Syllabus of M.Phil Research Methodology and Computer Applications

Semester – I   70   Paper – I   Time – 3 Hours

Written examination (F.M.: 100)   Assignment (F.M.: 30)

Answer any 4 questions selecting at least one from each group.

Group - A

Unit I : Research Methodology (2 questions to be set)

Introduction to Research Methodology, Meaning and Motivations, Research approaches, Significance of research, Identification and selection of research problems, Formulation of research objectives, Research processes and research design, components and importance.

Unit II: Study of Mathematical Research of procedure and Presentation (2 questions to be set)

Research and Scientific methods, Research survey and experimental methods, Criteria of good research, Selection of research problems, Mathematical journals and their abbreviations, Mathematics Subject Classification Codes, Mathematical on Line Database and Review Journals: American Mathematical Review, Zb MATH, techniques and procedure for written factor, Essential techniques and procedure for writing Mathematical research articles/dissertations/thesis.

Unit III: Quantitative Techniques (2 questions to be set)

Sampling fundamentals: Ned for sampling, terminologies and definition, determination of sample size, sampling distributions, Central limit theorem, Standard errors, Estimation of population mean.

Hypotheses testing: Basic concepts, procedure, Confidence limits, Chi-Square test.

Group – B : Computer Application

Unit – 1

Computer System: An Overview; Basic Applications of Computer in different fields, Functional Components of a Computer, Benefits and limitations of Computers, Computer Virus and Cyber Crime. (1 question to be set)

Unit – 2

MS Window Operating System – features, Getting started with windows; Managing files and folders – to create, Rename, Copy, Cut, Paste and Delete, Basic window accessories: Mouse pointer, Control Panel, Creating Shortcuts, Shutting down the computer. (1 question to be set)

Unit – 3

Introduction to MS Word and MS Excel, How to type, edit, format and save a document: Spell Check, Page and Paragraph Setup, Inserting Pictures, Creating Tables and Charts in Word and Excel, Printing and Closing the document. (1question to be set)

Unit – 4

MS Power Point: Steps to Power Point Presentation, Physical Aspects of a Power Point Presentation, Creating New Presentation; Editing: Adding New Slides, Adding Illustration to slides, Inserting Pictures; Creating Slide Shows, What is Internet, Sending and receiving Emails, Attachments, Logging in. (1 question to be set)

Recommended Books:

1. Research Methodology, New Age Publication, C.R.Kothari
2. Computer Fundamental – BPB Publication, Pradeep Sinha & Priti Sinha
3. Fundamentals of Computer – Oxford Publication, Reema Thareja
4. MS Office – Laxmi Publication, S.S.Shrivastava.
5. Mastering MS Office – Repro knowledgecast Publication, Bittu Kumar

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Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

Paper – II
Semester – I
Written examination
Full Marks 70   **Time – 3 Hours**

Ten questions are to be set and any four to be answered.

The following are the details of the course content and distribution of questions:

Unit I : Advanced Abstract Algebra
Group of automorphism of a field and fixed field of a group of automorphism, G(K/F), O[G(K/F)]/[K:F] for a finite extension K of F, Normal extension, characterization of normal extension, Galois group of a polynomial Fundamental theorem of Galois theory, Cyclotomic polynomials, Solvability by radicals. (Two questions)

Unit II: Real Analysis
General product, Space product, invariant properties, Embedding theorems and metrizability, Quotient Space, one point compactification. Banach Spaces, Normed Banach algebra, Dual spaces, Dual Bases reflexivity, Modulus, Sub-modules, Homomorphism of modulus, Quotient modulas, Cyclic modules, finitely generated modulus. (Two questions)

Unit III : Measure Thory
Comparison of Riemann and Lebesgue integral Lebesgue integral of non-negative measurable fraction, Elementary properties of Lebesgul integral, Additivity, oder preservation and integrability properties.
Variation function of a function of bounded variation, Jordan's decomposition theorem. Absolute continuous functions and their properties, Differentiation of an integral. Fundamental theorem of integral calculus. (Two questions)

Unit IV : Differential Equations
Method of solving a system of differential equations, stability of autonomous system of differential equation. Stationary points of autonomous system and its classification as stable, asymptotically stable and unstable stability for linear systems with constant cofficients. (Two questions)

Unit V : Operation Research
Simplex – Algorithm, The Beg M-method, Two phase simplex method, Formation of Dual problems, Dual Simplex – Algorithm, Transportation problem North-west corner rule, least cost or Matrix – Minima Method, Assignment problems and its solution. (Two questions)

References:
1. Prof. K.K.Jha : Advanced Algebra
2. N.Herstein : Topics in Algebra
3. R.E. Goldberg : Real Analysis

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4. W.B.Rudin : Principles of Mathematical Analysis
5. H.L. Royden : Real Analysis
6. K.K.Jha : Advanced course in Real Analysis and Higher Analysis
7. E.A. Coddington and Levinson: Theory of ordinary differential equation, McGraw-Hill, H.J.(1955)
8. J.C.Burkil : Ordinary differential equation – Oliver and Boyd
9. K.K.Jha : Functional Analysis.
10. Operations Research: S.D. Sharma
11. Operations Research: B.S. Goel and S.K.Mittal

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Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

Paper – III
Semester – I
Written examination
Full Marks 70   **Time – 3 Hours**

Syllabus of Recent Trends in Pure Mathematics
Answer any 4 questions out of 8 questions set

Unit I (Two questions)

Definition and examples of categories, Some basic, categorical concepts and natural transformation, Equivalence of categories, Products and co-products, Finite- Field Extension and Galois Theory

Unit II (Two questions)

Universal Algebra Ω-algebras, Subalgebras and products, Homomorphisms and congruences. The lattice of congruences, Subdirect products, Direct and inverse limits, Ultra products.

Unit III (Two questions)

General Product, Space product, invariant properties Embedding theorem and metrizability, Quotient Space, One point Compactification. L Banach Spaces. Normed Banach algebras.

Unit IV (Two questions)

Dual Spaces, Dual Bases Reflexivity, Modules, sub modules Homomorphism of modules. Quotient modules cyclic modules finitely generated modules (Nonstandard Real Models, Ultrafilters, Ultrapowers, Embedding in a Superstructure, Nonstandard Real Analysis, Hyperreal Numbers, Hyperreal and hypernatural Numbers Interpretation of the Standard Part Homomorphism, The Permanence Principle and finite Sets. Calculus, Sequences, set and functions, Fuctionals. Congruences). (2 questions to be set)

4. Primitive Roots:

Primitive roots for prime moduli and for composite moduli, Applications of primitive roots and solvability of congruences. (1 questions to be set)

5. Quadratic Residues, Legendre's symbol and Jacobi's generalization, Quadratic
Congruences with Prime or compocomposite modulus Law of Reciprocities, Solution of the equation (P/Q) (1-questions to be set)

6. Diopphantine Equations and its solution, the equations $x^2 + y^2 = x^2$, $x^4 + y^4 = z^4 x^2 - dy^2 = 1$ and $x^2 - dy^2 = .1$ and Pell's equation and continued Fractions. (1-questions to be set)

Recommended Books:

1. An Introduction to Theory of Numbers, By G.H. Hardy & E.M. Wright Oxford University Press, New York, U.S.A.

2. Elementry Theory of Numbers by William J. Leveque, Addision-Wesleyp publishing Co., I.N.C. Reading, Messachusetts, U.S.A.

3. Number Theory, by Z.I. Borerich and I.R. Shaforarich, Academic Press, New York, U.S.A.

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Unit 1. Primability and Divisubility of numbers:

It includes g.c.d. greatest common divisor) and L.C.M. (least common multiple of numbers, Educlid's algorithm to find the g.c.d. to two numbers, fundamental theorem of Arithmetic, Total number of and sum of all divisors of a natural number n, Fermat's numbers, Mersenne's numbers, perfects, Amicable numbers of and Ep (in) (2 questions to be set)

2. Euler's function and Mobius function, Mobius-inversion formula and reduced residue system. (1 question to be set)   (2 questions to be set)

Unit II. Congruences:

Elementary Properties of congruences, Linear congruences, Fermat's theorem, Euler's Extension of Fermat's theorem, Converse of Fermat's theorem, Exponent of midule and its properties, Wilson's Theorem and its Converse, Lagrange's Theorem on the roots of a congruence and its applications, Linear congruences and their solution, Chinese Remainder. Theorem on solution of simultaneous.   (2 questions to be set)

Unit III

Geometrical knowledge in Indus Valley Civilization and in Vedas and other Ancient Hindu Epics including Sulbasutras, Geometrical and Mensurational knowledge in Jaina's works.
The contribution of Samgamrama Madhava, Parameshwara, Nilkantha, Putumana somayajin and others to the knowledge of Geometry & Trigonometry in 14th Century on the soil of India. (3 questions)   (2 questions)

Unit – IV

Contributions of Aryabhata-I, Bhaskaracarya-I, Brahmagupta, Mahaviracarya, Aryabhata-II, Bhaskaracarya-II, Narayana Pandita and Sridharacarya to the knowledge of Mathematics and Astronomy. (3 questions)   (2 questions)

Recommended Books:

1. History of Mathematics in Ancient and Medieval India, by A.K.Beg, Varanasi, 1979.

2. Ancient India's Contributions to the Origin of Geometrical Knowledge by Ganesh Kumar & Ruchita Raj, Samiksha Prakashan, Delhi/Muzaffarpur.

3. History of Hindu Mathematics by B.B.Dutta and A.N.Singh, Lahore.

4. Numerical System in Ancient India, by Ganesh Kumar & Sunil Kumar, Saiksha Prakashan, Delhi/Muzaffarpur.

Unit – I

Traces of Numerical Symbols in Indus Valley, Babylonian, Sumeriam, Greek, Egyptian and Roman Civilizations, Traces of Herbew Numeral Symbols, Phoenician and Syrian Ancient Numeral Symbols, Arabic Numerical Symbols, Maya Numeral Symbols and Chinese Numeral Symbols, Traces of Brahmi and Kharosthi Numeral Symbols.
Discovery of Zero and Decimal place value system of numerals in Ancient India. (4-questions)

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Unit – II

Numerical words in Vedas, Taittiriya Samhita, Satapath Brahmana and other Ancient Hindu Epics, Numerical words in Budha's and Jaina's works, Numers names in Decimal scale in Ancient India in Post Christian Era. (2-questions)

a.Basic Readings:

1. R.Weinstock: Calculas of Variations with Applications to Physics and Engineering, McGraw Hill Book Comp. (1952).

2. A.S.Gupta, Calculas of Variation with Applications, Prentice Hall of India (1977).

3. L.M.Gelfand and S.V. Formin: Calculus of Variations, Prentice Hall of Inc. (1963).

4. E.D. Rainwhille: Special Functions, Mac Millan (1967).

5. L.N. Sneddon: Special functions of Mathematical Physics and Chemistry, Oliver and Boyd (1961).

6. N.N. Legecev: Special Functions and their Applications Premtice Hall of Inc. (1965).

7. K.Sankara Rao: Introduction to Partial Differential Equations, Prentice Hall of India New Delhi, 2005.

b. Additional Reading:

c. References

i. Books:

ii. Periodicals/Journals:

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Syllabus of Fuzzy Mathematics
Answer any 4 questions out of 8 questions set

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Unit I (2 questions)

Basic definitions of fuzzy sets, α-level sets, Types of fuzzy sets, Basic operations of fuzzy sets, Cartisian and algebraic products, Bounded sum & difference, t-norm & t-conorms

Unit II (2 questions)

Extension principle for fuzzy sets, fuzzy relations, Min-Max composition & its properties, Fuzzy equivalence relations, Fuzzy compatibility relations, Fuzzy graphs, Similarity relation.

Unit III (2 questions)

Multivalued logics, Fuzzy propositions, Fuzzy quantifiers, Linguistic variables & hedges Inference from conditional fuzzy propositions.

Unit IV (2 questions)

Fuzzy Controllers, Fuzzy Rule base, Fuzzy inference engine, Fuzzification & Defuzzification, Applications of Fuzzy sets theory in Medical and Engineering.

Recommended Readings:

1. Frorgie J. Klir and Bo Yuan, "Fuzzy sets & Fuzzy logic theory & applications", Prentice Hall of India, Pvt. Ltd. 2000.

2. H.J.Zimmermann; "Fuzzy Set Theory & Its applications" Kluwer, 1984.

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Syllabus of Commutative Algebra
Answer any 4 questions out of 8 questions set

Unit I

Minimal Prime and Primary Ideals: Examples and products of Minimal, Prime and Primary Ideals, The nil radical of an ideal and its properties, semiprime dieals. The associated prime Ideal of a primary ideal, Problems. (2 questions)

Unit II

Minimal prime ideals of a rind-Certain Radicals of a Ring: Jacobson Redical, The diefinition of the idempotents of R/I can be raised or lifted into R and its properties, Primary rings, Problems. (2 questions)

Unit III

Quasiregular element and its properties, Prime radicals, Modular ideals, Jradial of a ring, Boolean rings, Regular rings, Stone representation theorem, Direct sum of Rings, Problems. (2 questions)

Unit IV

Birkhoff theorem, Rings with Chain conditions Equivalence of three conditions of a ring with a.c.c., Hilbert Basis Theorem, Levitsky Theorem, Wedderbum Theorem, Problems.

Recommended Readings: (2 questions)

a.Basic Reading:

1. Barton David M.: A first vourse in Rings and Ideals Addison Wesley Publishing Company, 1970.

2. Oscar Zoriski and P.Samuel: Commutative Algebra, Vol. I, affiliated East Press Pvt. Ltd., New Delhi.

Syllabus of Lattice Theory
Answer any 4 questions out of 8 questions set

Unit I

Types of Lattices: Posets Isomorphism, Graded Poset, Lattices, Latices Algebra, Distributavity, Boolean Lattices, Boolean, Algebra, Quasi-ordering, Lattice Postulates, Semi lattices, Morphisms and ideals, Cogruence Relations, Modularity, Brouwerian Lattices. (2 questions)

Unit II

Complete Lattice: Closure Operation, Ideal Lattices, Fix point Theorem, Topological closure, Infinite Distributivity, Lattices with Unique Complements, Complete Brouwerian Lattice, Theorem of Glivenko. (2 questions)

Unit III

Application of Lattice Theory to Algebra: Module; Group with Operators, Premutable congruence, Direct decompositions, Hurosh-Ore Theorem, Theorem of Ore, Subgroup Lattices, Modular Subgroup Lattices. (2 questions)

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Unit IV

Application of Lattice to General Topology: Properties of the Lattices of all open sets and lattices of all closed sets of given topological space, TI-lattices, Bases and Subbases; Compactness, Alexander and Tychonoff Theorem, Wallman Theorem, Metric Lattices, Valuation on Lattice, Distribution valuation. (2 questions)

Recommended reading:
a) Basic Reading:
1. Gratzer G. : Lattice Theory – First concepts and Distributivity lattices.
2. Birkhoff G.: Lattice Theory, (American Mathematical Society, Proidence, Rhose Isnald) Colloquium Publications, Volume 25.

Syllabus of Space Dynamics
Answer any 4 questions out of 8 questions set

1. Three Body Problem: (2- questions)
Equation of motion, General integrals, Stationary solutions, Equations of relative motion, N-Body problem, Viral theorem.

2. Restricted Three Body Problem: (Two questions)
Equation of motion, Jacobi integral, Hill's surface, Collinear and triangular solution, Stability of Collinear and triangular solution.

3. Non-Linear Stability: (Two questions)
Normalization of Hamiltorian Application of Kam theory, Normal forms, Computation of normal forms with the help of Mable, Mathematica Stability Condition for gencralizod RTBP.

4. Theory of pertorbations, Effect of oblateness, air dragoon RTBP (two questions)

Syllabus of Stability Theory
Answer any 4 questions out of 8 questions set

Unit I (Two questions)
Lagrangian equation of a dynamical System, Hamilton's Cononical equations, Dynamical System defined by a system of differential equation, Definition of stability due to POINCARE, POISSON, LYAPUNOV, Asymptotic stability with examples. Analytical Criteria for various types of singular points in phase Plane, general properties of integral curves, Conservative system, Motion in large with examples.

Unit II (Two questions)
Fundamental theorem of Lyapunov on stability and instability for autonomous system (Theorem 1, 2, 3, 4) with examples.
Unit III (Two questions)

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Stability of the solution of the system of linear equation with Constand Co-efficient, Hurwitz theorem, Stability of the solution of a system of linear equations on the basis of linear system (Theorem, 1, 2, 3, 4).

Unit IV (Two questions)

Energy Criteria for stability of an equilibrium point, Lagrange's theorem, its Converse and its improvement by Cetayev, Stability of Cononical equations.
Fundamental theorem of Lyapunov for non-autonomous system (Theorem 1, 2, 3, 4). Chetayev theorem on instability, Criterian for the rotational motion of a torque free rigid body.

Syllabus of Operators Theory
Answer any 4 questions out of 8 questions set

Unit – I (Two questions)

Convergace of Nets & Filters, Isotone nap, Cluester points of a net Comparison of filters, Filter bases, Ultrafilters, Ultra Filter base, Characterisation of Ultrafilters, Limit points of a filter, Limit points of a filter base Cluster points of a filter.

Unit – II (Two questions)

Operators, adjoint of an Operator, Self adjoint operators, Normal & Unitary Operators, Projections, Matrices in finite dimensional spectral theory, Determinat & Spectrum of an operator, The spectral theorem.

Unit – III (Two questions)

Banach Algebra: Definition and Examples of Banach Algebra, Regular and Singular elements, Topological divisors of zero, the Spectru, The formula for Spectral radius, The radical & Semisinplicity. Commutative Banach Algebra: Gelfand mapping, Application of the formula $r(x) = \lim \| x^n \|^{1/n}$

Unit – IV (Two questions)

Involutions in Banach Algebras, The Gelfand-Neumark Theorem, Idals in C(x) and the Banach Stone theorem, The Stone-Cech Compactification Commutative C algebra.

Syllabus of Theory of Relativity and Cosmology
Answer any 4 questions out of 8 questions set

Unit – I (Two questions)

General Relativity: Transformation of coordinates, Tensors, Algebra of Tensors, Symmetric and skew symmetric Tensors, Contraction of tensor and quotient law, Riemannian metric, Parallel Transport, Christoffel curvature tensor and its symmetric properties, Bianchi identities and Einstein tensor.

Unit – II (Two questions)

Review of the special theory of relativity and the Newtonian. Theory of gravitation, Principle of equivalence and covariance, geodesic principle, Newtonian approximation of relativistic equation of motion, Einstein's field equations and its Newtonian approximation.

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Unit – III (Two questions)

Schwarzschild external solution and its isotropic form, Planetary orbits and analogues of Kepler's Laws in general relativity. Advance of peribelion of a planet. Bending of light rays in gravitational field. Gravitational redshift of spectral lines. Energy-momentum tensor of a perfect fluid. Schwarchild internal solution. Boundary conditions. Energy momentum tensor of an electromagnetic field. Einstein-Maxwell equations. Reissner Nordstrom solution.

Unit – IV (Two questions)

Cosmology: Mach's principle, Einstein modified equations with cosmology term. Static Cosmological models of Einstein and Desitter their derivation, properties and comparison with the actual universe.

Hubble's law, Cosmological principles. Weyl's postulate. Derivation of Roertson Walker metric. Hubble and deceleration parameters, Redshift. Redshift verses distance relation. Angular size verses redshift relation and source counts in Robertson-Walker space time.

References:

1. J.V. Narlikar, General Relativity and Cosmology. The Macmilan, Company of India Limited, 1978.
2. R.Adlev, M. Bazin, M. Schiffer, Introduction to general relativity. McgrawHill, Inc., 1975.
3. Satya Prakash: Relative Mechanics, Pragati Prakashan, Meerut.

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Syllabus of Fluid Dynamics

Answer any 4 questions out of 8 questions set

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Unit – I : Introduction and Phsical Properties of Fluid

Concepts of fluids, types of fluid, continuum hypothesis, Physical properties of fluid: Density, specific weight, Specific volume, Pressure, Viscosity and surface tension, Compressibility and Bulk modules, vapour pressure and examples.   (2 questions)

Unit – II : Kinematics of Fluid

Basic concepts, Eulerian and Lagrangian method for description fluid motion, steady and unsteady motion, stream line motion and turbulent motion, uniform and non-uniform motion rotational and irrotational motion, stream line, path line, streak line, velocity potential, stream function, vorticity vector, Equation of continuity, equation of continuity by Eulerian and lagragian methods, equation of continuity, equation of continuity by Eulerian and Lagragian methods, equation of continuity in different co-ordinates, Velocity and acceleration of fluid particle.   (2 questions)

Unit – III : Equation of Motion

Euler's equation motion, pressure equation, Bernoulli's equation Cauchy's integrals. Equation for impulsive action, example. Flows and circulation, Kelvin's Circulation theorem, Helmholtza Vorticity equation.   (2 questions)

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Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

Unit – IV : Magnetthohy Drodynamics

Nature of Magnetohy drodynamics, Maxwell's electromagnetic field equations: Medium at rest, Maxwell's electromagnetic field equations: Medium at motion, the equations of motion of a conducting fluid, rate of flow of charge, simplification of electromagnetic field equations, Electromagnetic waves.

(2 questions)

Recommended Reading:

a. Basic Reading:

1. A textbook of Fluid Dynamics by F.Chorlton, CBS publishers & Distributors, Delhi.

2. Fluid Dynamics by Dr. J.K. Goyat & K.P. Gupta, Pragati Prakashan.

b. Additional Readings:

c. References

(i) Books:

1. A textbook of Fluid Dynamics by R.K.Rajput, S. Chand & Distributors, Delhi.

2. Fluid Dynamic by A.K.Jain, Khanna Pub. Delhi.

3. Streeter, McGraw-Hill International Co. Auck' and.

4. Fluid Dynamics by White.

5. Fluid Dynamics by Arora.

(ii) Periodicals/Journals:

S.N.Jha
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University Professor &
Head of the Deptt. of Mathematics
B.R.A.B.U., Muzaffarpur

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