Ordinary Differential Equations　　　　**L-T-P: 3-1-0**　　**Credit:4**　　　　　　　　**MAxxxxx**
Prerequisite: None

Introduction and First-Order Differential Equations: Classifications, order, degree of Differential Equations, Separable Equations, Linear Equations, Integrating Factors, Theory of Exact Differential Equations, First order non-linear Equations, Clairaut's Equation, The Existence and Uniqueness Theorem and its Applications, Dependence of Solutions on Initial Conditions and Boundary Conditions. **[8 hours]**

Second- and Higher-Order Linear Equations: Second-Order Equations, Linearly Independent Solutions, Wronskian, Linear Homogeneous Equations with Constant Coefficients; Characteristic Equations, Cauchy-Euler Equations, Variation of Parameters (both Second- and higher-order), Applications of higher order equations. [**7 hours**]

Series solutions to the linear ordinary differential equations: Power series, Series solutions near an ordinary point, Series solutions near a regular singular point; Bessel Equations. [**5 hours**]

The Laplace Transform and applications to ODEs: Definition and Basic Properties of the Laplace Transform and The Inverse Laplace Transform, Discontinuous Forcing Terms, The Heaviside function and Delta Function, Convolutions, Solution to Initial Value Problems with and without source terms. [**7 hours**]

First-Order Linear Systems of Equations: Basic Theory of Phase Space, Phase Plane, and Fundamental Set of Solutions, Homogeneous Linear Systems with Constant Coefficients: Phase Portraits; The Classification of Equilibrium and The Trace-Determinant Plane, Fundamental Matrices: Complex Eigenvalues and Repeated Eigenvalues, Qualitative Analysis, Autonomous Systems and Stability; Phase Plane. [**8 hours**]

Nonlinear Systems of Equations: Autonomous Systems and Stability; Phase Plane, The Linearization of a Nonlinear System, Invariant Sets and the Use of Nullclines, The Method of Lyapunov. **[5 hours]**

Around 12 tutorial classes will be taken.

Books:

1. William E. Boyce, Richard C. DiPrima and Douglas C. Meade, Elementary Differential Equations and Boundary Value Problems, 11th Edition, Wiley, 2017.
2. V. Arnold, Ordinary Differential Equations, MIT Press, 1978.
3. E. A. Coddington and N. Levinson, Theory of Ordinary Differential Equations, Krieger Publishing Co, 1984.
4. S. L. Ross, Differential Equations, 3rd edition, Wiley India, 1984.
5. P. Hartman, Ordinary Differential Equations, 2nd Edition, Birkhauser, 1982.

6. A.C. King, J. Billingham, S. R. Otto, Differential Equations: Linear, Nonlinear, Ordinary, Partial, Cambridge University Press, 1st edition, 2003.

7. Differential Equations and Dynamical Systems, Lawrence Perko, Third Edition, Texts in Applied Mathematics Series, Springer, 2001.