GAUUTAM BUDDHA UNIVERSITY, GREATER NOIDA

SYLLABUS FOR PhD. MATHEMATICS: GBU-ET

RESEARCH METHODOLOGY

Nature and Purpose of Research: Meaning of research, aim, Nature and scope of research, Prerequisites of research, Types of research: Exploratory, Descriptive and Experimental.

Research Problem: Types of research problems, Characteristics of a good research problem, Hypothesis: Meaning and types of hypothesis, Research proposal or synopsis.

Research Methods: Qualitative and Quantitative

Review of Literature: Purpose of the review, Identification of the literature, organizing the literature.

Data Collection and Analysis: Types of data, Methods of data collection, Sample and Population, Sampling Techniques, Characteristics of a good sample, Tools of Data Collection: Observation method, Interview, Questionnaire, various rating scales, Characteristics of good research tools.

Descriptive Statistics: Tabulation, Organization, and Tabulation and Graphical Representation of Quantitative data, Measures of Central Tendencies: Mean, Median, Mode Measures of Variability: Range, Quartile Deviation, Standard Deviation, and Coefficient of variation. Normal Probability Distribution: Properties of normal probability curve, Skewness and Kurtosis, Data analysis with Statistical Packages (MS-Excel, SPSS), Hypothesis Testing, Generalization and Interpretation.

Research Report: Structure and Components of Research Report, Types of Report, Characteristics of Good Research Report, Bibliographical Entries, Research Ethics

MATHEMATICS

Analysis:

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences. and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation., inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra:

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigen values and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms

Complex Analysis:

Algebra of complex numbers, the complex plane, polynomials, power series, transcendental - functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchyus theorem, Cauchy" s integral formula, Liouville"s theorem, Maximum modulus principle, Schwarz Jemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

Algebra:

Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements. Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler”s Ø- function, primitive roots. Groups, subgroups, normal subgroups, quotient groups, homornorphisms, cyclic groups, permutation groups, Cayley"s theorem, class equations, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Etelidean domain. Polynomial rings and in-educibility criteria. Fields, finite fields, field extensions, Galois Theory.

Topology:

Basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

Ordinary Differential Equations (ODEs):

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Lowville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave.

Numerical Analysis:

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hennite and spline interpolation,Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Fluid Mechanics:

Real and Ideal fluids, Basic flow concepts, Viscosity, Laminar and Turbulent flows, Reynolds Number, Eulerian and Lagrangian description of fluid motion, steady and unsteady flows, Couette-Poiseuille flows. Equations of mass and momentum (Euler equation).

Probability and Distributions: Descriptive statistics, exploratory data analysis.Sample space, discrete probability, independent events, Bayes theorem.Random variables and distribution functions (univariate and multivariate), Binomial, Poisson, Normal distributions, expectation and moments.independent random variables, marginal and conditional distributions.

Operations Research:

Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Jobsequences, Game theory, Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, MIMIC with limited waiting space, M/G/1.