## Chapter 1

## Introduction to Differential Equations

#### 1.1 Definitions and Terminology

- 1. Second order; linear
- Third order; nonlinear because of (dg/dx)<sup>4</sup>
- 3. Fourth order; linear
- Second order; nonlinear because of cus(r + u)
- Second order; nonlinear because of (dy/dx)<sup>2</sup> or \(\sqrt{1} + (dy/dx)^2\)
- Second order; nonlinear because of R<sup>2</sup>
- 7. Third order; linear
- Second order; nonlinear because of F<sup>2</sup>
- Writing the differential equation in the form x(dy/dx) + y<sup>2</sup> = 1, we see that it is nonlinear
  in y because of y<sup>2</sup>. However, writing it in the form (y<sup>2</sup> 1)(dx/dy) + x = 0, we see that it is
  linear in x.
- 10. Writing the differential equation in the form u(dv/dv)+ (1+u)v = ue<sup>n</sup> we see that it is linear in v. However, writing it in the form (v + uv − ue<sup>n</sup>)(du/dv) + u = 0, we see that it is nonlinear in u.
- 11. From  $y = e^{-s/2}$  we obtain  $y' = -\frac{1}{2}e^{-s/2}$ . Then  $2y' + y = -e^{-s/2} + e^{-s/2} = 0$ .
- 12. From  $y = \frac{6}{5} \frac{6}{5}e^{-20t}$  we obtain  $dy/dt = 24e^{-20t}$ , so that

$$\frac{dy}{dt} + 20y = 24e^{-20t} + 20\left(\frac{6}{5} - \frac{6}{5}e^{-20t}\right) = 24.$$

13. From  $y = e^{3\sigma} \cos 2x$  we obtain  $y' = 3e^{3\sigma} \cos 2x - 2e^{3\sigma} \sin 2x$  and  $y'' = 5e^{3\sigma} \cos 2x - 12e^{3\sigma} \sin 2x$ , so that y'' - 6y' + 13y = 0.

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