JSPM UNIVERSITY
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JSPM UNIVERSITY PUNE

SYLLABUS

RPET 2023

Research Program Entrance Test

Subject Concerned Syllabus

Mathematics

1: **Algebra** : Groups, Group action, Sylow Theorems, Rings, PID, UFD, Fields, Field Extension, Finite Fields.

2: **Linear Algebra** : Finite dimensional Vector Spaces, Algebra of Linear transformations, Diag- onaziblity, Jordan canonical form, Primary decomposition theorem, Cayley Hamilton theorem, Hermitian and Unitary transformations, Spectral theorem.

3: **Real Analysis** : Real valued functions of one variable, bounded functions, limits of functions, monotonic functions, continuous functions, uniformly continuous functions, sequences of functions, series of functions, differentiability of function, Rolle's theorem, Mean value theorem, Riemann integral and properties, Fundamental theorem of Calculus, Taylor series, Fourier series, topology of R^n (convergence, continuity, compactness, connectedness, completeness), Bolzano-Weierstrass theorem, Cantor's intesection theorem, Heine-Borel theorem, Weierstrasss approximation theorem, Baire category theorem.

4: **Complex Analysis** : Topology of complex plane, Power series and radius of convergence, an- alytic functions, chain rule, branch points, Cauchy-Riemann equations, Mobius transformations, complex integration, Riemann-Stieltjes integral, Fundamental theorem of algebra, maximum mod- ulus theorem, winding number, Cauchy theorem and integral formula and its applications, Morera's theorem, Open mapping theorem, Goursat's theorem, classification of singularities, Laurent series, residue theorem.

5: **Differential Equations** : Linear Differential Equations with constant and variable coefficients, Existence and uniqueness of solution, Picard's iteration theorem, Boundary value problems, Ap- plications of differential equations, System of linear differential equations.

6: **Advanced Calculus** : Functions of several variables, Limit, Continuity, Differentiability, Chain rule, maxima and minima, Implicit function theorem, Inverse function theorem, integration, Stoke's theorem.

7: **Measure and Integration** : Measure on the real line, Lebesgue outer

measure, Measurable sets, Measurable functions, Borel and Lebesgue measurability, Integration of measurable functions, functions of bounded variation, Lebesgue's differentiation theorem, L^p spaces, convex functions, Jensen's inequality, Hölder's and Minkowski's inequality, completness of L^p spaces.

8: **Functional Analysis** : Normed linear spaces, continutity of linear maps, Hahn-Banach theo- rem, Banach spaces, Uniform boundedness principle, Closed graph and Open mapping theorems, Bounded inverse theorem, Spectrum of bounded operator, Duals and Transposes, Duals of $L^p([a, b])$ and $C([a, b])$, Inner product spaces, Orthonormal sets, Approximation and optimization, Projec- tion, Riesz-representation theorem, Bounded operators and adjoints, self adjoint, Normal, Unitary operators.

9: **Topology** : Topological of metric spaces, Continuity, Convergence, Homeomorphism, Compact- ness, Connectedness, Axioms, Subspaces, Product Spaces, Quotient spaces, Tychonoffs theorem, Urysohns metrization theorem.

10: **Discrete Mathematics** :Partially ordered sets, Lattices, Complete lattices, Distrbutive lattices, Complements, Boolean algebra, Boolean expressions, Application to switching circuits, Elements of Graph Theory, Eulerian and Hamiltonian graphs, Planar graphs, Directed graphs, Trees, Permuta- tions and Combinations, Pigeonhole principle, Principle of inclusion and exclusion, Derangements.