

## Review for Exam I

### MATH 2306

Sections Covered: 1, 2, 3, 4<sup>1</sup>

*This review is provided as a courtesy to give some idea of what material is covered. Nothing else is intended or implied.*

(1) For each equation, specify all independent and dependent variables. Identify the given equation as Linear or Non-linear and specify the order.

(a)  $\frac{dy}{dt} + \frac{dx}{dt} = x^2 + y^2$

(b)  $x^3y''' - 2x^2y'' + 7y = \ln x$

(c)  $e^x dy = x^2 y dx$

(2) Verify that the given expression defines a solution to the ODE. State whether the solution is given implicitly or explicitly.

(a)  $\frac{d^2y}{dx^2} + y = e^x$ ,  $y(x) = 2 \cos x + \frac{1}{2}e^x$

(b)  $\frac{dy}{dx} = \frac{y}{e^x}$ ,  $e^{-x} + \ln |y| = 1$

(3) Find values of  $m$  so that the function  $y = x^m$  is a solution of the differential equation

$$x^2y'' - 7xy' + 15y = 0$$

---

<sup>1</sup>First order linear and Bernoulli (no exact or near-exact equations).

(4) Solve each first order separable equation.

(a)  $\frac{dy}{dx} = \sqrt{xy}$

(b)  $\sin^2 x \frac{dy}{dx} = \sec^2 y$

(c)  $\frac{dy}{dx} = \frac{x}{y} e^{x-y}$

(5) Solve each IVP.

(a)  $\frac{dy}{dx} = \sqrt{xy}, \quad y(0) = 1$

(b)  $e^y \ln(x) dx + y dy = 0, \quad y(1) = -1$

(c)  $y'' = -\cos x + 6x, \quad y(0) = 3, \quad y'(0) = -1$

(6) Solve each IVP.

(a)  $\frac{dy}{dx} - \tan x y = \sin x, \quad y(0) = 1$

(b)  $x \frac{dy}{dx} + 3y = \frac{1}{x^2(1+x^2)}, \quad y(1) = 0$

(c)  $ty' + y = 2te^{2t}, \quad y(1) = 0$

(7) Find an explicit solution to each differential equation.

(a)  $y' + 3y = y^2 e^{3x}$

(b)  $\frac{dy}{dx} + 4xy = 4x\sqrt{y}$