MATH353 Sec. 6, Fall 2015 Syllabus

Course:	ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS
Webpage:	`http://math.duke.edu/~haizhao/Teaching/Math353.html`
Location/Time:	Section 6: MW 03:05 PM-04:20 PM in **Gross Hall 304B**
Instructor:	Haizhao Yang, haizhao@math.duke.edu, Phys. Bld. 224 Office hours, Monday, 10:30- AM-12:30 PM or by appointment
Description:	First and second order ordinary differential equations with applications, Laplace transforms, series solutions and qualitative behavior, Fourier series, partial differential equations, boundary value problems, Sturm-Liouville theory.
Texts:	• *Elementary Differential Equations and Boundary Value Problems* – 10th Edition, William E. Boyce and Richard C. DiPrima . • *ODE and PDE Notes (parts I and II)*, Stephanos Venakides. • *Notes taken in class.*
Important prerequisites:	Students must review linear algebra by themselves. Essential for 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.
Approximate Schedule:	Ordinary Differential Equations (ODE) will be taught in the first part of the course. Partial Differential Equations (PDE) will be taught in the second part. In both parts, the Notes I and II will be used primarily, and the book will serve for further readings. This is particularly important for the PDE part. It is important that all bold faced words in the Notes are thoroughly understood, *i.e. what they mean and how they are connected to each other*. Mostly they are definitions of important concepts. Homework problems will be assigned from the book. The schedule below is approximate. 1. Week of Aug 24, Chapter 2, § 2.1- 2.3; 2. Week of Aug 31, § 2.4-2.7; 3. Week of Sep 7, § 3.1-3.6; 4. Week of Sep 14, § 5.1, 5.2; 5. Week of Sep 21, § 5.3, 5.4(go light);

6. Week of Sep 28, § 6.1-6.4;
7. Week of Oct 5, § 6.5, 6.6; **EXAM 1**;
   Midsemester Grades due Friday Oct 9
   LECTURES FROM NOTES II, book for extra reading (rough correspondence with book sections in parenthesis)
8. Week of Oct 12, FALL BREAK Ch. 1 (§ 10.2-10.4)
9. Week of Oct 19, NOTES II Ch. 1, 2 (§ 11.1, 10.5-10.6)
10. Week of Oct 26, NOTES II Ch. 2,3 (§ 10.7-10.8)
11. Week of Nov 2, NOTES II Ch. 3 (§ 11.2)
12. Week of Nov 9, NOTES II Ch. 3 (§ 11.3)
13. Week of Nov 16, Review/buffer; **Exam 2**
14. Week of Nov 23, Special topics/review.
15. Week of Nov 30, Special topics/review.

GRADING:

▶ **Homework and Reading** – Weekly assignments based on encouraged readings. A component of your final grade.

- A weekly assignment from the homework problem list at the end of this syllabus will usually be due in class every Monday 4:20 PM. The assignment will be made in class and will generally not be placed in sakai.
- Additional problems may be e-mailed to you together with other course material; they are optional but HIGHLY encouraged.

▶ **Midterms** – Two, full-period, in-class exams. A very significant portion of your final grade.

- To be taken in or close to the week indicated in the schedule.

▶ **Final Exam** – A three-hour final exam common to all sections. A very significant portion of your final grade.

NOTES/ EXPECTATIONS:

• Missed course work is officially accommodated in the following three circumstances:

1. Illness or other extraordinary personal circumstance:
   http://trinity.duke.edu/undergraduate/academic-policies/illness
2. Religious observance
3. Varsity athletic participation

Makeup exams are not allowed. No notes are allowed in exams. A list of useful formulas will be given in exams. All exams should be completed on your own.

Late work for any other reason will not be accepted unless requested and approved at least one week ahead of the due date.

• It is important that you understand and adhere to the Duke Community Standard (http://www.integrity.duke.edu/standard.html). Direct or indirect use of a solution manual either physical or online, either by a publisher or by some "random" individual, is not allowed and constitutes a violation of the Standard. If a student is found responsible through the Office of Student Conduct for academic dishonesty on a graded item in this course, the student will receive a score of zero for that assignment. If a student's admitted academic dishonesty is resolved directly through a faculty-student resolution agreement approved by the Office of Student Conduct, the terms of that agreement will dictate the grading response to the assignment at issue.

• Working in groups on homework and to study is encouraged! Mathematics can be a wonderfully collaborative endeavour. However, please submit individual work, in your own words. Exams will be taken individually and are closed-notes/book. A formula sheet is available for use and can be downloaded from Sakai.

• 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. We will compute, but we will also discuss and reflect. You must **understand** the meaning of bold-faced words in the text and the notes.

• THE GOAL OF THE COURSE IS FOR THE STUDENT TO LEARN NOT ONLY "MATERIAL" BUT ALSO A WAY OF THINKING. This course will introduce the classical and rich theory of differential equations. It is a subject which can easily suffer from the perception that it is little more than a collection of rules and procedures to be appropriately (and blindly) applied to a handful of problem types. In reality, there are deep insights to be gained from this material. 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.

TEMPORARY HOMEWORK PROBLEMS:

2.1 - 1, 4, 14, 20, 28, 33
2.2 - 1, 3, 7, 9, 10, 16, 21, 30, 31, 35
2.3 - 8, 9, 10
2.4 - 7, 9, 14, 22
2.5 - 3, 22
2.6 - 1, 5, 7, 11, 12, 18, 21, 25
2.7 - 1, 7, 12, 15
3.1 - 6, 7, 11, 16, 28
3.3 - 17, 18, 31, 34, 35
3.4 - 1, 5, 7, 11, 12, 18, 21, 25
3.5 - 5, 8, 16, 17
3.6 - 3, 5, 8, 15, 18
5.1 - 1, 5, 12, 13, 18, 19, 21, 25
5.2 - 2, 10, 15 (no graphs necessary)
5.3 - 3, 8, 11, 15 (see Hint 1), 22, 23, 24
5.4 - 1, 6, 21, 22, 28, 36, 37, 41, 42
6.1 - 2, 3, 5, 6, 9, 26, 27
6.2 - 3, 8, 9, 13, 14, 16
6.3 - 6, 14, 16, 17, 21, 33, 37
6.4 - 3, 5, 9, 12
6.5 - 1, 4, 9, 12, 13, 17
6.6 - 1, 6, 9, 11, 13, 14
10.1 - 2, 3, 7, 14, 17, 20 (see Hint 2)
10.2 - 4, 6, 8, 9, 16, 18, 29
10.3 - 2, 4, 13, 14, 15, 17 (see Hint 3 for 13-15)
10.4 - 3, 5, 6, 7, 12, 16, 17, 35, 36
10.5 - 3, 4, 7, 11, 12, 22
10.6 - 1, 2, 8, 11, 12, 15
10.7 - 4, 8, 9, 10
10.8 - 2, 8, 10
11.1 - 2, 3, 4, 5, 8, 10, 19
11.2 - 1, 4, 7, 8, 11, 13, 14, 15
11.3 - 3, 5, 7, 9, 11, 12, 13, 20, 21

Hint 1: Use Theorem 3.2.1 and note that the values of x and x^2 at $x = 0$.
Hint 2: Try the substitution $y(t) = Ax\sin(b\ln x) + Bx\cos(b\ln x)$, where $b = \sqrt{\lambda - 1}$.
Hint 3: Expand y in a Fourier series, then identify its coefficients using the equation.

Plots doableonly by computer are optional.