#### Tamil Nadu Public Service Commission Syllabus Statistics, Mathematics and Economics PG Degree Standard

### Unit I: Probability, Random Variables and Distribution Theory (25 Questions)

Introductory concepts of Probability, Definition, Axioms, Basic Theorems and Baye's Theorem. Random Variables – Mathematical Expectation and Conditional Expectation. Chebechev's inequality – Convergence in Probability – Weak and Strong laws of large numbers – CLT (Lindberg-Levy and Lyapunov's). Marginal and Conditional distributions, MGF, PGF and CGF. Univariate Distributions: Negative Binomial, Hyper geometric, Geometric, Cauchy, Beta, Gamma, Weibull, Log-Normal. t, F and Chi-square distributions. Bivariate Binomial, Bivariate Poisson, Multinomial, Bivariate Normal distributions.

# Unit II: Estimation Theory, Testing of Hypothesis and Non-Parametric Tests (15 Questions)

Properties of Estimators, Cramer – Rao inequality, Rao-Blackwell, Lehman-Scheffe and Factorization theorems and applications. Methods of Estimation – MLE, Moments and Least squares. Confidence intervals for mean and variance in large and small samples.

Elements of Testing of Hypothesis – Definitions, Types of errors – Critical region, size and level of a test – Power function. Most powerful test, NP Lemma, UMP and Unbiased tests. MLR property and simple applications.

Non-Parametric Tests: Run, median, Sign, Mann-Whitney, Wilcoxon, K-S (one and two samples) and Kruskal-wallis tests

# Unit III: Sampling Theory, Design of Experiments and Index numbers and Time series (25 Questions)

Sampling Designs: SRSWR, SRSWOR, Stratified, Systematic, Cluster and Multistage sampling methods – Estimation procedures and properties of estimators. Ratio and Regression estimators (under SRSWOR and Stratified], CSO and NSO.

Linear models - Fixed, Random and Mixed effect models. Construction and analysis of 2<sup>n</sup> and 3<sup>n</sup> Factorial experiments including partial and complete confounding. Incomplete block designs – BIBD, PBIBD. Split plot design and Youden square design.

Index Numbers: Introduction – Construction of simple and weighted index numbers, Tests of Ideal index number, Cost of living and Whole Sale Price Index numbers.

Time series: Introduction, Models and their components. Determination of trend by the method of moving averages and fitting of linear, quadratic and exponential curves. Determination of Seasonal indices by Ratio- to- Trend and Ratio to moving averages. Estimation of variance for random components by Autoregressive (AR) and Moving Averages (MA) and ARIMA models.

# Unit IV: Correlation, Regression and Machines Learning Techniques using Python (15 Questions)

Correlation Analysis – Simple, Partial and Multiple correlations. Regression Analysis – Simple and Multiple Linear regression models, description, estimation and Testing of hypothesis of regression coefficients. Model Adequacy measures – Multicollinearilty Analysis and selection of variables by stepwise method.

Generalized linear models – Introduction, Components of GLM, Logistic regression – Fitting and interpretation.

Introduction to Python – Character set, Data types, Operators expressions, Control and Loop statements, Arrays, Lists, Dictionaries. Libraries - numpy, scipy, matplotlib and Pandas. Machine Learning Techniques - Supervised learning – Classification using KNN, and Regression (Linear and Logistic) techniques. Unsupervised learning - Linkage methods, k-means and k-Medoids methods.

# Unit V: Algebra and Real Analysis (20 Questions)

Algebra: Groups – Sub groups – Normal sub-groups – Homomorphisms – Isomorphisms – Caley's theorem – Sylow's theorems - Finite abelian groups – Rings – Euclidean rings – Polynomial rings – Polynomial over the rational fields – Polynomials over the commutative rings – Division rings – Field – Finite fields – Wedderburn's theorem – Extension fields.

Real Analysis: Limit – Continuity – Types of discontinuities – Functions of bounded variation – Riemann steilje's integral – Infinite series and infinite products – Sequences of functions – Fourier series and Fourier integrals.

### Unit VI: Complex Analysis and Functional Analysis (20 Questions)

Complex Analysis: Analytic functions – Properties – Singularities – Taylors and Laurents' series – Zeros and poles – Maximum principle – Harmonic Functions – Mean Value Property – Poisson's formula – Schwarz theorem – Power series expansion – Radius of convergence.

Functional Analysis: Banach spaces – Definition and Examples – Holder's inequality and Minkowski's inequality – Continous Linear transformations – The Hahn – Banach Theorem – Natural imbedding of x in to x<sup>\*\*</sup> - The open mapping theorem and the closed graph theorem – Properties of conjugate of an operator. Hilbert spaces – Orthonormal bases – Conjugate space H<sup>\*</sup> - Adjoint of an operator – Projection – Spectrum of an Operator – Spectral theorem for operators on Finite dimensional Hilbert space – Regular and singular elements in a Banach Algebra – Topological divisor of zero spectrum of an element – Formula for spectral radius – Radical and Semi simplicity.

#### Unit VII: Differential Equations and Operations Research (20 Questions)

Differential Equations: Linear Differential equations of Higher order – Wronskian – Linear dependence and independence – Solutions in power series – Singularities of second order linear differential equations – Legendre's Equations – Legendre Polynomials – Bessel's equations – Bessel's functions – Generating functions – Rodrigue's formula – Partial Differential Equations of first order – Completer integrals – Singular integrals – General integrals – Charpitz method – Solutions of second order Linear partial Differential Equations.

Operations Research: Linear Programming Problems (LPP) – Formulation – Graphical solutions – Standard form – Basic solutions – degenerate solution – Simplex method – Artificial variables BigM – Method and two phase method – Principle of duality – Dual simplex method – Revised simplex method.

Transportation problems – Initial basic feasible solutions – Balanced and Unbalanced Transportation problems – Optimality Test – Degeneracy.

Assignment – Problems – Hungarian method.

# Unit VIII: Principles of Economics (15 Questions)

a) Microeconomic Principles – Theory of consumer behavior – Utility – Indifference curve analysis Revealed Preference theory. Analysis of choices involving risk, uncertainty and asymmetric information – Neumann – Morgernstern hypothesis. Adverse selection and moral hazards, adverse selection in the Labour market – Market structure.

b) Macroeconomic Principles – General equilibrium – IS – LM – BP model – Business cycle Theories.

# Unit IX: Growth and Development (15 Questions)

Monetary and Fiscal Policy instruments. Effects of Monetary and Fiscal Policies through Mundell – Fleming model. Foreign trade – BOP problems – Correcting methods. (NIEO) International Organizations and their functions. WTO, World Bank, IMF,

# Unit X: Indian Economy (30 Questions)

Economic Development – Leading issues in India and in Tamil Nadu Human Development Index – Progress in HDI in India. Poverty – Reforms on Poverty. India's demographic transition – Population Policy in India. Characteristics of Indian labour market – Employment Policy in India – Issues and problems of migrant labourers. Agriculture prospects and problems – Land reforms and effects. Industrialization in India - Performance of MSMEs - Large scale industries in India – New Industrial Policy of 1991 – New Direction of Policy on Public Sector - Planning in India – Objectives and achievements at National and State level – Failures of Five Year Plans in India – NITI AAYOG – Liberalization, Privatization and Globalization in India - Environmental degradation and sustainable development – Issues and challenges.

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