MATH.2360 Engineering Differential Equations

Review Sheet for Exam #1

Necessary Skills

Section	You should be able to
1.1	• determine whether a given function is a solution of a given d.e. • use initial conditions to determine the values of arbitrary constants in the general solution of a d.e. • translate a verbal description of a physical system into a d.e.
1.2	• solve d.e.'s of the form $dy/dx = f(x)$ • find the position of an object as a function of time given its acceleration, its initial position, and its initial velocity
1.4	• recognize and solve separable first-order d.e.'s/initial value problems • formulate and solve separable first-order d.e.'s to analyze such problems as radioactive decay, compound interest, simple population models, and cooling/heating.
1.5	• recognize and solve linear first-order d.e.'s/initial value problems • formulate and solve first-order linear d.e.'s to analyze mixture problems

Answers to Sample Problems

The full solutions to the sample problems are available on the course web page under the Course Materials Link

1. $y(x) = x^2$ **is not** a solution of the d.e. $x^2y' = y^2 + x^3$

2. $y(x) = x^3$ **is** a solution of the d.e. $x^4y' = x^6 + 2y^2$

3. $x = 50$ m.

4. $2\dfrac{\ln(0.4)}{\ln(0.9)} \approx 17.4$ hours

5. $\ln\left(y^2+1\right) = \dfrac{x^2}{2} - 2$

6. $y = 2x^2 + x$

7. $y = x^2\ln(x) + 2x^2$

8. $y = \dfrac{-1+\sqrt{4x^2-7}}{2}$

9. $\dfrac{dx}{dt} = 40 - \dfrac{6x}{100-2t}$ with $x(0) = 50$

Exam Policy

It is important that everyone take the same exams under the same conditions for maximum fairness and reliability of testing. I therefore do not give makeup exams unless you have a valid reason (for example, illness or religious holiday) for missing the scheduled exam, and I do not allow extra time on exams unless you have a note from Disability Services. If you have to miss a scheduled exam, please let me know ahead of time if at all possible. I am much more likely to be sympathetic if you call me the morning of the exam and say "I have the flu and can't take the exam" than if you come in two days after the exam and say "I missed the exam. When can I take a makeup?"

You may bring one 8.5 × 11 inch formula sheet. You may use both sides of the sheet. I will hand out the integral tables that appear in the textbook.

Calculator/Phone Policy
Cell phone use is not permitted during exams.

The use of a calculator **is** permitted.

Tips on Preparing for Exams

- Start studying for an exam one week ahead of time. Focus your studying on the items given on the list of specific objectives for each section.
- Begin by reviewing the homework problems for the sections that will be covered on the exam. Make sure you know how to solve each problem without looking at the solution manual. If you cannot solve a particular problem, make a note of the problem number and move on to the next problem.
- Ask me or someone else for help on any homework problem that gave you trouble, then try to solve a similar problem from the textbook.
- Two days before the exam, try solving the sample problems using only your calculator, formula sheet, and the integral tables. Do not look at the answers until you have tried the problems.
- Ask me or someone else for help on any sample problem that gave you trouble, then try to solve a similar problem from the textbook.
- Get a good nights sleep the night before the exam. You will perform better if you are fresh and able to think clearly.

Tips on Taking Exams

- Read every question on the exam before you start working. This will give you a feel for how long the exam is and how you should pace yourself. It will also give your subconscious mind a chance to start working on the questions.
- If you are not sure what a question means, please ask me. I am trying to see how well you know the material, not to trick you with ambiguous wording.
- Look at the point value of each question. Obviously, it is more important to do well on the questions that count the most than the ones that count the least.
- It is generally best to do the easiest problem first, then the next easiest, and so on. You do not have to do the problems in the order they appear on the exam.
- If you get stuck on one question, move on to the next. Come back later to the question that is giving you trouble.
- Be aware of how much time you have left. Do not spend too much time on a single question. It is generally better to get partial credit on every question than full credit on a single question.

MATH.2360 Engineering Differential Equations   Sample Problems for Exam 1

There is no guarantee that the actual exam questions will bear any resemblance to these sample problems.

Problem 1. Is $y = x^2$ a solution of the d.e. $x^2y' = y^2 + x^3$? Why or why not?

Problem 2. Is $y(x) = x^3$ is a solution of the d.e. $x^4y' = x^6 + 2y^2$? Why or why not?

Problem 3. A car is traveling at a speed of 20 m/s when the driver applies the brakes. The car stops in 5 seconds. How far (in meters) does the car travel in that time? Assume the car's deceleration is constant.

Problem 4. A container initially holds 50 grams of a radioactive substance. There are 45 grams of the substance left after 2 hours. When will there be 20 grams of the substance left in the container?

Problem 5. Solve the following initial value problem.

$$2y\frac{dy}{dx} = x\left(y^2 + 1\right), \quad y(2) = 0.$$

Problem 6. Solve the following initial value problem.

$$x\frac{dy}{dx} = 2x^2 + y, \quad y(1) = 3.$$

Problem 7. Solve the following initial value problem.

$$\frac{dy}{dx} = \frac{x^2 + 2y}{x}, \quad y(1) = 2.$$

Problem 8. Solve the following initial value problem.

$$\frac{dy}{dx} = \frac{2x}{1 + 2y}, \quad y(2) = 1.$$

Problem 9. A tank initially contains 100 liters of water in which 50 grams of salt are dissolved. A salt solution containing 10 grams of salt per liter is pumped into the tank at the rate of 4 liters per minute, and the well-mixed solution is pumped out of the tank at the rate of 6 liters per minute.

Let t denote time (in minutes), and let x denote the amount of salt in the tank at time t (in grams). Write down the differential equation $\left(\frac{dx}{dt} = \text{something}\right)$ and initial condition describing this mixing problem.

DO NOT SOLVE THE INITIAL VALUE PROBLEM. JUST WRITE DOWN THE D.E. AND INITIAL CONDITION.