

**Syllabus for Ph.D. (Department of Mathematics and Statistics) Entrance
Exam Paper -II**

UNIT-1	Probability
Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions.	
UNIT-2	Stochastic Processes
.Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution. Poisson process, birth process, birth-death process.	
UNIT-3	Linear Algebra
Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose. Determinants, Laplace expansions, cofactors, adjoint, Cramer's rule.	
UNIT-4	Differential Equations
ODE: General solution of homogeneous equations, non-homogeneous equations, Wronskian, method of variation of parameters. PDE: Linear and quasilinear first order partial differential equations, method of characteristics; second order linear equations in two variables and their classification.	
UNIT-5	Numerical Methods
Bisection method, fixed-point iteration, Newton's method. Error analysis for Iterative Methods. Computing roots of polynomials. Interpolation: Lagrange Polynomial. Divided Differences. Numerical differentiation; numerical integration: Trapezoidal and Simpson rules; numerical solution of systems of linear equations: direct methods (Gauss elimination, LU decomposition); iterative methods (Jacobi and Gauss-Seidel); numerical solution of ordinary differential equations: initial value problems: Modified Euler's method, Runge-Kutta 4th order methods.	
References: 1. Rao, C. R., <i>Linear Statistical Inference and Its Applications</i>, 2nd ed., John Wiley & Sons, New York. ISBN: 978-0-471-70823-0. 2. Das Gupta, A., <i>Fundamentals of Probability: A First Course</i>, 1st ed., Springer, New York, 2010. ISBN: 978-1-4419-5779-5. 3. Casella, G., and Berger, R. L., <i>Statistical Inference</i>, 2nd ed., Duxbury, Pacific Grove, CA, 2002. ISBN: 978-0-534-24312-8. 4. Grewal, B. S., <i>Higher Engineering Mathematics</i>, 45th Edition, Khanna Publishers, New Delhi, ISBN: 978-81-933284-9-1. 5. Kreyszig, Erwin, <i>Advanced Engineering Mathematics</i>, 10th Edition, Wiley, 2011, ISBN: 978-1-118-04927-3.	

6. Jain, M. K., Iyengar, S. R. K., and Jain, R. K., *Numerical Methods for Scientific and Engineering Computation*, 7th Edition, New Age International Publishers, New Delhi, 2019, ISBN: 978-93-87477-25-4.