**SCHOOL OF STUDIES IN MATHEMATICS**

**Vikram University, Ujjain (M.P.)**

The Syllabus

For the

**Doctoral Entrance Test (DET)** /(M.Phil. Entrance Test)

(As per Ph.D. Ordinance No.11) & (M.Phil. Ordinance No. 13)

Subject:- **MATHEMATICS**

**YEAR-** 2020-21

The Test will have the question paper in **two parts**. **Part-A** shall consist of 50 **objective type** compulsory questions of mark each based on **Research Methodology**. It shall be of generic nature, intended to assess the research aptitude of the candidate. It will primarily be designed to test readoning ability, data interpretation and quantitative aptitude of the candidate. **Part-A** may be common within the same faculty. **Part-B** shall also consist of 50 **objective type** compulsory questions of 1 mark each based on the subject of the research.

The duration of the Doctoral Entrance Test will be of **two hours**. There will be **no negative** marking.

The candidates must score minimum **50% marks (45% for SC/ST/OBC)** in the entrance test to qualify for the interview.

7.7.18 07/07/18 7.7.18

# THE DOCTORAL (Ph.D.) ENTRANCE TEST

**Maximum Marks:100**

## Syllabus for Part-A: Research Methodology 50×1=50

- Meaning of research, Objective of research, Types of research, Research approaches, Significance of research, Research methods versus research methodology, Research process, Criteria of good research.
- Research Problem, Selecting the problem, Necessity of defining the problem, Technique involved in defining problem.
- Meaning of Research Design, Need for Research Design, Feature of good Design, Important Concepts Relating to Research Design: Dependent and Independent variables, Extraneous Variable, Control, Confounded Relationship, Research Hypothesis, Experimental and Non-Experimental Hypothesis, Experimental and Control Groups, Treatments, Experiment, Experimental unit (s), Research Designs in Case of Exploratory Research Studies, Descriptive and Diagnostic Research Studies.

- Concepts of Sampling and Non-Sampling Errors, Sample Surveys versus Census Survey, Non-probability sampling, Probability sampling, Simple random sampling with and without replacement.

- Quantitative and Qualitative data, Classification of Measurement Scales: Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale. Goodness of Measurement Scale: Validity, Reliability and Practicality.

- Types of data: Primary and Secondary, Methods of Collecting Primary data: Observation method, Interview method, Collection of data through questionnaires, Collection of data through schedules, Difference between questionnaires and schedule, Collection of secondary data.



7.7.18

2/5

- Classification of data, Tabulation, Diagrammatic and Graphical representation of data: Bar chart, Pie chart, Box plot, Histogram, Frequency polygon, Frequency Curve, Ogive.

- Meaning of Correlation, Scatter diagram, Karl Pearson Coefficient of Correlation, Rank Correlation, Regression lines, Regression coefficients, Properties of regression coefficient.

- Testing of Hypothesis and Test of significance: Null and Alternative Hypothesis, Type I and Type II errors, Critical region, Level of significance, Two- Tailed and One-Tailed Test, Large sample tests: Test of significance for single proportion, Difference of proportions, Single mean and difference of means, Chi –Square test of goodness of fit and independence of attributes. Small sample tests: t-test for single mean, t-test for difference between two sample means, Paired t-test for difference of means, F-test for equality of population variances.

- Analysis of Variance.

- Computer generation and classification: First, second, third, fourth, and fifth generation of computers, classification of computers.

- Computer languages and Operating System(OS)-Assembly languages,4GL, Machine language, MS-DOS and windows, Multiprogramming OS, Batch OS and Time OS.

- MS-Word and Power point presentation.

- Binary number, Octal number, Hexadecimal and Decimal number with its conversion to each other.

7.7.18

07/07/18

7.7.18

# Vikram University, Ujjain

## Ph.D./M.Phil. Entrance Test

Syllabus for Subject: Mathematics 50×1=50

**Part B**

**RESEARCH APTITUDE / SUBJECT SPECIFIC QUESTIONS**

Real number system as a complete ordered field, Finite, countable and uncountable sets, bounded and unbounded sets, Archimedean property, Supremum, Infimum, Limit, Continuity, Differentiability, Maclaurin & Taylor series, Definition of a sequence, Theorems on limits of sequences, Bounded and monotonic sequences, Cauchy's convergence criterion, Series of non-negative terms, Comparison test, Ratio test, Leibnitz's theorem, Absolute convergence.

Bolzano-Weierstrass theorem, Heine Borel theorem, Continuity, Uniform continuity, Differentiability, mean value theorem, sequences & series of functions, Point wise convergence, limit superior, limit inferior, Uniform convergence, Riemann sums and Riemann integral, Improper integrals, Monotonic functions, types of discontinuity, functions of bounded variations, Lebesgue outer measure, Lebsegue measure and Lebsegue integration, Riemann and Lebesgue integrals.

Elements of Topological spaces: Neighbourhoods, Limit points, Interior points, Open sets, closed sets, Closure and interior, Boundary points, Subspace of a metric space, Cauchy sequences, Completeness, Cantor's intersection theorem, continuity, convergence, homeomorphism, compactness, connectedness, separation axioms, first and second countability, separability, subspaces, product spaces.

Normed linear spaces, Inner product spaces, Orthonormal basis, Spaces of continuous functions, Quotient space, Conjugate space, Banach spaces, Hahn-Banach theortem, open mapping and closed graph theorem, principle of uniform boundedness, boundedness and continuity of linear transformations, dual spaces, embedding in the second dual, Hilbert spaces,

7.7.18 4/5

projections, orthonormal bases, Riesz representation theorem, Bessel's inequality, Parseval's identity.

Vector spaces, Sub spaces, linearly dependent & linearly independent vectors, Basis, Dimension, linear transformation, Matrix representation of a linear transformation, Rank & Nullity theorem. Finite dimensional vector spaces, Existence theorem for basis, Quotient space and its dimension. Rank of a matrix, Eigen values & Eigen vectors.

Change of basis, Canonical forms, Diagonal forms, Triangular forms, Jordan forms, Quadratic forms, reduction and classification of quadratic forms, Orthogonal transformations, Unitary transformations, Positive semi definite matrices, Semi definite matrices.

Algebra of complex numbers, The complex plane, Polynomials, Power series, Continuity and Differentiability of a function of a complex variable, Analytical functions, Cauchy Riemann equations, Harmonic functions, Mobius transformations.

Transcendental functions such as exponential, Trigonometric and Hyperbolic functions, Contour integrals, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem, Taylor series, Laurent series, calculus of residues, conformal mappings.

Divisibility in the set of integers, congruences, Groups, Sub groups, Permutation groups, Cyclic groups, Lagrange's theorem and its consequences, Normal subgroups, Quotient groups, Group homomorphism, Kernel of a homomorphism, Fundamental theorem of homomorphism of groups, Group isomorphism, Cayley's theorem, Rings, Ideals, Maximal ideals, Prime ideals, Domains & fields, Ring homomorphism, Ring isomorphism & related theorems, Quotient rings. Polynomial rings, irreducibility criteria, Basic concepts related to extension of fields. Structure of modules over Principal Ideal Domains.

07/07/18

7.7.18