

Chapter 9

Differential Equations

Introduction to Differential Equations

An equation that involves an independent variable, dependent variable and differential coefficients of dependent variable with respect to the independent variable is called a **differential equation**.

e.g.,

$$(i) \ x^2(d^2y / dx^2) + x^3 (dy / dx)^3 - 7x^2y^2$$

$$(ii) \ (x^2 + y^2) dx = (x^2 - y^2) dy$$

Order and Degree of a Differential Equation

The order of a differential equation is the order of the highest derivative occurring in the equation. The order of a differential equation is always a positive integer.

The degree of a differential equation is the degree (exponent) of the derivative of the highest order in the equation, after the equation is free from negative and fractional powers of the derivatives.

Linear and Non-Linear Differential Equations

A differential equation is said to be linear, if the dependent variable and all of its derivatives occurring in the first power and there are no product of these. A linear equation of n th order can be written in the form

$$P_0 \frac{d^n y}{dx^n} + P_1 \frac{d^{n-1} y}{dx^{n-1}} + P_2 \frac{d^{n-2} y}{dx^{n-2}} + \dots + P_{n-1} \frac{dy}{dx} + P_n y = Q$$

where, $P_0, P_1, P_2, \dots, P_{n-1}$ and Q must be either constants or functions of x only.

A linear differential equation is always of the first degree but every differential equation of the first degree need not be linear.

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Partial Differential Equations and Their Applications Peter Charles Greiner, Canadian Mathematical Society. Seminar, 1997-01-01 Just list for purposes of NBB

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Preliminary Reports, Memoranda and Technical Notes of the Materials Research Council Summer Conference Materials Research Council. Summer Conference, 1982

Scientific and Technical Aerospace Reports, 1990

Stochastic Analysis Michael Craig Cranston, Mark A. Pinsky, 1995 This book deals with current developments in stochastic analysis and its interfaces with partial differential equations dynamical systems mathematical physics differential geometry and infinite dimensional analysis The origins of stochastic analysis can be found in Norbert Wiener's construction of Brownian motion and Kiyosi Itô's subsequent development of stochastic integration and the closely related theory of stochastic ordinary differential equations The papers in this volume indicate the great strides that have been made in recent years exhibiting the tremendous power and diversity of stochastic analysis while giving a clear indication of the unsolved problems and possible future directions for development The collection represents the proceedings of the AMS Summer Institute on Stochastic Analysis held in July 1993 at Cornell University Many of the papers are largely expository in character while containing new results

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