

# MATH 427-1001 DIFFERENTIAL EQUATIONS I

FALL SEMESTER (August 29 - December 10, 2016)

Location: BEH 127 Time: Mo We 2:30 P.M. - 3:45 P. M.

Textbook: ELEMENTARY DIFFERENTIAL EQUATIONS AND BOUNDARY VALUE PROBLEMS, 10th Edition - William E. Boyce & Richard C. DiPrima (Chapters 1-5 and part of 6)

Recommended reading material: PROBLEMS IN DIFFERENTIAL EQUATIONS (Dover Books on Mathematics) – J. L. Brenner (adopted from PROBLEMS IN DIFFERENTIAL EQUATIONS by A. F. Filippov)

## Learning Outcomes:

Knowledge of the fundamental notions and important theorems covering differential equations. Ability to recognize and solve exactly/analytically or approximately/semianalytically the following ODEs with one unknown function,  $y(x)$ :

(A) Order 1: Separable; Homogeneous in  $x$  and  $y$ ; Reducible to Homogeneous; Linear with respect to  $x$  and  $dx/dy$  or  $y$  and  $dy/dx$ ; Bernoulli with respect to  $x$  or  $y$ ; Riccati with respect to  $x$  or  $y$  (special cases); Exact; Reducible to Exact by using integrating factor that is a function of only  $x$ , or of only  $y$ , or of a given function of  $x$  and  $y$ ; ODEs not solvable for  $dy/dx$  that are solvable for either  $x$  or  $y$ , or missing  $x$  or  $y$ , or homogeneous in  $x$  and  $y$ ; Lagrange for  $x$  or  $y$ ; Clairaut; etc.

(B) Order 2 or higher: Autonomous (missing  $x$ ); ODEs with missing  $y$  (and eventually the first several consecutive derivatives of  $y$ ); Homogeneous in  $y$  and the derivatives of  $y$ ; Linear homogeneous and inhomogeneous ODEs; Linear homogeneous ODEs with constant coefficients; Linear inhomogeneous ODEs whose right-hand side is a quasipolynomial (Resonance theory); Lagrange method of variation of parameters; Homogeneous and inhomogeneous Euler's ODEs; etc.

(C) Power series solutions for linear ODEs about an ordinary point; classification of singular points; Frobenius series solutions for linear ODEs about a regular singular point; series solutions about infinity; Difference equations; Bessel types of ODEs and various kinds and orders of Bessel functions.

(D) System of second order linear equations – reduction to a system of first order solved for the derivatives.

(E) Laplace Transform: Use of the definition, proofs of formulas, solutions of initial value problems, non-elementary right hand sides and use of unit step function, impulse and delta functions, convolution theorem and exact solutions of Volterra integral equations.

Prerequisites: MATH 283 and MATH 330/365 (min. grade C)

The final grade for the course is obtained from the **total** (max 500) of:  
-- biweekly quizzes and homework - 120 points

- midsemester test - 120 points
- final exam (partially comprehensive) - 220 points
- instructor's discretion - 40 points

There is going to be a recitation/discussion class taught by my graduate student every Friday. During this his class, the graduate student is going to solve problems, answer questions, collect and return homework, and administer quizzes. There will be a quiz (on the material covered in class during the previous weeks at the end of Friday's recitation) or a test (on Friday) about every other week. No calculators or other electronic devices, notes, or textbooks are allowed to be used during the examinations.

The homework for a section is due at the beginning of the recitation class on the first Friday after the section has been fully covered in class. All work must be shown to receive any credit. A solution that includes only the answer will receive 0 points. On the other hand, the answer always needs to be given.

In this class, the textbook is only a tool rather than a self-study text. Very often, easier and more powerful methods are going to be presented in class. This textbook was chosen by the instructor because of the good choice and order of topics and also because of the quality and relevance of the problems. All chapters plus an additional topic (First order Partial Differential Equations), that is not in the book, are intended to be covered in the sequence of classes MATH 427 and MATH 428. The latter of these classes will hopefully be offered to the students who have at least a C in the former in Spring 2017. Further natural continuations of these classes are the graduate Ordinary Differential Equations class (MAT 723), as well as the undergraduate and graduate Partial Differential Equations classes. Mastery of integration techniques, especially integration by parts as well as series, especially power series is absolutely necessary for understanding the course from the beginning. Students are encouraged to review these topics and study the distributed handouts extensively from the beginning and to seek the instructor's assistance, if needed. Later on, Linear Algebra and other mathematical disciplines will start being involved. Since Differential Equations and Complex Analysis are the first and most important parts of Applied Mathematics, the main goal of this and the other above mentioned classes (at least when I teach them) are going to be analytical, semi analytical (approximate), and some numerical solutions of differential equations. Issues of existence, uniqueness, stability, convergence, etc. will also be considered, but their formal treatment will be secondary in these classes. Use of Fortran, C++, etc. codes and software packages such as Mathematica, Maple, MATLAB, etc. is encouraged but will not be considered in this and the other above mentioned classes. As it is seen from the previous remarks, this is a very serious and time consuming class. Besides coming to class, students need to review past material, work on homework, prepare for quizzes and tests, read the text, and consult the instructor. Handouts are essential part of this course. Some of them are the result of several tens of years of effort and experience with students' difficulties. Timely learning of the handouts could facilitate students' studies a lot. Accordingly, students should plan to allow sufficient time. Regular attendance, prompt arrival, and taking elaborate notes are strongly recommended; students who do not maintain these good habits do not usually succeed in this course. Knowledge of phone number of and keeping in touch with a classmate could be very helpful. Participation in a study group is even better.

Please keep this syllabus for future reference. If you have any questions about the issues raised here or other issues, please come to my office hours.

## UNLV POLICIES

**Academic Misconduct** – Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <http://studentconduct.unlv.edu/misconduct/policy.html>.

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**Disability Resource Center (DRC)** – The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

**Religious Holidays Policy** – Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

**Transparency in Learning and Teaching** – The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:  
<https://www.unlv.edu/provost/teachingandlearning>  
<https://www.unlv.edu/provost/transparency>

**Incomplete Grades** – The grade of I – Incomplete – can be granted when a student has

satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student's control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

**Tutoring and Coaching** – The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call 702- 895- 3177. The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

**UNLV Writing Center** – One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>

**Rebelmail** – By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

**Library Resources** – Students may consult with a librarian on research needs. For this class, the subject librarian is [https://www.library.unlv.edu/contact/librarians\\_by\\_subject](https://www.library.unlv.edu/contact/librarians_by_subject). UNLV Libraries provides resources to support students' access to information. Discovery, access, and use of information are vital skills for academic work and for successful post-college life. Access library resources and ask questions at <https://www.library.unlv.edu/>.

**Final Examinations** – The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.