24 - Mathematics

GULBARGA UNIVERSITY, KALABURAGI

DEPARTMENT OF STUDIES AND RESEARCH IN MATHEMATICS

Proposed Syllabus in Mathematics

for Ph.D. Entrance Examination

to be Effective from 2016-17

Unit - 1 Real Analysis:

The Riemann - Stieltje's Integral: Definition and existence of integral, Properties of the integral, Function of bounded variation. Integral and Differentiation, First and second mean value theorems, Change of variables.

Sequence and Series of Functions: Uniform convergence and continuity, uniform convergence and integration, uniform convergence and differentiation, uniform convergence and bounded variations, equicontinuous families of functions, The Stone-Weierstrass theorem.

REFERENCE BOOKS:

1. W. Rudin , Principles of Mathematical Analysis, 3rd ed., Mc Graw Hill Book Co., New York (1986).
2. T. M. Apostol, Mathematical Analysis, 2nd ed., Addison-Wesley, Narosa, New Delhi.
3. H.L. Royden, Real Analysis, 2nd ed., The McMillan Co., New York (1968).

Unit - 2 Complex Analysis:

Complex Integration: Complex valued functions, contours, contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Morera's theorem, Lowville's theorem, fundamental theorem of algebra.

Residues and Poles: Residues, Cauchy Residue theorem, residues at poles, evaluation of improper integrals, evaluation of definite integrals, the argument principle, Rouche's theorem, Schwartz lemma, Maximum modules principle.

REFERENCE BOOKS:

1. L. V. Alfors, Complex Analysis, Mc Graw Hill, Kogakusha (1979).
2. J. S. Conway, Functions of one Complex Variable, Springer Verlag, New York , (1973).

Unit- 3 Algebra:

Groups: Sylow's theorems and its applications, direct products, finite Abelian groups as direct product of cyclic groups, Abelian p-groups and their invariants, solvable groups.

Rings: Field of quotients of an integral domain, Euclidean rings, Fermat's theorem, Einstein criterion, unique factorization domain, modules and rings.

Linear Algebra: Linear transformation, algebra of linear transformations. Characteristic roots, interpretation in terms of matrices.

REFERENCE BOOKS:

1. J. N. Herstein, Topics in Algebra, 2nd Ed., Wiley Eastern Ltd., New York, (1990).
2. Surjeet Singh and Qazi Zameruddin, Modern Algebra, 6th Ed., V. P. House, New Delhi.
3. S. Lang, Linear Algebra, Addison Wesley, (1972).

Unit – 4 Differential Equations:

O. D. E.: Fundamental sets of solutions and their standard properties, Initial value problems, Existence and uniqueness theorems. Boundary value problems, Sturm – Liouville problems, Eigen function and expansion formulae, Comparison and Separation theorems on the zero solutions of Sturm – Liouville equations, Picard's iterative method, Nonlinear equations of all orders.

P. D. E.: Partial Differential Equations of first and second order, Equations with variable coefficients, separation of variables. Laplace Equation, Wave Equation, Diffusion Equation, Non-linear Partial Differential Equations, Charpit's method, Jacobi's method, Monge's method.

REFERENCE BOOKS:

1. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall, (1968).
2. G. Birkof and G. C. Rota, Ordinary Differential Equations, Ginn and Co., (1962).
3. Ian Sneddon, Elements of Partial Differential Equations, International Student Edition.

4. Gupta, Malik and Mittal, Differential Equations, 3rd ed., (1995), Pragati Prakashan.

Unit-5 Discrete Mathematics:

Lattices and Boolean Algebra: Partially ordered sets, Lattices, Distributive and complimented lattices, Boolean lattice and algebra, Uniqueness of finite Boolean algebra, Boolean functions and Boolean expressions, Prepositional calculus, Design and implementation of digital networks, switching circuits.

Combinatorics: Basic counting principles, Permutations and Combinations, principles of inclusion and exclusion, Recurrence Relations, Generating Functions, applications.

Coding theory: Semigroups, Monoids and Groups, Codes and Group Codes, Coding of Binary Information and Error Detection, Decoding and Error Correction.

Topology: Definition of topologies in terms of open sets, closed sets, closure operations and their equivalence, Neighborhood systems, Limit points, interior, exterior and boundary points.

Base and sub - bases of a topology, Continuity and homeomorphism, subspaces, product and quotient spaces, metric space, continuity, convergence, compactness.

REFERENCE BOOKS:

1. Trembley J. P. and Manohar R. , Discrete Mathematical Structure with Application to Computer Science, TMH (1997).
2. Liu C. L. , Elements of Discrete Mathematics, McGraw Hill, (1995).
3. Narasingh Deo, Graph Theory with Application to Engineering and Computer Science, PHI, (1984).
4. J. T. Munkers,Topology, PHI, New Delhi (1998).
5. J. Dugundgi, Topology, UBS, Pub., New Delhi (1997).

Unit-6 Programing in C:

Preprocessor Character Set, Identifiers, Reserved Words, Constants and Variables, Data Type, Modifiers, Types of Statements, Declaration and Initialization, Comments.

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Type of I/O Statements: Formatted and Unformatted, getchar (), putchar (), print f (), scan f ( ), Escape Sequences and Format Specifies (%d, %f, %c,...).

Conditional Statements: (if, if else, switch case), Looping statement (for, while, do while), Nested Loops, Infinite Looping, break and continue, Gottlried Programming in C. Schism's Series.

REFERENCE BOOKS:

1. Brian W. Kernighan, Dennis M. Ritichie, The C Programming Language (2^{nd} ed.).
2. M. T. Somashekar, Programming in C, PHI New Delhi, (2006)
3. Yeshwant Kanetkar, Let US C.

Unit - 7 Functional Analysis:

Banach Space: continuous linear transformation, dual spaces, Hahn Banach theorem, the nature embedding of normed linear space into its second conjugate space, the open mapping theorem, closed graph theorem, the conjugate operator, Banach-Steinhans theorem, applications to partial differential equations.

Hilbert Spaces: orthogonal complements, orthonormal sets, conjugate spaces. Gram Schmidt orthonormalization process, Riesz-representation theorem, the adjoint of an operator, self – adjoint operators, normal and unitary operators, Projection.

Differential Geometry:

Calculus on Euclidean Spaces: Euclidean spaces, tangent vectors, directional derivatives, curves in E3, 1-Forms, differential Forms, mappings.

Frame Fields: Dot product, Curves, the Frenet formulas, arbitrary – speed curves, covariant derivatives, Frame fields, connection forms.

Euclidean Geometry: Isometrics of E3, the derivative map of an isometry, orientation, Euclidean geometry, convergence of curves.

REFERENCE BOOKS:

1. Limaye B. V., Functional Analysis, Wiley Eastern Ltd., (1981).
2. Kreysizg E., Introduction to Functional Analysis with Applications, John Wiley, New York, (1978).

3. Barrett O'Neil, Elementary Differential Geometry, Academic Press, New York, (1966).
4. T. J. Wilmore, Introduction to Differential Geometry, Oxford Clarendon Press, (1959).

Unit- 8 Numerical Analysis:

Solution of Non Linear Equations: Newton-Raphason method (system of non-linear equations), Birge-viete method, Bairstow's method, modified Bairstow's method, Muller's method, and Graffe's root squaring method, Generalized Newton method, Iterative methods.

Matrix Algebra: Solution for linear system of equations - Direct methods: Gauss elimination method, Gauss-Jordan methods, Crouts Method, Iterative Methods: Jacobi, Guess - Seidal and Successive over relaxation method.

Computation of inverse of a matrix: Jordan method, Triangularization method, Choleski's method, partition method. Eigen values & Eigen vectors: Given's method for real symmetric matrices, Jacobi's method for real symmetric matrices, Power method.

Numerical Solution of Ordinary Differential Equations: Single Step methods: Explicit Runge- Kutta methods, Runge-Kutta Gill, Runge-Kutta Butcher (derivation of 2^{nd} order method only), Stability of 1^{st} & 2^{nd} order Runge - Kutta methods, Step - size control of Runge - Kutta 4^{th} order method, Runge - Kutta method for simultaneous and higher order differential equations. Multi step methods: Adam Bash forth's and Milne's predicator – corrector methods.

Measure Theory:

Measure and outer measure: Ring of a sets, σ-ring of sets, Algebra of sets σ-algebra of sets, measure space, Caratheodory's postulates of outer measure, measurable set, problems related to measure function, σ-algebra of sets and Lebesgue measure of a set, Exterior and interior measure, Vitali's covering theorem, Borel measurable set.

REFERENCE BOOKS:

1. Jain, Iyengar and Jain, Numerical methods for scientific and Engineering Computation, Wiley Eastern, (1983).
2. Atkinson K. E. , An introduction to Numerical Analysis, Ed.3, John Wiley and Sons, (1989).

3. Paul R. Halmos, Measure theory, D. Van. Nostrand Co. Inc, New York and Affiliated East-West Presses Pvt. Ltd., Delhi, (1966).
4. I. K. Rana, An Introduction to Measure and Integration, Narosa Publishing House (1997).
5. K. P. Gupta, Measure Theory , Krishna Prakashan Media (P) Ltd., II, Shivaji Road, Meerut, (U. P.), India.

Unit-9 Graph Theory:

Trees: Characterization of trees, distance in a graph, Radius of a graph Diameter of a graph, central vertex, branch of a tree, rank and nullity, cut set, Fundamental cutset, fundamental circuit, conservation equation, network flow, f-unsaturated, f-augmenting semi path, max-flow, min-cut theorem, connectivity, edge-connectivity, Menger's theorem, n-connected graphs, n-edge connected graphs.
Eulerian path, Eulerian trial, Eulerian circuit, Eulerian graphs, Hamiltonian path, Hamiltonian cycles, Hamiltonian graph, Dirac's theorem. Line graph, total graph, block graph, cut-vertex graph.

Planar Graph: Operations on graphs. Combinatorial and Geometric graphs, planar graph, plane graph, Maximal planar graph, Detection of planarity, Subdivision of a graph, inner vertex set, inner vertex number, outer planar, minimally non-outer planar graph, geometric dual of a graph and its properties. Crossing number and thickness of a graph.

Coloring, Covering and Independence: Coloring, Color class, Chromatic number of a graph, Bi-chromatic graph, Vertex coloring algorithm, Simple sequential algorithm, Welsh & Powel algorithm, the smallest-last sequential algorithm, edge- coloring, n-edge coloring of a graph, coloring of a plane map, uniquely colorable graphs, four color problem, edge covering number, vertex covering number, vertex independence number, edge independence number.

REFERENCE BOOKS:

1. F. Harary, Graph Theory, Addison-Wesley, Reading Mass (1969).
2. N. Deo, Graph Theory, Prentice Hall of India Ltd., New Delhi, (1990).
3. M. Behzard and G. Chartrand, Introduction to Theory of Graphs, All Allyn and Bacon Inc. Mass (1971).

Unit - 10 Fluid Mechanics:

Langrange's and Euler's method in fluid motion, Equation of Continuity, Boundary surface, Boundary condition on velocity for deformable / non-deformable surface with / without surface tension, stress free Boundary condition. Boundary conditions on temperature, concept of rotational and irrotational flows, Stream lines, Path lines and Streak lines, Velocity Potential, Vortex lines.

Exact Solution: Poiseuille and Coutte flow between two parallel, flow between two coaxial cylinders, flow through tubes of uniform cross section in form of circle, Annulus, ellipse and equilateral triangles under constant pressure gradients, Stoke's first and second problems.

REFERENCE BOOKS:

1. F. Chorllion, Text Book of Fluid Dynamics, CBS Publishers, New Delhi (1985).
2. A. C. Eringen, Mechanics of Continua.
3. W. Prager, Mechanics of Continuous Media.
4. H. Schlichting, Boundary layer theory, McGraw Hill Book Company, New York (1979)

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