Course Type	Course Code	Name of the Course	L	T	P	Credits
DC	NCSC502	Computing Techniques and Mathematical Tools	3	1	0	4

Course Objective
To teach various important and relevant mathematical and statistical techniques and tools so as to enable the students to handle academic and research problems with enhanced understanding and confidence

Learning Outcomes
• The PG and PhD students will develop more analytical power, skill, understanding in dealing with various course and research topics, will help the students in developing and presenting the research method they propose in articles with an objective to publish them in various journals / conference proceeding

Unit No.	Topics to be Covered	Lecture Hours (L+T)	Learning Outcome
1	Sets, Fuzzy sets, Rough Sets: basic concepts, operations, application in various problems	3+1	Sets and their variants (fuzzy, rough) are extensively used in AI/ML/DS an Students are expected to become more knowledgeable
2	Linear algebra: Matrix, matrix decomposition, dimensionality reduction techniques, sparse linear model vector calculus, gradient of vectors, backpropagation and automatic differentiation, vector space, operations, transformation, affine space. Associated numerical methods	7+2	The student will develop knowledge and concepts about matrix algebra before they apply them in related problems
3	Optimization and search techniques: Basics of constrained optimization, linear programming, convex optimization, Fibonacci search, golden section search, simulated annealing	6+2	Students will learn about optimization and search techniques which are essentially used in dealing with data of high dimension and volume
4	Number theory: basic concepts, divisibility, primes, linear and quadratic residues	7+2	Students will develop concepts before they apply them in the field of cryptography to enhance security essentially urgent in the public domain
5	Probability distribution, density estimation, Gaussian mixture model, regression techniques,	5+2	Students will develop skill in these tools and techniques and will become more comfortable in the fields where handling large data set or samples statistically.

6	Signal and image transforms, multiresolution decomposition and analyses/techniques	3+1	These topics will help the students to deal with data in the form of signals and analyze them in both real and spectral domain with specified precision
7	Special functions (beta function, error function, hypergeometric function, Bessel, Legendre),	4+2	Special functions have applications in various field like security, cryptography, computer vision etc. The students will be able to deal with related problems with more confidence
8	Interpolation techniques, numerical differentiation, integration	4+2	Numerical techniques help solve problems efficiently from the programming perspective and the students will learn them.
9	Programming: Problem solving using scripting language like Python, Matlab, C/C++ etc	3	The students will learn about programming. They will be able to implement the methods they learn in all other modules
	Total	42+14(T)= 56	

Text Books:

1. Fuzzy Set Theory—and Its Applications H.-J. Zimmermann, Springer
2. Rough Sets: Mathematical Foundations, Lech Polkowski, Springer
3. An Introduction to Numerical Methods and Optimization Techniques by Richard W Daniels, Elsevier
4. Probability, Statistics, and Queuing Theory with Computer Science Applications, Arnold O Allen, Academic Press
5. Special Functions for Scientists and Engineers, W.W.Bell, Courier Corporation
6. Numerical Mathematical Analysis by J B Scarborough
7. Introduction to Number Theory: Martin Erickson and Anthony Vazzana

Reference Books:

1. Numerical recipes in C: the art of scientific computing, Press W.H.,
2. Teukolsky S.A., Vetterling W.T., Flannery B.P., Cambridge University Press