**Syllabus for the post of**
**Assistant Professor- Mathematics, Maharashtra Education Services, Group - A (Collegiate Branch)**

Steps of Exam: Written Exam - 200 Marks                   Interview - 50 Marks

<table>
<thead>
<tr>
<th>Level: - Degree</th>
<th>No. of Questions: - 100</th>
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<tbody>
<tr>
<td>Medium: English</td>
<td>No. of Marks: - 200</td>
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<tr>
<td>Nature of Paper - Objective Type</td>
<td>Duration: - 1 hour</td>
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Final merit list will be prepared by considering the marks obtained in Written test & Interview.

**SYLLABUS**

1. **Real Analysis**: Riemann integrable functions; improper integrals, their convergence and uniform convergence. Euclidean space $\mathbb{R}^n$, Bolzano-Weierstrass theorem, compact Subsets of $\mathbb{R}^n$, Heine-Borel theorem, Fourier series.
   - Continuity of functions on $\mathbb{R}^n$, Differentiability of $F: \mathbb{R}^n \to \mathbb{R}^m$. Properties of differential, partial and directional derivatives, continuously differentiable functions. Taylor’s series.
   - Inverse function theorem, Implicit function theorem.
   - Integral functions, line and surface integrals, Green’s theorem, Stoke’s theorem.


3. **Algebra**: Symmetric groups, Alternating groups, Simple groups, Rings, Maximal Ideals, Prime Ideals, Integral domains Euclidean domains, principal Ideal domains, Unique Factorisation domains, quotient fields, Finite fields, Algebra of Linear Transformations, Reduction of matrices to Canonical Forms, Inner Product Spaces, Orthogonality, Quadratic Forms, Reduction of quadratic forms.

4. **Advanced Analysis**: Elements of Metric Spaces, Convergence, continuity, compactness, Connectedness, Weierstrass’s approximation Theorem, Completeness, Baire category theorem, Lebesgue measure, Lebesgue Integral, Differentiation and Integration.

5. **Advanced Algebra**: Conjugate elements and class equations of finite groups, Sylow theorems, solvable groups, Jordan Holder Theorem, Direct Products, Structure Theorem for finite abelian groups, Chain conditions on Rings; Characteristic of Field, Field extensions, Elements of Galois theory, solvability by Radicals, Ruler and compass construction.
6 Functional Analysis: Banach Spaces Hahn-Banach Theorem, Open mapping and closed Graph Theorems. Principal of Uniform boundedness, Boundedness and continuity of Linear Transformations, Dual Space, Embedding in the second dual, Hilbert Spaces, Projections. Orthonormal Basis, Riesz representation theorem, Bessel’s Inequality, parsaaval’s identity, self adjoined operators, Normal Operators.


8 Discrete Mathematics: Partially ordered sets, Lattices, Complete Lattices, Distributive lattices, Complements, Boolean Algebra, Boolean Expressions, Application to switching circuits, Elements of Graph Theory, Eulerian and Hamiltonian graphs, planar Graphs, Directed Graphs, Trees, Permutations and Combinations, Pigeonhole principle, principle of Inclusion and Exclusion, Derangements.

9 Ordinary and partial Differential Equations: Existence and Uniqueness of solution dy/dx = f(x,y) Green’s function, sturm Liouville Boundary Value Problems, Cauchy Problems and Characteristics, Classification of Second Order PDE, Separation of Variables for heat equation, wave equation and Laplace equation, Special functions.

10 Number Theory: Divisibility; Linear diophantine equations. Congruences. Quadratic residues; Sums of two squares, Arithmetic functions Mu, Tau, and Signa (and ).

11 Mechanics: Generalise coordinates; Lagranges equation; Hamilton’s cononical equations; Variational Principles-Hamilton’s principles and principles of least action; Two dimensional motion of rigid bodies; Euler’s dynamical equations for the motion of rigid body; Motion of a rigid body about an axis; Motion about revolving axes.

12 Elasticity: Analysis of strain and stress, strain and stress tensors; Geometrical representation; Compatibility conditions; Strain energy function; Constrictutive relations; Elastic solids “Hookes law; Saint-Venant’s principle, Equations of equilibrium; Plane problem-Airy’s stress function vibrations of elastic, cylindrical and spherical media.

13 Fluid Mechanics: Equation of continuity in fluid motion; Euler’s equations of motion for perfect fluids; Two dimensional motion complex potential; Motion of sphere in perfect liquid and montion of liquid past a sphere; vorticity; Navier - Stokes’s equations for viscous flows - some exact solutions.

14 Differential Geometry: Space curves-their curvature and torsion; Serret Frehat Formula; Fundamental theorem of space curves; Curves on surfaces; First and second fundamental form; Gaussian curvatures; Principal directions and principal curvatures; Goedesics, Fundamental equations of surface theory.


16 Linear Integral Equations: Linear Integral Equations of the first and second kind of Fredholm and Volterra type; solution by successive substitutions and successive approximations; Solution of equations with separable kernels; The Fredholm Alternative; Holbert-Schmidt theory for symmetric kernels.
17 Numerical analysis: Finite differences, Interpolation; Numerical solution of algebraic equation; Iteration; Newton-Raphson Method; Solution on Linear system; Direct method; Gauss elimination method; Matrix-Inversion eigenvalue problems; Numerical differentiation and integration. Numerical solution of ordinary differential equation; iteration method, Picard’s method Euler’s method and improved Euler’s method.

18 Integral Transform: Laplace transform; Transform of elementary functions, Transform of Derivatives, Inverse Transform, Convolution Theorem, Applications, Ordinary and Partial differential equations; Fourier transform; sine and cosine transform, Inverse Fourier Transform, Application to ordinary and partial differential equations.


22 Distribution Theory: Properties of distribution functions and characteristic functions; continuity theorem, inversion formula, Representation of distribution function as a mixture of discrete and continuous distribution functions; Convolutions, marginal and conditional distributions of bivariate discrete and continuous distributions. Relations between characteristic functions and moments; Moment inequalities of Holder and Minkowski.


25 **Multivariate Statistical Analysis** : Singular and non-singular multivariate distributions. Characteristics functions. Multivariate normal distributions, marginal and conditional distributions; distribution of linear forms, and quadratic forms, Cochran’s theorem. Inference on parameters of multivariate normal distributions, one-population and two population cases. Wishart distribution. Hotellings T2, Mahalanobis D2 Discrimination analysis, Principal components, Canonical correlations, Cluster analysis

26 **Linear Models and Regression** : Standard Gauss-Markov models; Estimability of parameters; best linear unbiased estimates (BLUE); Method of least squares and Gauss-Markov theorem; Variance-covariance matrix of BLUES. Tests of linear hypothesis; One-way and two-way classifications. Fixed, random and mixed effects models (two-way classifications only); variance components, Bivariate and multiple linear regression; Polynomial regression; use of orthogonal polynomials. Analysis of covariance. Linear and nonlinear regression outliers.


30 **Stochastic Processes** : Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution; branching processes; Random walk; Gambler’s ruin. Markov processes in continuous time; Poisson processes, birth and death processes, Wiener process.
31 Demography and Vital Statistics: Measures of fertility and mortality, period and Cohort measures.


32 Industrial Statistics: Control charts for variables and attributes; Acceptance sampling by attributes; single, double and sequential sampling plans; OC and ASN functions, AOQL and ATI; Acceptance sampling by varieties. Tolerance limits Reliability analysis: Hazard function, distribution with DFR and IFR; Series and parallel systems. Life testing experiments.

33 Inventory and Queueing theory: Inventory (S,s) policy periodic review models with stochastic demand. Dynamic inventory models. Probabilistic re-order point, lot size inventory system with and without lead time. Distribution free analysis. Solution of inventory problem with unknown density function. Warehousing problem. Queues: Imbedded markov chain method to obtain steady state solution of M/G/1, G/M/1 and M/D/C, Network models. Machine maintenance models. Design and control of queueing systems.