Computational applied mathematics **(MST374)** content listing

Unit 1: *Getting started*	Introduction to Python in the context of solving equations of one variable using various iterative methods such as simple iteration, bisection methods, Newton-Raphson method, and the convergence of simple iterative schemes.
Unit 2: *Interpolation*	Practical root-finding, Lagrange interpolation; least-squares curve fitting, splines.
Unit 3: *Systems of linear equations*	Solution of linear equations by **LU** decomposition, ill-conditioning, applications in finding eigenvalues, least-squares regression analysis.
Unit 4: *Data analysis*	Analysing big data, single value decomposition (SVD), principal component analysis (PCA), independent component analysis (ICA), multidimensional scaling, k-means.
Unit 5: *Linear programming*	Simplex method, graphical formulations, two-phase simplex method, duality and sensitivity analysis.
Unit 6: *Systems of nonlinear equations*	Newton-Raphson method for multivariate problems, quasi-Newton methods, Broyden's method, convergence of simple iterative schemes.
Unit 7: *Nonlinear optimization*	Minimising functions of one variable, moving on to multivariate problems that include unconstrained minimization and constrained minimization with equality and inequality constraints.
Unit 8: *Differentiation, integration and ordinary differential equations*	Numerical differentiation, numerical integration, Newton-Cotes formulae, trapezium method, Simpson method, Euler method, Runge-Kutta method, boundary value, eigenvalue problems, shooting methods.
Unit 9: *Random processes*	Basic theory of random variables, random walks, Markov chains, Monte Carlo integration, numerical solution to stochastic differential equations.
Unit 10: *Case studies*	A series of case studies which consolidate ideas presented in the previous units.