MATH 353 SUMMER I 2015 SYLLABUS

Instructor: Yuhao Hu
Email: yh89@math.duke.edu
Office: 274G Physics
Office Hours: MTh: 12:00-2:00pm

Course: Ordinary and Partial Differential Equations
Location/Time: MTuWThF 9:30-10:45 am in Physics 259
Course Webpage: http://www.math.duke.edu/~yh89/teaching/Math353_15Summer_I/main.html

Topics: 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.
- (Optional) *ODE and PDE Overview*, Prof. Stephanos Venakides.

Goal: This course will introduce the classical and rich theory of differential equations. Students will learn not only rules and procedures to be appropriately applied to a handful of problem types, but also fundamental ideas that will influence the way of thinking and problem solving.

Requirements: Your final grade will be based on the following components: homework 20% (lowest homework dropped), two midterms 20% each, final exam 40%.

Exams: The final exam will be on **Thursday, June 25, from 9:00am to noon**. The midterm exams are during class on **Friday, May 29** and **Friday, June 12**. Make sure you can attend these exams before enrolling in the course.

Homework: Working in groups on homework and to study is encouraged. However, your submitted homework must be written up individually, in your own words, and without consulting anyone else's written solutions.

Homework is due at the beginning of class on **Tuesdays and Fridays**. Late homework will not be accepted, though the lowest score will be dropped. Duke policies apply in cases of illness, personal emergency, varsity athletic participation, or religious observance, and in such cases you are expected to inform me as early as possible.

Ethics: Students are expected to follow the Duke Community Standard. Use of a solution manual is not allowed. If a student is found responsible for academic dishonesty through the

Office of Student Conduct, 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.

Schedule:

Topic(s)	**Reading**	**Problems**
Linear Equations, Integrating Factors	2.1	1 ,4, 14, 20, 28, 33
Separable Equations	2.2	1, 3, 7, 9, 10, 16, 21, 30, 31, 35
Modeling with First Order Equations	2.3	8, 9, 10
Linear&Nonlinear Equations: Difference	2.4	7, 9, 14, 22
Autonomous Equations, Population Dynamics	2.5	3, 22
Exact Equations, Integrating Factors	2.6	1, 5, 7, 11, 12, 18, 21, 25
Euler's Method	2.7	1, 7, 12, 15
Constant Coefficient Homogeneous Equations	3.1	6, 7, 11, 16, 28
Complex Roots, Characteristic Equation	3.3	17, 18, 31, 34, 35
Repeated Roots, Reduction of Order	3.4	1, 5, 7, 11, 12, 18, 21, 25
Non-homogeneous Eqn.s, Undetermined Coeff.	3.5	5, 8, 16, 17
Variation of Parameters	3.6	3, 5, 8, 15, 18
Power Series	5.1	1, 5, 12, 13, 18, 19, 21, 25
Series Solutions Near an Ordinary Point I	5.2	2, 10, 15(no graphs necessary)
Series Solutions Near an Ordinary Point II	5.3	3, 8, 11, 15(Hint 1), 22, 23, 24
Euler Equations, Regular Singular Points	5.4	1, 6, 21, 22, 28, 36, 37, 41, 42
Laplace Transform	6.1	2, 3, 5, 6, 9, 26, 27
Solution of Initial Value Problems	6.2	3, 8, 9, 13, 14, 16
Step Functions	6.3	6, 14, 16, 17, 21, 33, 37
DE with Discontinuous Forcing Functions	6.4	3, 5, 9, 12
Impulse Functions	6.5	1, 4, 9, 12, 13, 17
The Convolution Integral	6.6	1, 6, 9, 11, 13, 14
Two-Point Boundary Value Problems	10.1	2, 3, 7, 14, 17, 20(Hint 2)
Fourier Series	10.2	4, 6, 8, 9, 16, 18, 29
Fourier Convergence Theorem	10.3	2, 4, 13-15(Hint 3), 17
Even and Odd Functions	10.4	3, 5, 6, 7, 12, 16, 17, 35, 36
Separation of Variables	10.5	3, 4, 7, 11, 12, 22
Heat Conduction Problems	10.6	1, 2, 8, 11, 12, 15
Wave Equation, Vibrating Strings	10.7	4, 8, 9, 10
Laplace's Equation	10.8	2, 8, 10
Two-Point BVP: Occurrence	11.1	2, 3, 4, 5, 8, 10, 19
Sturm-Liouville BVP	11.2	1, 4, 7, 8, 11, 13, 14, 15
Nonhomogeneous BVP	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 substitutions

$$y(t) = Ax\sin(b\ln x) + Bx\cos(b\ln x),$$

  where $b = (\lambda - 1)^{\frac{1}{2}}$.
- Hint 3: Expand y in a Fourier series, then identify its coefficients using the equation.