Syllabus for Ph.D. Comprehensive Examination Autumn 2023
(Full Time)
Department: MATHEMATICS
National Institute of Technology Meghalaya

Name of Research Group: Pure Mathematics

No. of Students Appearing: 02

Syllabus Content:

(a)	Course Name and Code	:	Analysis (MA 702)
	Syllabus	:	Metric spaces, convergence of sequences, completeness, connectedness and sequential compactness; Continuity and uniform continuity; sequences and series of functions, uniform convergence, equicontinuity, Ascoli's theorem, Weierstrass approximation theorem, Partial and directional derivatives, differentiability, Chain Rule, Taylor's theorem, Maxima and Minima, Lagrange multipliers, Inverse function theorem, Implicit function theorem. Fubini's Theorem, Line integrals, Surface integrals.
(b)	Course Name and Code	:	Linear Algebra (MA 403)
	Syllabus	:	Vector spaces, subspaces, linear independence and dependence, bases, dimension, coordinates, reduced row-echelon form. Linear transformations, rank- nullity theorem, representation of transformations by matrices, linear functionals, dual and double dual of a space, annihilator of a subset, transpose of a linear transformation. Eigenvalues and eigenvectors, characteristic polynomial, diagonalization of matrices and linear transformation, annihilating polynomials, Cayley- Hamilton theorem, minimal polynomial, invariant subspaces, invariant direct sums, Jordan canonical form. Inner products, inner product spaces, orthogonality, orthonormal sets, Gram-Schmidt process.
(c)	Course Name and Code	:	Advanced Number Theory (MA 535)
	Syllabus	:	Divisibility, primes and their properties, congruences and various associated theorems, arithmetic functions, linear congruences, Chinese remainder theorem. Primitive roots, Quadratic residues, Diophantine equations. the equation $x^2 + y^2 = z^2$. Method of Descent; the equation $x^4 + y^4 = z^2$. Continued fractions.
(d)	Course Name and Code	:	Numerical Analysis (MA409)
	Syllabus	:	Systems of Linear Equations: Gaussian elimination, pivoting strategies, vector and matrix norms, error estimates and condition number; iterative techniques for linear systems: Jacobi, Gauss Seidel. Iterative Method for Non-Linear Equations: Bisection method, fixed point iteration schemes, Newton's method, secant method. Interpolation: Polynomial interpolation-Lagrange and Newton's divided difference; piecewise interpolation. Numerical Integration: Newton-Cotes quadrature formulas, composite Newton-Cotes quadrature formulas. Numerical Solution of IVPs: Single step methods.

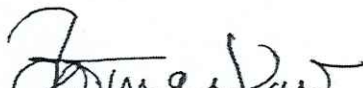|	Name of Research Group: Probability and Statistics No. of Students Appearing: 01 Syllabus Content:		
(a)	Course Name and Code	:	Analysis (MA 702)
	Syllabus	:	Metric spaces, convergence of sequences, completeness, connectedness and sequential compactness; Continuity and uniform continuity; sequences and series of functions, uniform convergence, equicontinuity, Ascoli's theorem, Weierstrass approximation theorem, Partial and directional derivatives, differentiability, Chain Rule, Taylor's theorem, Maxima and Minima, Lagrange multipliers, Inverse function theorem, Implicit function theorem.Fubini's Theorem, Line integrals, Surface integrals.
(b)	Course Name and Code		Probability Theory (MA407)
	Syllabus		Discrete and continuous random variables, probability mass, probability density, and cumulative distribution functions. Binomial, geometric, Poisson, uniform, exponential, and normal distribution. Mathematical expectation, moments, moment generating function, Chebyshev's inequality. Weak law of large numbers, central limit theorem. Joint, marginal, conditional distributions, product moments, simple correlation and simple linear regression.
(c)	Course Name and Code		Statistical Inference (MA539)
	Syllabus		Concept of sufficiency, minimal sufficiency, Neyman factorization criterion, unbiasedness, Fisher information, exponential families, maximum likelihood estimator (MLE), and method of moment estimator (MME). Uniformly minimum variance unbiased estimator (UMVUE), Rao-Blackwell theorem, Cramer-Rao lower bound, Lehmann-Scheffé Theorem. Statistical hypotheses-simple and composite, statistical tests, critical regions, Type-I and Type-II errors, size and power of a test. Confidence intervals and construction of confidence intervals.

Signatures and Names of DRC members:

S. Mukherjee   T. Subedi   M. Saha   B. Kumbhakar

T. Karmakar   K. Senthilkumar   A.K. Jena