Differential Equations Test I Overview

As always your first best line of defense is to complete and understand the Problem Set, Practice Homework and lecture examples.

1. What is a solution to a differential equation ? What is a general solution to a differential equation ?
2. What is an initial value problem? Do we always get a unique solution to an initial value problem? How many initial conditions do we need to find a unique solution for an n-th order constant coefficient linear ODE?
3. Be able to identify features such as: order, linear, homogeneous, exact, constant coefficient DEqns.
4. Be able to solve (without hints) first order ODEs by separation of variables, the integrating factor method, or as an exact equation. (see homeworks from 2.2,2.3 and 2.4)
5. Be able to solve (with hints) first order ODEs by the generalized integrating factor method (I'll suggest a function or type of function for μ) (see homeworks from 2.5)
6. Be able to solve (with hints) first order ODEs by changing variables (I will suggest a the substitution but you have to carry it out)(see homeworks from 2.6)
7. Be prepared for problems similar to those we did on Newtonian mechanics. I do expect you can set up problems similar to the ones we have covered in the lecture notes and/or the Practice Homework. If another application was on the test I will do the set-up and just ask you to do and interpret the math
8. What is the Characteristic Equation for a constant coefficient linear ODE ? What is it good for?
9. How many arbitrary constants do you expect in a first order ODE's solution? What about a 2nd order ODE?
10. If a real number λ_1 is a double-root of the Characteristic Equation then what two solutions do you get from λ_1?
11. If a complex number $\lambda_+ = 3 + 2i$ is a complex solution of the Characteristic Equation then what two solutions do you get from this complex root? What about $\lambda_- = 3 - 2i$, do we need solutions from that solution, or do we already have enough from the $\lambda_+ = 3 + 2i$ solution?
12. The DEqn $(D^2 + 1)^2[y] = 0$ is shorthand for what DEqn in the prime notation? In other words, find a, b, c, d such that $(D^2 + 1)[y] = y'''' + ay''' + by'' + cy' + dy = 0$. The Char. Eqn. is $(\lambda^2 + 1)^2 = 0$ which has a complex double-root of $\lambda = \pm i$. What four solutions form the general solution $y = c_1y_1 + c_2y_2 + c_3y_3 + c_4y_4$?
13. Finish the following equivalence: $\int f(x)dx = y$ same as $\frac{dy}{dx}$ =??? ? In other words, every indefinite integration we did in calculus amounts to solving a particularly simple first order differential equation. We have (hopefully) learned by now that solving differential equations is not usually accomplished by straigh-forward integration, however behind our tricks and techniques we are integrating n-times when we solve an n-th order ODE. Perhaps this comment makes the term "integrating factor" understandable.
14. Be able to solve n-th order homoegeneous constant coeff. ODEs with or without initial conditions. Be prepared for distinct or repeated real or complex roots(See homeworks from 4.2,4.3,6.2)