Course Title:	CS-835, Numerical Simulation
Credit Hours:	3+0
Pre-requisites:	▪ Numerical Analysis ▪ Linear Algebra ▪ Calculus
Course Description:	The course is devoted to the introduction of advanced numerical methods in Scientific Computing for large-scale applications. The aim of the course is to give the students an introduction to the construction principles of advanced numerical methods so that they will be able to understand, use, and develop efficient algorithms for large-scale problems.
Tools and Technologies:	▪ MATLAB ▪ C/C++
Learning Outcomes:	On successful completion of this course students will be able to: ▪ Apply advance numerical methods to solve complex problem. ▪ Identify strength and weakness of different type of methods and related them to given problem. ▪ Understand and use fast method for sparse linear systems. ▪ Understand the need of fast summation method. ▪ Able to use fast summation methods for model problem.
Tentative MS Thesis:	▪ Parallelization of fast summation methods ▪ Fast summation method for Stokes flow ▪ Fast summation method for elliptic and parabolic problem
Text Books:	James W Demmel (1997): Applied Numerical Linear Algebra, Michael Hanke (KTH) Lecture notes: Advance Numerical Method

Reference Books:	▪ *Computational Science and Engineering*, By G. Strang, Wellesley-Cambridge, 2007.
Course Contents:	Example problem and Basic equation ▪ Basis of solving Linear System Solution - Dense Gauss Elimination, Conditioning, Stability ▪ Linear System Solution - Orthogonalization Methods, QR, Singular Matrices, Singular Value Decomposition. ▪ Nonlinear System Solution - 1D Newton Method, Multidimensional Newton Method, Convergence Analysis ▪ Spectral methods for periodic and non-periodic problems. ▪ Iterative method for linear system: Jacobi, Gauss-Seidel, SOR ▪ Krylov subspace Iterative Methods: Conjugate Gradient ▪ Multi level Method: Multi grid method ▪ Fast summation method: FFT, fast multipole method