

GANPAT UNIVERSITY

Syllabus for the Ph. D. Entrance Examination

Instructions:

1. The question paper of the Ph. D. Entrance Examination shall be of 100 marks, to be attempted in 2 hours duration.
2. The question paper will have 2 sections (Section-A and Section-B).
3. Section-A (From Research Methodology) will consist of 50 objective type questions (Multiple Choice), each carrying one mark. Section A shall be common for all the candidates appear in Entrance Examination.
4. Section-B shall be of 50 marks which is Subject specific depends on respective discipline/branch) will consist two parts.
 - Part - I shall be of 25 marks having 25 objective type of questions with multiple choice answers having only one correct answer.
 - Part - II shall be of 25 marks and having descriptive type of questions.
5. There is no negative marking.

SECTION – A

(Common for all candidates)

RESEARCH METHODOLOGY

Total Marks: 50

Unit	Content	Marks
1	Basics of Research: Research: Meaning, Objective, Characteristics, Steps of research, Methods of research, Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.	[05]
2	Research Problem and Research Design Introduction to Research Problem, Necessity of Defining the Problem, Selecting the Problem, Techniques Involved in Defining a Problem, Meaning and Types of Research Design, Important Concepts Relating to Research Design	[10]
3	Data Collection and Analysis Methods of Data Collection- Observation, Interview, Questionnaires, Schedules, Survey and Experimental. Selection of Appropriate Method for Data Collection, Different Techniques of Sampling such as Probability and Non-Probability, Basic Statistical Methods of Data Analysis such as Frequency distribution, Measures of central tendency, Measures of Dispersion, Coefficient of variation, correlation and regression.	[20]
4	Ethics in Research: Environmental impacts and Ethical issues, Commercialisation, Copy right, Royalty, Intellectual property rights and Patent law, Plagiarism, Citation, Referencing style and acknowledgement.	[05]

Reference Books

1. 'Research Methodology- A Step-By-Step Guide for Beginners', Ranjit Kumar, (Pearson Education, Delhi) ISBN: 81-317-0496-3.
2. 'Research Methodology- Methods and Techniques', Kothari, C.K., New Age International, New Delhi.
3. Research In Education, John V. Best, John V. Kahn 10th ed., Allyn & Bacon Publisher, 2005.
4. Practical Introduction of copyright by Gavin Mcfarlane, McGraw Hill Inc., USA.
5. Introduction to Scientology Ethics, Hubbard, L. Ron. New Era Publisher, Denmark.
6. Research Methodology by Deepak Chawala, Vikas Publications.
7. Statistics for Management, Levin & Rubin, Pearson Publication

SECTION – B

Faculty of Science

[Mathematics]

Unit	Content	Marks
1	<p>Analysis: Elementary set theory, finite, countable and uncountable sets Real number system as a complete ordered field, Archimedean property, supremum, infimum.</p> <ul style="list-style-type: none">• Sequences and series, convergence, limsup, liminf.• Bolzano Weierstrass theorem, Heine Borel theorem.• Continuity, uniform continuity, differentiability, mean value theorem.• Sequences and series of functions, uniform convergence.• Riemann sums and Riemann integral, Improper Integrals.• Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.• Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation. <p>Metric spaces, compactness, connectedness. Normed Linear Spaces. Spaces of Continuous functions as examples.</p>	[5]
2	<p>Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations.</p> <ul style="list-style-type: none">• Algebra of matrices, rank and determinant of matrices, linear equations.• Eigenvalues and eigenvectors, Cayley-Hamilton theorem.• Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.• Inner product spaces, orthonormal basis.• Quadratic forms, reduction and classification of quadratic forms.	[10]
3	<p>Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions.</p> <ul style="list-style-type: none">• Analytic functions, Cauchy-Riemann equations.• Contour integral, 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, Mobius transformations.	[10]
4	<p>Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements.</p> <ul style="list-style-type: none">• Fundamental theorem of arithmetic, divisibility in \mathbb{Z}, congruences, Chinese Remainder Theorem, Euler's ϕ-function, primitive roots.• Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.• Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria.• Fields, finite fields, field extensions	[5]

5 Ordinary Differential Equations (ODEs):

[10]

- Existence and Uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs.
- General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

- Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs.
- Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis:

[10]

- Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence
- Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods
- Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration
- Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods
- Numerical Solution of PDEs. Finite difference method: Explicit and implicit schemes, Crank-Nicolson schemes, consistence, stability and convergence, Numerical solutions to elliptic, parabolic and hyperbolic partial differential equations. Dirichlet, Neumann and Mixed problems.

Reference Books:

1. 'Advanced Differential Equations', Dr. M.D. Raisinghania, S.Chand, New Delhi.
2. 'Partial Differential Equation', Lawrence C Evans , American Mathematical Society
3. 'Advanced Ordinary Differential Equations', Athanassios G. Kartsatos, Hindawi Publishing Corporation
4. 'Introduction to Linear Algebra', Gilbert Strang, Wellesley-Cambridge Press
5. 'Topics in Algebra', I.N.Herstein, John Wiley & Sons
6. 'Real Analysis', N.L. Carothers, Cambridge University Press
7. 'Complex Analysis', Joseph Bak & Donald J. Newman, Springer
8. 'Numerical Solution of partial Differential Equations', G.D.Smith, Clarendon Press-Oxford Applied Mathematics and Computing Science series
9. 'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley & Sons, Inc.
10. 'Numerical Methods in Engineering & Science', B.S.Grewal, Khanna Publishers.