DIFFERENTIAL EQUATIONS FOR ENGINEERS

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IIT Madras

PRE-REQUISITES : Basic Calculus

INTENDED AUDIENCE : Physical Mechanical Sciences and Engineering

COURSE OUTLINE :

The course is to introduce the essential differential equations and their solution methods. The course is very much essential to all engineering students for its use in any kind of scientific or engineering work. The course offers them a good exposure of both ordinary and partial differential equations that arise in physical and engineering sciences.

ABOUT INSTRUCTOR :

Prof. Srinivas Rao Manam is working as an associate professor at Department of Mathematics, IIT Madras. He works in the area of differential equations arise in physical and engineering sciences.

COURSE PLAN :

Week 1: Introduction to Differential Equations, Solutions of first order ODEs, Homogeneous Equations, Exact Equations.
Week 2: Solution methods for first order ODEs, Reducible to Exact Equations, Integrating factors, Linear first order ODE, Reducible to linear equations, Bernoulli’s Equation.
Week 3: Introduction to Second order ODEs' , Properties of solutions of second order homogeneous ODEs', Abel's formula to find the other linear independent solution, Abel's formula-Demonstration with examples.
Week 4: Second order ODE's with constant coefficients, Euler-Cauchy equation, Non-homogeneous ODEs-Variation of parameters, Method of undetermined coefficients,Demonstration of Method of undetermined coefficients
Week 5: Power series and its properties, Power series method to solve second order linear homogeneous ODEs, Legendre Equation, Properties of Legendre polynomials.
Week 6: Classification of Singular points, Solution around a regular singular point- Frebeneous Method, Bessel Equation and properties of Bessel functions.
Week 7: Sturm-Liouville theory, Finding Eigenvalues and Eigenfunctions, Generalised Fourier series.
Week 8: Introduction to second order Linear Partial Differential Equations (PDEs), Classification of nd order linear PDEs, Solutions by the method of classification.
Week 9: One-dimensional Wave Equation, D’Alembert’s solution, Solution of wave equation in semi-infinte domains, Uniqueness by the energy argument, non-homogeneous wave equation and its solution.
Week 10: Separation of variable method for -dim wave equation over a finite domain, Vibration of a finite string, Two-Dimensional Wave equation, Vibration of a drum.
Week 11: One-dimensional Heat equation, Temperature distributions in an infinite,semi-infinite and finite rods, Uniqueness of solutions, Solution of a Heat equation with external source
Week 12: Steady-State Heat Equation, Solutions of the Laplace equation in rectangular domains, Solution of the Laplace equation in circular domains.