

## Tamil Nadu Public Service Commission

### Statistics and Mathematics (Degree Standard)

Code: 505

#### Unit I: Descriptive Statistics (12 Questions)

Uses, Scope and limitations of Statistics – Collection, Classification and Tabulation of data – Diagrammatic and Graphical representations – Measures of location, dispersion, skewness and kurtosis – Correlation and regression – Curve fitting – Linear and quadratic equations by the method of least squares.

#### Unit II: Probability Theory and Probability Distribution (30 Questions)

Probability – Addition, Multiplication and Baye's Theorems and their applications. Random variables – Univariate and Bivariate – Probability distributions – Marginal and conditional distributions – Mathematical expectations – Moments – Moment generating functions – Characteristic function and cumulant generating functions - Discrete distributions – Binomial, Poisson, Geometric distributions, Continuous distributions – Uniform, exponential, normal distribution - Sampling distributions and Standard error – Student's "t", Chi-square and F – Distributions and their applications.

#### Unit III: Estimation Theory and Test of Hypothesis (30 Questions)

Estimation – Point estimation – Properties of estimators – Cramer-Rao inequality, Rao-Blackwell theorem, MLE and method of moments estimation – Interval estimation for population mean and variance based on small and large samples.

Hypothesis testing – Null and Alternative Hypotheses – Types of errors – Level of Significance – Test procedures for large and small samples – t, F, Chi-square and Z Tests.

#### Unit IV: Sampling Theory and Design of Experiments (24 Questions)

Simple random sampling – Stratified, systematic, cluster (Single stage) – Estimation of mean and variance in SRS – Sample Survey Organisation – CSO and NSO – Sampling and non-sampling errors. Analysis of Variance – Principles of design – CRD, RBD and LSD –  $2^2$  Factorial experiments.

#### Unit V: Time Series and Vital Statistics (12 Questions)

Time series – Components of time series – Trend and Seasonal Variations – Determination and elimination.

Vital Statistics – Importance – Collection – Mortality and its measurements – Life table construction and uses – Fertility and its measurements.

#### Unit VI: Statistical Computing using MS-Excel and SPSS (12 Questions)

Introduction to MS-Excel – MS-Excel Options using Excel Shortcuts – Link the Data in Rows, Columns and Sheet – Functions: Logical Functions – Math and Statistical Functions – Charts-Plotting Density Function and Distribution Function. Understanding on the usage of Statistical Package SPSS.

#### Unit VII: Algebra and Calculus (25 Questions)

Theory of Equations: Relations between roots and Coefficients – Complex roots – Irrational roots – Related roots - Transformations of equations – Reciprocal equations.

Matrix Theory: Symmetric – Skew Symmetric – Hermitian – Skew Hermitian – Orthogonal and Unitary Matrices – Rank of a matrix – Consistency and Solutions of Linear Equations – Cayley Hamilton Theorem – Eigen values and Eigen Vectors.

Differential Calculus:  $n^{\text{th}}$  derivative – Leibnitz's theorem and its applications.

Integral Calculus: Methods of integration – Properties of definite integrals – Double Integrals – triple integrals – Beta and Gamma functions and their properties.

#### Unit VIII: Differential Equations Laplace Transforms and Vector calculus (25 Questions)

First order but of higher degree equations – solvable for p, solvable for x, solvable for y, Clairaut's form. Second order differential equations with constant coefficients with particular integrals for  $e^{ax}$ ,  $x^m$ ,  $\cos mx$ ,  $\sin mx$ ,  $e^{ax} \cos mx$ ,  $e^{ax} \sin mx$ .

Partial Differential equations: Formation of Partial Differential equations by eliminating arbitrary constants and arbitrary functions – First order Partial Differential equations – Complete integral – Singular integral – General integral – Charpit's method – standard types  $f(p,q)=0$ ,  $f(x,p,q)=0$ ,  $f(y,p,q)=0$ ,  $f(z,p,q)=0$  and  $f(x,p)=f(y,q)$  – Clairaut's form and Lagrange's equations –  $Pp+Qq=R$ .

Laplace transform – Inverse Laplace transform (usual types) – applications of Laplace transform to solution of first and second order linear differential equations (constant coefficients).  
Vector Differentiation: Gradient, divergence, curl, directional derivative, unit normal to a surface.  
Vector integration: line, surface and volume integrals – Applications of Gauss, Stokes and Green's theorems – simple problems.

#### **Unit IX: Algebraic Structures (15 Questions)**

Groups, subgroups, cyclic groups and properties of cyclic groups – Lagrange's Theorem – Normal subgroups – Homomorphism – Permutation groups.  
Vector Spaces: Definition and examples – linear dependence and independence – dual spaces – inner product spaces.

#### **Unit X: Real and Complex Analysis (15 Questions)**

Sets and Functions: Sets and elements – Operations on sets – functions – real valued functions – equivalence – countability – real numbers – least upper bounds.  
Sequences of Real Numbers: Definition of a sequence and subsequence – limit of a sequence – convergent sequences – divergent sequences – bounded sequences – monotonic sequences.  
Series of Real Numbers – Convergence and divergence – series with non-negative numbers – alternating series – conditional convergence and absolute convergence.  
Analytic functions: Functions of a complex variable – limits – theorems of limits – continuity - derivatives – differentiation formula – Cauchy-Riemann equations, sufficient conditions – Cauchy – Riemann equations in polar form – Harmonic functions.  
Complex Integrals: Definite integrals – Cauchy's theorem - Cauchy's integral formula – Formula for higher derivatives.