direction Fields. Separable ODEs. Modeling. Exact ODEs. Integrating Factors. Linear ODEs. Bernoulli Equation. Population Dynamics. Orthogonal Trajectories. Existence and Uniqueness of Solutions.
([1]: ch. 1.1-1.7, [2] : ch. 1, [3] : ch. 1-2,[4] : ch. 1-4, [5] : ch. 1-2)

Week 5-8. Second-Order Linear ODEs

Homogeneous Linear ODEs of Second Order. Homogeneous Linear ODEs with Constant Coefficients. Differential Operators. Modeling: Free Oscillations. (Mass-Spring System). Euler-Cauchy Equations. Existence and Uniqueness of Solutions. Wronskian. Nonhomogeneous ODEs. Modeling: Forced Oscillations. Resonance.: Electric Circuits. Solution by Variation of Parameters.
([1]: ch. 2.1-2.10, [2] : ch. 2, [3] : ch. 3,[4] : ch. 5,6, [5] : ch. 3)

Week 9-10. Higher Order Linear ODEs.

Homogeneous Linear ODEs. Homogeneous Linear ODEs with Constant Coefficients. Nonhomogeneous Linear ODEs.
([1]: ch. 3.1-3.3, [2] : ch. 2-3, [3] : ch. 3, [5] : ch. 7)

Week 11-15. Systems of ODEs. Phase Plane.

Qualitative Methods. Basics of Matrices and Vectors. Systems of ODEs as Models. Basic Theory of Systems of ODEs. Constant-Coefficient Systems. Phase Plane Method. Criteria for Critical Points. Stability. Qualitative Methods for Nonlinear Systems. Nonhomogeneous Linear Systems of ODEs.
([1]: ch. 4, [2] : ch. 4, [3] : ch. 7, [4] : ch. 10,[5] : ch. 8)