Ordinary and Partial Differential Equations: Third Year College Course For Mathematicians, Physicists, and Engineers

Mohamed F. El-Hewie

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This book comprises a course in differential equations, which students of engineering, physics, and mathematics complete as a requirement of bachelor in science degree. The reader must possess basic skills in calculus, since all elementary differentiations and integrations in this book assume that the student could visually spot the derivation from previous years in high school or college. The book is organized in the logical fashion as presented to college students. The ordinary differential equations (o.d.e.) are first studied in great details, since partial differential equations (p.d.e.) must be rendered ordinary by separation of variables so as yield meaningful solution. When separation of variables is untenable (such as in nonlinear partial differential equations), then referrals to numerical solutions are given. Within the scope of o.d.e., first- and second-order differential equations are discussed in details, also since equations of higher orders could be reduced in order by successive methods of substitutions, discussed in the book. Also, within the scope of o.d.e., equations with constant coefficients are dealt with greater details, since variable coefficients could be rendered constants by interim substitutions and reverse substations. Also, dealt with is the reduction of higher degrees of variables to lesser degrees. The following is a brief outline of the topics discussed in the book: Separable exact o.d.e o Homogeneous first-order o.d.e. o Homogenizing first-order o.d.e. with quadratic polynomial o Condition for a total derivative o Solving first-order o.d.e. by integrating factor o Solving first-order o.d.e. by product of two arbitrary functions g(x)f(x) o Solving first-order o.d.e. of higher degree by reduction of degree followed by using product of two arbitrary functions g(x)f(x) o Solving first-order o.d.e. of 2nd-degree by means of quadratic roots. o Solving first-order o.d.e. of 2nd-degree by substitutive reduction to 1st-degree o Parametric integration of first-order o.d.e. of 2nd-degree to express y in terms of powers in y'. o General solution of Clairaut's equation. o General solution of Lagrange's equation. o Orthogonal curves of fluid flow. o Orthogonal projection of curves. o Isogonal projection of curves. o Solution of second-order o.d.e. by reducing it to first-order o Solution of second-order o.d.e. and higher degree by reducing it to first-order. o Conditions required for general solution of homogeneous o.d.e. o Reducing order of o.d.e. when a particular solution is know. o Characteristic equations and solution of 2nd-order o.d.e. by D-Operator. o Characteristic equations and solution of 2nd-order o.d.e. with complex roots. o General and particular solutions of the non-homogenous 2nd-order o.d.e. o Integrating 4th-order nonhomogeneous o.d.e. with sine function by using the Inverse D-Operator. o Simultaneous solution of 1st-order o.d.e. o Simultaneous solution of 2nd-order o.d.e. o Order reduction of 3rd-order nonhomogeneous o.d.e. by known particular solution o Solving 2nd-order o.d.e by product of two arbitrary functions g(x)f(x). o Solution of 2nd-order nonhomogenous o.d.e. by the method of variable parameters o Solution by the method of change of the independent variable x o Solution of 2nd-order o.d.e. by power series. o Solution of 2nd-order o.d.e. by power series by Frobenius's method. o Airy-Lévy's equation o Elastic Vibration o Heat Equation o Laplace Equation o Wave Equation o Free oscillation or homogeneous o.d.e. o Forced oscillation or nonhomogeneous o.d.e. o Euler's elastic bending problem. o Whirling of elastic rod. o Transverse wave transmission in a vertical elastic body. o Propagation of sound waves in gas medium. o Flow of electricity in wire. o Telegraph Equations: o Radio Equations o Heat conducting plate with rectangular cross-section. o One dimensional variable heat conduction o One dimensional variable heat conduction with nonvanishing final temperature.

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