

## 16. SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF TEACHING ASSOCIATE IN MATHEMATICS

### 1. **Differential and Integral Calculus:**

Partial Differentiation, Euler's Theorem for homogeneous functions, Total Differentiation, Maxima and Minima of two and three variables, Lagrange's Multipliers Method, Curvature, Asymptotes, Envelopes and Evolutes, Singular Points. Rectification, Multiple Integral, volume and surface of revolution of curves. Beta and Gamma functions.

### 2. **Two Dimensional Coordinate Geometry (Cartesian and Polar coordinates):**

Polar equation of conics. Polar equation of tangent, normal, asymptotes and chord of contact. Auxiliary and Director circle. Second degree equation of General Conic. Centre, Asymptotes, eccentricity, foci, directrix axes and latus rectum of a conic, Co-ordinate of center, equation of conic referred to center as origin, lengths and position of axes of a standard conic.

### 3. **Three Dimensional Coordinate Geometry:**

Straight Line, Sphere, Cylinder, Cone and their properties (Rectangular Coordinates only), Central Conicoids and their properties (Referred to principal axes only).

### 4. **Vector Calculus:**

Differentiation of Vectors, Del operator, Gradient, divergent, Curl and directional derivative, their identities and related theorems. Integration of Vectors, line, Surface and Volume integration of vectors. Gauss Divergence, Stokes and Green theorem.

### 5. **Ordinary Differential Equations:**

First order non-linear differential equation, singular solutions and extraneous Loci, Second order linear differential equation with constant and variable coefficients. Simultaneous and Total Differential Equations.

### 6. **Partial Differential Equations:**

Linear and Non-linear Partial differential equation of first order. Linear Partial Differential Equations of Second Order. Solution of Partial Differential Equations by Lagrange's, Charpit's and Monge's Method.

### 7. **Mechanics:**

Equilibrium of coplanar forces, Moments, Friction, Catenary. Simple harmonic motion, Rectilinear motion under variable laws, Motion in resisting medium. Projectile.

## 8. **Abstract Algebra:**

Groups– Normal Sub-groups, Quotient groups, Homomorphism, Isomorphism of groups. Classification of finite groups. Cauchy's Theorem for finite abelian groups, Permutation groups, Solvable groups and their properties. Rings, Morphism, Principal Ideal domain, Euclidean Rings, Polynomial Rings, Irreducibility criteria, Fields, Finite fields, Field extensions. Integral domain.

## 9. **Linear Algebra:**

Vector Spaces, Linear dependence and independence, Bases, Dimensions, Linear transformations, Matrix representation of Linear transformations, Change of bases. Inner product spaces, Orthonormal basis, Quadratic forms, reduction and classification of quadratic forms. Algebra of Matrices, Eigenvalues and Eigenvectors, Cayley-Hamilton theorem. Canonical, Diagonal, Triangular and Jordan forms, Rank of Matrix.

## 10. **Complex Analysis:**

Analytic Functions, Cauchy's Theorem, Cauchy's Integral Formulae, Power Series, Laurent's Series, Singularities, Theory of Residues, Complex Transformations, Contour Integration.

## 11. **Special Functions:**

Hypergeometric, Confluent Hypergeometric Functions and their properties. Bessel, Legendre Function/Polynomial of first kind and their properties. Hermite, Laguerre Polynomials and their properties.

## 12. **Integral Transforms:**

Laplace, Inverse Laplace transform and their properties. Fourier transform, Inverse Fourier transform and their properties, Hankel, Mellin transform and their properties.

## 13. **Differential and Integral Equations:**

Classification of Second Order Partial Differential Equations, Green's Functions, Sturm-Liouville Boundary Value Problems, Cauchy's Problems and Characteristics. Calculus of variation-Variation of a functional, Euler-Lagrange's equation, Necessary and sufficient condition for extrema, Variational method for Boundary Value Problems in ordinary and partial differential equations. Integral Equations of first and second kind of Fredholm and Volterra type, solution by successive substitutions and successive approximations.

## 14. **Metric spaces and Topology:**

Metric spaces, compactness, Connectedness, Topological spaces, closed sets, closure, Dense set, Neighbourhood. Interior, exterior and boundary points, Accumulation points and derived sets.

Bases and sub-bases. First and Second Countable spaces, Separable spaces, Separation axioms, compactness, continuous functions and compact sets, connected spaces.

**15. Differential Geometry:**

Curves in space (Osculating, Normal and rectifying planes, Serret-Frenet formulae, curvature, torsion, circle of curvature and sphere of curvature), Envelopes, curves on surfaces.

**16. Tensors:**

Covariant, Contravariant and Mixed tensors, Invariants and algebraic properties of tensors. Contraction of tensors, Quotient Law of tensors. Fundamental and Associated tensors, Christoffel symbols, Covariant differentiation of tensors.

**17. Mechanics:**

D'Alembert's Principle, Moment and Product of inertia, Motion in two-dimensions. Lagrange's equations of Motion, Euler's Equations of Motion, Motion of a top.

**18. Numerical Analysis:**

Interpolation, Difference schemes, Lagrange's interpolation, Numerical differentiation and integration. Numerical solution by Bisection, Secant, Regula-Falsi and Newton's Methods, Roots of polynomial. Linear Equation – Direct Methods (Jacobi, Gauss and Seidel Method).

**19. Operations Research:**

Simplex methods, Duality, Degeneracy, Revised Simplex Method, Integer Programming Problems, Assignment and Transportation Problems, Game Theory– Two person zero sum game, Inventories- Single item deterministic inventory models with finite replacement, simple probabilistic models.

**20. Mathematical Statistics:**

Probability, Conditional Probability, Addition and Multiplication theorems of probability, Baye's Theorem, Expectations, Moment Generating Function, Probability Distributions: Binomial, Poisson, Uniform and Normal, Correlation and Regression, Line of Regressions.