MATH 2 Lecture Notes

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1 Chapter 1

1.1 Terminology

Definition A differential equation is an equation containing the derivatives or differentials of one or more dependent variables, with respect to one or more independent variables.
· An Ordinary Differential Equation (ODE) involves only ordinary derivatives
· A Partial Differential Equation (PDE) involves partial derivatives.
Definition The order of a DE is the order of the highest-order derivative that appears in the DE
Notation $F(x, y, \frac{dy}{dx}, \frac{d^2y}{dx^2})$
Definition A linear DE is any DE that can be written in form:
$a_0(x)y + a_1(x)y' + a_2(x)y'' \cdots + a_n(x)y^{(n)} = b(x)$
For a DE to be linear:

1. Y and all of its derivatives much be of the 1st degree
2. Any term that does not include y or any of its derivatives must be a function of x

Definition A **solution** of a DE is any function defined on some interval I which, when substituted into the DE, reduces it to an *identity* on I.

2 Example Problems with Solutions

2.1

Find the value(s) of m such that $y = e^{mx}$ is a solution of $y'' + 4y' - 21y = 0$
$y' = me^{mx}$, $y'' = m^2e^{mx}$
$m^2e^{mx} + 4me^{mx} - 21e^{mx} = 0$
$e^{mx}(m^2 + 4m - 21) = 0$
$(m^2 + 4m - 21) = 0$
$\boxed{m = -7, m = 3}$ are both solutions