

Review For Exam I

Elements of Differential Equations

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1. Find $y(x)$ if $\frac{dy}{dx} = \frac{e^x}{3+6e^x}$

2. Verify that the following DE is exact and then solve it:

$$(x + \cos y)y' + y = 0$$

3. Is $y = xe^{-2x}$ is a solution to the DE: $y'' + 4y' + 4y = 0$? Why ?

4. Complete the following table:

| Equation | Order | Linear / Nonlinear |
|---------------------------|-------|--------------------|
| $10y'' + y' + 6y = 0$ | | |
| $y = 5xy' + y(y')^2$ | | |
| $y' = 4 + y^2$ | | |
| $y'' + 2y = \tan x$ | | |
| $y' + 8x(y'')^3 = \sin x$ | | |
| $9xy dx + x^2 dy = 0$ | | |

5. Classify the following 1st Order ODE as **Separable**, **Linear in y (or in x)**, **Homogeneous (with its degree)**, **Bernoulli**, or **Exact**.

i. $(y + y^2)dx - (x + x^2)dy = 0$

ii. $(y - xy^2)dy = ydx$

iii. $(e^{y/x} + e^{x^3/y^3} + 1)dy = (1 + \ln(y/x))dx$

iv. $3x^2y' + xy^3 = 6y$

v. $3\frac{dy}{dx} = 4x - y$

6. Determine $M(x, y)$ so that the equation: $M(x, y)dx + (xe^{-xy} + 2xy + \frac{1}{x})dy = 0$ is exact.

7. Solve $x^2 \frac{dy}{dx} = y - xy$

8. Solve $x \frac{dy}{dx} - y = x^2 \sin x$

9. Solve the initial value problem $(e^x + y)dx + (2 + x + ye^y)dy = 0$, $y(0) = 1$.

10. Solve the initial value problem $\frac{dy}{dx} = \cos(x + y)$, $y(0) = \pi/4$.

11. Solve $x \frac{dy}{dx} - (1 + x)y = xy^2$

12. Solve $(y^2 - xy)dx + x^2 dy = 0$

13. How many solutions are there to the initial value problem $\frac{1}{x^2} \frac{dy}{dx} + y^2 = \frac{1}{x}$, $y(0) = 2$. Justify your answer.