**RANI DURGAVATI UNIVERSITY, JABALPUR**

**SYLLABUS OF M.A./M.Sc. MATHEMATICS SEMESTER SYSTEM SEMESTER – III**

(Session 2017-18 and onwards)

Syllabus opted by the board of studies in Mathematics, R.D. University in the meeting held on 30-04-2016.

Choose any **five Papers** from following list of twelve papers.

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<tr>
<td>Paper I: Applied Functional Analysis</td>
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<tr>
<td>Paper II: Approximation Theory</td>
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<tr>
<td>Paper III: Divergent Series</td>
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<tr>
<td>Paper IV: Fuzzy Sets and their Applications - I</td>
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<td>Paper V: Operator Theory on Banach Algebra</td>
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<td>Paper VI: Simplicial Homology Theory</td>
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<td>Paper VII: Advanced Numerical Analysis</td>
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<td>Paper VIII: Linear Programming</td>
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<td>Paper IX: Mathematical Statistics</td>
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<tr>
<td>Paper X: Programming in C (Theory and Practical) - I</td>
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<td>Paper XI: Special Functions</td>
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<td>Paper XII: Spherical Trigonometry and Astronomy</td>
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**Note:**

- In attendance 10 marks is allocated as per ordinance No. 79 of R.D. University Jabalpur.
- The students, whose attendance is less as per ordinance No. 79 of R.D. University Jabalpur, will not allow to appear in the examination at the close of semester and he/she would be declared having failed in that semester.
- At the end of IIIrd semester a Internship Viva-Voce is to be conducted by a board of at least three examiner which includes at least one external examiner.

**M. Dharmi**
30.4.16

**M. Gaur**
30.4.2016

**F. N. Srivastava**
30.4.16
### M.A./M.Sc. (Mathematics) Third Semester
#### Paper I: Applied Functional Analysis

Max. Marks: 35  
Min. Pass. Marks: 12

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-1</td>
<td>Hilbert spaces obtained from Hilbert spaces, Cartesian and Tensor product of Hilbert spaces, convex sets and projections. Projection on a cone and a linear subspace.</td>
</tr>
<tr>
<td>Unit-2</td>
<td>Weak convergence, Weak compactness properties, Baire’s Category Theorem, sequence of continuous linear functional, Banach Saks, Theorem, Weak semi continuity, Continuity of Projection on a closed convex set.</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Convex sets and convex programming elementary notions, internal, bounding and external points. Support functional of a Convex set, simple example, Minkowski functional support plane through a boundary point, support mapping, Separation theorem.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Functions transformations and operators, Linear operators and their adjoints, bounded and unbounded operators projection operator and differential operator.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Spectral theory of operators, resolvent of operator, resolvent set and spectrum. Spectral radius, Compact operators, its characterizing property.</td>
</tr>
</tbody>
</table>

### Text Books:


### Reference:

M.A./M.Sc. (Mathematics) Third Semester
Paper II: Approximation Theory

Max. Marks: 35
Min. Pass. Marks: 12

<table>
<thead>
<tr>
<th>Unit-1</th>
<th>Linear Operators, Examples- Bernstein Polynomials, Fourier series.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-2</td>
<td>Approximation theorems, Bohman and Korvokin’s theorems and its applications, Theorem of Stone</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Existence of polynomials of best approximation, characteristics of polynomials of best Approximation.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Applications of convexity, chebyshev system, Uniqueness of polynomial of Best Approximation.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Chebyshev theorem, Chebyshev polynomial, Interpolation, Algebraic polynomials, Trigonometric polynomials.</td>
</tr>
</tbody>
</table>

Text Books:


Reference Books:

M.A./M.Sc. (Mathematics) Third Semester  
Paper III: Divergent Series

Max. Marks: 35  
Min. Pass. Marks: 12

<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-1</td>
<td>Definitions and Examples of Order Relations (big 0, little 0), Asymptotic Relation, The method of Arithmetic means, Holder means, Abel means, The Transformation matrix and regularity theorem for each mean.</td>
</tr>
<tr>
<td>Unit-2</td>
<td>Abel’s Transformation and its applications, Cesaro means, Definition and examples, Identities relating Cesaro sums, change of order of summation, Relation between Cesaro and Abel’s Summability: Theorems 55, 56, and 57.</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Consistency theorem for Cesaro Summability, Regularity Theorems for Cesaro’s method, Cesaro means of both integral and non-integral orders.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Limitation Theorems, Tauberian conditions and Tauberian Theorems, Littlewood’s extension of Tauber’s first Theorem.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Abelian method (A, λ) of summability, Regularity of Abelian means, Inclusion theorem, Euler mean, Regularity theorem.</td>
</tr>
</tbody>
</table>

Text Books:


Reference Books:

<table>
<thead>
<tr>
<th>Unit-I</th>
<th>Idea of fuzzy set and membership function, Definition of a fuzzy set, membership function, representation of membership function, General definitions and properties of fuzzy sets, Support, height, equality of two fuzzy sets, containment, examples.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-II</td>
<td>Union and Intersection of two fuzzy sets, Complement of a fuzzy set, normal fuzzy set, α-cut set of a fuzzy set, strong α-cut, convex fuzzy set, a necessary and sufficient condition for convexity of a fuzzy set (Theorem 1), Decomposition of fuzzy sets, Degree of sub sethood, Level set of a fuzzy set, Cardinality, fuzzy cardinality, examples.</td>
</tr>
<tr>
<td>Unit-III</td>
<td>Other important operations on fuzzy sets, Product of two fuzzy sets, Product of a fuzzy set with a crisp number, Power of a fuzzy set, Difference of two fuzzy sets, Disjunctive sum of two fuzzy sets, example.</td>
</tr>
<tr>
<td>Unit-IV</td>
<td>General properties of operations on fuzzy sets, Commutativity, associativity, distributivity, Idempotent law, identities for operations, Transitivity, involution, Demorgans laws, proofs and examples, Some important theorems on fuzzy sets, set inclusion of fuzzy sets and corresponding α-cuts and strong α-cuts (Theorem 1).</td>
</tr>
<tr>
<td>Unit-V</td>
<td>Comparison of α-cut and strong α-cut, Order relation of scalars α is inversely preserved by set inclusion of corresponding α-cuts and strong α-cuts, α-cut of union and intersection of two fuzzy sets, α-cut of complement of a fuzzy set (Theorem 2), Examples, α-cuts and strong α-cuts of union and intersection of arbitrary collection of fuzzy sets.</td>
</tr>
</tbody>
</table>

**Text book –**


**Reference Books:**

M.A./M.Sc. (Mathematics) Third Semester
Paper V: Operator Theory on Banach Algebra

Max. Marks: 35
Min. Pass. Marks: 12

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-1</td>
<td>The Banach Algebra of Continuous functions, Abstract Banach Algebras, Abstract Index in a Banach Algebra, Gelf and Mazur Theorem, Spectral radius formula.</td>
</tr>
<tr>
<td>Unit-2</td>
<td>Ston Weierstrass theorem, The Disk algebra, Algebra of functions with absolutely convergent Fourier series.</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Adjoint operator, Normal and self adjoint operators, Projections and subspaces, Multiplication operators.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>C* algebras, Gelfand Naimark theorem, Spectral theorem, Functional calculus, square root of positive operators.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Weak and strong operator topology, W* algebras, Isomorphism of L^∞ spaces, Maximal abelian W* algebras.</td>
</tr>
</tbody>
</table>

**TEXT BOOK:**


**REFERENCE BOOKS:**

M.A./M.Sc. (Mathematics) Third Semester
Paper VI: Simplicial Homology Theory

Max. Marks: 35
Min. Pass. Marks: 12

Unit I: Geometric Complexes and Polyhedra: Geometrically independent set, k-simplex, face of a simplex, properly joined simplexes, Simplicial Complex, Triangulation of Sphere, Mobius band, Torus and Klein bottle.

Unit II: Oriented simplex, Incidence number, Chains, Cycles, Boundaries and Homology Groups, Elementary p-chain, Homologous Cycles, homology group of oriented Complexes, Examples of Homology groups.

Unit III: Structure of homology groups, connected simplex, combinatorial Component, Euler-Poincare theorem, Euler’s theorem.

Unit IV: n-psuedomanifold, Examples, Minimal triangulation of sphere and Projective plane, Coherent orientation, Homology group of n-dimensional sphere, Theorem 2.11 (Statement only).

Unit V: Simplicial approximation: Chain map, Simplicial map, Examples, Star related Complexes, Simplicial approximation of a simplicial map, Mesh of a Complex, Simplicial approximation theorem.

Text Book :-

Reference Book :-
Satya Deo, Algebraic Topology, A primer, Hindustan Book Agency, New Delhi, 2003
Unit 1 -
Piecewise and spline interpolation, Bivariate interpolation Approximation, least squares approximation

Unit 2 -
Uniform approximation, Rational approximation, choice of method, numerical differentiation optimum choice of step length

Unit 3 -

Unit 4 -
Ordinary differential equation – boundary value problems shooting method.

Unit 5 -
Finite difference methods, finite element method

Textbook -

M. Dule
30.4.16

P. Pani
30.4.2016

H.
2014/2016

Y. Tade

B. S. D. P. S.
M.A./M.Sc. (Mathematics) Third Semester
Paper VIII: Linear Programming

Max. Marks: 35
Min. Pass. Marks: 12

<table>
<thead>
<tr>
<th>Unit-1</th>
<th>General Linear Programming Problem, Formulation of the Linear Programming Problem, Solution by Graphical method, Simplex method.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-2</td>
<td>Solution of a Linear Programming Problem by Big-M method, Two phase method, concept of duality, Fundamental theorem of duality, Dual simplex method.</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Assignment problem, Solution of assignment problem, Unbalanced Assignment Problem, Crew Assignment problem, Traveling Salesman problem.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Transportation problem, Initial basic feasible solution, Vogel’s Approximation method, Optimality test by MODI method, Stepping Stone method, Degeneracy in Transportation Problem.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Sequencing problem, processing n jobs on two machines, n jobs on m machines, processing two jobs through m machines.</td>
</tr>
</tbody>
</table>

**TEXT BOOKS:**


**REFERENCE BOOKS:**

3. H. Hadley, Linear and Dynamic programming, Addison-Wesley Reading Mass.
M.A./M.Sc. (Mathematics) Third Semester
Paper IX: Mathematical Statistics

Max. Marks: 35
Min. Pass. Marks: 12

Unit-I: Introduction: Attribute & variables, Frequency distribution and its representation. Measures of central tendency: Mean, Median & Mode, Geometric and Harmonic mean: Comparisons and usefulness of these measures. Measures of dispersion: Range, Mean deviation, standard deviation, their comparisons, measures based on mutual differences of observation, quartile deviation, curve of concentration.


Unit-III: Uniform distribution, Normal distributions and its properties, Fitting of Binomial, Poisson and Normal distributions, Bivariate distributions: Scatter diagram, Correlation coefficient and its limits, Correlation ratio and correlation index. Regression coefficients and lines, some related applications.

Unit-IV: Multivariate distributions: Multivariate data, Multiple and Partial correlation and coefficients. Rank correlation, Intra-class correlation, Basic Principles of Inference: Estimation and testing of hypotheses, Point and interval estimation, Maximum likelihood estimation, likelihood ratio tests, Confidence intervals.

Unit-V: Tests based on t, F, $\chi^2$, and Z distributions. Joint distribution of attributes: - Data on two or more attributes, independence and association, Measures of association for $2 \times 2$ case. Test for goodness of fit and homogeneity tests.

TEXT BOOKS:

[M. Pol] 30.4.16

M.A./M.Sc. (Mathematics) Third Semester
Paper X: Programming in C (Theory and Practical) -I

Max. Marks: 25
Min. Pass. Marks: 09

<table>
<thead>
<tr>
<th>Unit-1</th>
<th>An overview of programming languages.</th>
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</thead>
<tbody>
<tr>
<td>Unit-2</td>
<td>Classification. C Essentials – Programs development, Functions.</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Scalar Data types – Declarations, Different Types of integers. Different kinds of Integer Constants Floating – point type Initialization.</td>
</tr>
<tr>
<td>Unit-5</td>
<td>Mixing types Explicit conversions – casts. Enumeration Types. the void data type , Typedefs. Pointers.</td>
</tr>
</tbody>
</table>

Reference Books:

M.A./M.Sc. (Mathematics) Third Semester
Paper XI: Special Functions

Max. Marks: 35
Min. Pass. Marks: 12

Unit I
Gamma and Beta Functions: The Euler or Mascheroni Constant \( \gamma \), Gamma Function, A series for \( \Gamma'(z) / \Gamma(z) \), Difference equation \( \Gamma(z+1) = z\Gamma(z) \), Euler's integral for \( \Gamma(z) \), Beta function, value of \( \Gamma(z) \Gamma(1-z) \), Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.

Unit - II
Hypergeometric and Generalized Hypergeometric functions: Function \( 2F1(a,b;c;z) \) A simple integral form evaluation of \( 2F1(a,b;c;z) \) Contiguous function relations, Hyper geometrical differential equation and its solutions, \( F(a,b;c;z) \) as function of its parameters, Elementary series manipulations, Simple transformation, Relations between functions of \( z \) and \( 1-z \).

Unit-III
Bessel function and Legendre polynomials: Definition of \( J_n(z) \), Bessel's differential equation, Generating function, Bessel's integral with index half and an odd integer, Generating function for Legendre polynomials Rodrigues formula, Bateman's generating function, Additional generating functions, Hypergeometric forms of \( P_n(X) \), Special properties of \( P_n(X) \), Some more generating functions, Laplace's first integral form, Orthogonality.

Unit-IV
Hermite polynomial: Definition of Hermite polynomials \( H_n(x) \), Pure recurrence relations, Differential recurrence relations, Rodrigue's formula, Other generating functions, Orthogonality, Expansion of polynomials, more generating functions.

Unit-V
Laguerre Polynomials: The Laguerre Polynomials \( L_n(X) \), Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigo's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.

Books Recommended:

1- Rainville, E.D.; Special Functions, The Macmillan co., New york 1971,
3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application, Pragati prakashan, 1986.

Reference Books:

1- Lebedev, N.N, Special Functions and Their Applications, Prentice Hall,

\[ \text{Date: 30.4.2016} \]
\[ \text{Signature:} \]
M.A./M.Sc. (Mathematics) Third Semester
Paper XIII: Spherical Trigonometry and Astronomy

Max. Marks: 35
Min. Pass. Marks: 12

Unit-I: Spherical Trigonometry – up to solution of right angled triangles.

Unit-II: General ideas and relation between sides and angles of a spherical triangle.

Unit-III: Spherical Astronomy – Various system of references and related topics.

Unit-IV: Celestial sphere, Transit instrument.

Unit-V: Atmospheric Retraction. Time planetary phenomena.

TEXT BOOKS:


REFERENCE BOOKS:

2. Spherical Astronomy – Bell.