M.G.S. UNIVERSITY,

BIKANER

SYLLABUS

SCHEME OF EXAMINATION AND COURSES OF STUDY

FACULTY OF ARTS / SCIENCE

M.A. / M.SC. MATHEMATICS

M.A./M.Sc. PREVIOUS EXAMINATION – 2021
M.A./M.Sc. FINAL EXAMINATION - 2022

The Ordiances Governing the examination in the Faculties of Arts, Fine Arts, Social Sciences, Science, Commerce, Management, Engineering, Education and Law are contained in separate booklet. The students are advised to the same.

2. Changes in Statutes / Ordinances / Rules/ Regulations / Syllabus and Books may from time to time, be made by amendment or remaking, and a candidate shall, except in so far as the University determines otherwise comply with any changes that applies to years he has not completed at the time of change.

3. In each paper, 9 questions will be set, 3 questions from each section. Candidates have to answer five questions in all taking at least one question from each section.

4. The syllabus is given in both the languages i.e. Hindi & English, if there is any discrepency, English version will be authentic.

5. The list of text books/ Recommended books/Reference Books as approved by the various B.O.S. are printed along with the English version only.

Note : The decision taken by the Academic Council shall be final.

SCHEME OF EXAMINATION

Each theory paper	3 Hrs. duration	100 Marks
Dissertation/Thesis/Survey Report/Field Work. If any		100 Marks

1. The number of paper and the maximum marks for each paper practical shall be shown in the syllabus for the subject concerned. It will be necessary for a candidate to pass in the theory part as well as in the practical part (Whenever Prescribed) of a subject/Paper separately.

2. A candidate for a pass at each of the Pervious and the Final Examination shall be required to obtain (i) atleast 36% marks in the aggregate of all the paper prescribed for the examination and (ii) atleast 36% marks in practical (s) whenever prescribed the examination, provided that if a candidate fails to atleast 25% marks in each individual paper work. Wherever prescribed, he shall be deemed to have failed at the examination not with standing his having obtained the minimum percentage of marks required in the aggregate for the examination. No division will be awarded at the Pervious Examination, Division hsall be awarded at the end of the Final Examination combined marks obtained at the Pervious and the Final Examination taken together, as noted below :

First Division	60%	of the aggregate marks taken together
Second Division	40%	of the Pervious and the final Examination.

   All the rest shall be declared to have passed the examination.

3. If a candidate clears any paper (s) Practical(s)/Dissertation Prescribed at the Pervious and or/final Examination after a continuous period of three years, then for the purpose of working out his division the minimum pass marks only viz 25% (36% in the case of practical) shall be taken into account in respect of such paper(s) Particle(S) Dissertation are cleared after the expiry of the aforesaid period of three year, provided that in case where a candidate require more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make the deficiency in the requisite minimum aggregate.

4. The Thesis/Dissertation/Survey Report/Field Work shall be typs & written and submitted in triplicate so as to reach the office of the Register atleast 3 weeks before the commencement of the theory examinations. Only such candidates shall be permitted to offer dissertation/Fields work/Survey Report/Thesis (if provided in the scheme of examination) in lieu of a paper as have secured atleast 55% marks in the aggregate of all scheme and I and II semester examination taken in the case of semester scheme, irrespective of the number of paper in which a candidate actually appeared at the examination.

N.B. (i) Non-Collegiate candidates are not eligible to offer dissertation as per Provision of 170-A.

M.A./M.SC. EXAMINATION

MATHEMATICS

SCHEME OF EXAMINATION

There shall be 10 papers in all. Out of these Five shall be offered in previous and Five in final. Each paper shall be of 100 marks and of 3 hours duration.

M. A. / M. Sc. (Previous) Examination, 2021

Papers	Nomenclature	Duration	Max.Marks
I	Advanced Abstract Algebra	3 Hrs.	100
II	Analysis	3 Hrs.	100
III	Mathematical Methods	3 Hrs.	100
IV	Differential and Integral Equations	3 Hrs.	100
V	Numerical Methods	3 Hrs.	100

Paper - I (ADVANCED ABSTRACT ALGEBRA)

Duration : 3 Hrs. Max. Marks : 100

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Homomorphism theorems on groups, conjugate elements. Classes and class equation of a finite group, Sylows Theorem, P-sylow subgroup, structure theorem for finite abelian groups. Field theory-Extension fields, Algebraic and transcendental extensions, Separable and inseparable extensions

Unit II

Normal and subnormal series, Composition series, Jordan-Holder Theorem, Solvable group, Nilpotent groups. Normal extensions, Perfect fields, Finite fields. Primitive elements, Algebraically closed fields. Automorphisms of extensions. Galois extensions, Fundamental theorem of Galois theory.

Unit III

Vector space of a linear transformation, Matrix representation of a linear transformation, Change of Basis, Similarity, eigen value and eigen vectors for a linear operator, Caley-Hamilton, theorem, diagonalization, minimal

Polynomial and equation. Polynomials over rational fields. The Einstien criterion, Polynormial rings over commutative ring, unique factorization domain, Chain condition and rings.

Unit IV

Linear functionals, Dual and bidual of a vector space and their properties, Annhilators, Invariance, projections and its properties, Adjoints of a linear transformation and its properties. Solution of polynomial equations by radicals, insolvability of the general equation of degree 5 by radicals.

Unit V

Bilinear quadratic and hermition forms, Inner product spaces, Cauchy-Swarchz inequality, orthogonal vectors, orthogonal complements, ortho-normal sets and bases. Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalisation process.

REFERENCES :

1. Maclane and Birkoff : Algebra, Macmillan & Co.
2. Hofman and Kunz. : Linear Algebra, Prentice Hall of India.
3. I.N. Herstein : Topics in Algebra, Wiley Eastern India Ltd.
4. I.S. Luthar and B.S. Passi, : Algebra Vol-I Groups, Vol-II Rings, Narosa Publishing House
5. Gokhroo et.al. : Advanced Abstract Algebra, Navkar Publications, Ajmer
6. Gokhroo et.al : Advanced Linear Algebra, Navkar Publications, Ajmer
7. Purohit, Pareek, Sharma, : Linear Algebra, Jaipur Publishing House
8. Bhattacharya, P.B. etc. : Basic Abstract Algebra (II ed.) Camb. Univ. Press India, 1997
9. P.M. Cohn : Algebra vol I,II & III, John Wiley & Sons, 1982-89, 91
10. D.S. Malik, J.N. Mordeson & M. K. Sen : Fundamental of Abstract Algebra MecGraw Hill International Edition, 1997
11. Vivek Sahai & Vikas Bist : Algebra, Narosa Publishing, 1999
12. Gopal Krishanan, N.S. (II ed.) : University Algebra New Age International Publication
13. Gopal Krishanan, N.S. : University Algebra through 600 problems New Age International Publication
14. B.S. Vatssa : Modern Algebra, 1999 New Age International Publication, (1999)

Paper - II (ANALYSIS)

Duration: 3 Hrs. Max. Marks : 100

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Countable and non countable sets, lebesgue measure of sets of real numbers. Measurable functions, structure of measurable functions, weierstras's theorem on the approximation of continuous functions by polynomials.

Unit II

Lebesgue integral of measurable functions, lebesgue theorem on the passage to the limit under the integral sign. Summable functions, the space of square summable functions, function of finite variation, stieltjes integral, the indefinite lebesgue integral.

Unit III

Algebra of Complex numbers, Analytic functions, Cauchy-Reimann equations, Cauchy Theorem and integral formula, Power series, Taylor's and Laurents series, Morera's Theorem, Lioville's Theorem, Fundamental Theorem of Algebra, exp, sine, Cosine functions, Maximum modulus principal, Swartz Lemma.

Unit IV

Classification of Singularities, Branch points, Reimann Theorem on removable Singularity, open mapping theorem, casoratti-weirstrass theorem, meromorphic functions. The argument Principle, Roche's Theorem

Unit V

Residues, cauchy's residue theorem, Evaluation of Integrals, Branches of many value function with reference to argz, logz and Z^a, ã definition and examples of Contour mapping. Analytic continuation.

REFERENCES :

1. T.M. Apostal : Mathematical Analysis, Narosa Publishing House, New Delhi (1985)
2. Gabriel Klambauer : Mathematical Analysis, Mared Dekker Inc., New York (1975)
3. G-de Barra : Measure Theory and Integration, Wiley Eastern Ltd. 1981
4. P.K. Jain and V.P. Gupta : Lebesgue Measure and Integration, New Age International Pub. Ltd., New Delhi (Reprint 2000)
5. Indra Kumar Rana : An Introduction to Measure and Integration, Narosa Publishing House, New Delhi (1997)

6. G.N. Purohit : Advanced Analysis, Jaipur Publishing House, Jaipur

7. G.N. Purohit : Lebesgue Measure and Integration, Jaipur Publishing House, Jaipur

8. T.S. Nahar : Advanced Analysis, Navkar Publications, Ajmer

9. T.S. Nahar : Measure Theory, Navkar Publications, Ajmer

10. S. Ponnusamy : Foundation of Complex Analysis, Narosa Publishing House, New Delhi (1997)

11. Shanti Narain : Complex Analysis, S.Chand & Co., New Delhi

12. L.V. Ahlfords : Complex Analysis, McGraw Hill Co., 1979

13. Purohit and Goel : Complex Analysis, Jaipur Publishing House, Jaipur.

14. K.P. Gupta : Complex Analysis, Krishana Prakashan Mandir, Meerut.

15. B. Choudhary : Complex Analysis, Wiley Eastern Ltd. New Delhi.

16. Gokhroo et.al : Complex Analysis, Navkar Publications, Ajmer

17. S.K. Sharma etc. : Complex Analytic Functions Theory and Applications New Age International Publishers.

18. M.R.Speigel : Real variables (Lebesgue Measure and Integration) McGrawHill Co.

Paper - III (Mathematical Methods)

Duration: 3 Hrs. Max. Marks: 100

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit-I (Special Functions)

Hyper Geometric and Confluence, Hyper geometric Functions. Hermite and Laguerre Polynomial, their generating functions and general integral properties.

Unit-II (Special Functions)

Legendres polynomial . Associated Legendre's functions. Bessel's functions. Recurrence relations. Orthogonal properties.

Unit-III (Tensors)

Transformation of Coordinates, Covarient, Contravarient and mixed tensors. Invariants. Addition, subtraction and multiplication of tensors. Contractions of tensors Quotient Law of tensors. Fundamental Tensors, Length of Curve, Associated tensors.Christoffel symbols, Covariant Differentiation of tensors, Laws of covariant differentiation

Unit-IV(Tensors)

Geodisics, Null Geodesics, Geodesics Coordinates Parallelism, Covarient derivatives, Reimann-christroffel tensor, curvature tensor, Ricci tensor, Bianchi identity, Reimaan curvature, Flat space, space of constant curvature.

Unit-V (Integral Transform)

Laplace Transform: Definition and properties, Rules of manipulation: Laplace Transform of derivatives, Inverse Transform, Complex in version formula, Convolution theorem , Use of Laplace Transform to solve differential equation with constant coefficient, Variable coefficients, Simultanens equations and simple Partial differential equation.

REFERENCES :

1. Rainville E.D. : Special Functions Chapter :1,6,8,11 & 12
2. Sneddon I.N. : The use of Integral Transform , Mc-Graw Hill Co., 1966
3. Speigal M.R. : Theory and Problem of Laplace Transform , McGraw Hill Co.
4. Slater L.J : Confluent Hypergeometric Functions, Cambridge University Press,1966
5. L.J. Slater : Generalized Hypergeometric Functions, Cambridge University Press, 1966
6. Gokhroo et.al : Special Functions, Navkar Publications, Ajmer

7. Gokhroo et.al : Transform Calculus, Navkar Publications, Ajmer

8. Berry Spain : Tensor Calculus

9. Bansal J.L. : Tensor Calculus, Jaipur Publication House, Jaipur.

10. Raj Bali : Tensor Calculus, Navkar Publications, Ajmer

Paper - IV (Differential and Integral Equations)

Duration – 3 Hrs. **Max Marks 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit-I (Differential Equations)

Existence and uniqueness of solution of dy/dx = f(x,y), Cannonical forms and reduction to canonical forms. Classification of second order PDE, Separation of variable for Heat Equation, Wave equations and Laplace Equation.

Unit-II (Differential Equations)

Linear Boundary value problem, (Eigen values eigen functions, normalized eigen functions eigen function expansion, Rayleigh quotient), Strum Liouville Boundary value problem, Cauchy problem and characteristics, Green's function.

Unit-III (Calulus of Variation)

Linear functionals, Minimal functional theorem, General Variations of a function, Euler-Lagranges equation, Variational method for Boundary value problems in ordinary and partial differential equations.

Unit-IV (Integral Equations)

Linear integral equations of first and second kind of Fredholm and Volterra types, Homogeneous Fredholm integral equations, Fredholm integral equations with separable kernels, solution by successive substitutions and successive approximations

Unit-V (Integral Equations)

Volterra integral equations and their solutions solutions by successive substitutions and successive approximations, Classical Fredholm theory, The Fredholm alternative Helbert Schimdt theory of Symmetric Kernels.

REFERENCES :

1. Lovitle W.V. : Integral Equation, Dover Publications

2. Kanwal R.P. : Linear Integral Equation Theory and Techneques, Academic Press, New York

3. Gokhroo et.al : Differential Equation and Calculus of variation, Navkar Publications, Ajmer

4. Gokhroo et.al : Integral Equation, Navkar Publications, Ajmer

5. Fred A. Hinchey : Introduction to Applicable Mathematics Part-II, Wiley Eastern Ltd.

6. S.G. Mikhlin : Linear Integral Equation 1960 (Translated from Russian) Hindustan Book agency

7. A.N. Sneddon : Mixed Boundary Value Problem in Potential Theory, North Halland, 1966

8. Goyal et.al. : Integral Equation, jaipur publishing house jaipur

PAPER - V (Numerical Methods)

Duration: 3 Hrs. Max. Marks: 100

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Note : scientific calculators (non programming) are allowed

Unit-I

Iterative methods : Simple iteration, theory of iteration, acceleration of conversion, methods for multiple and complex roots, Newton Raphson method for simultaneous equations, convergence of iteration process in the case of several unknowns.

Unit-II

Solution of polynomial equations, polynomial evaluation, real and complex roots, synthetic division, the Birge-Vieta, Baristow and Graffe's root squaring methods, system of simultaneous equation (Linear) –direct methods –Methods of determination. Gauss elimination, Gauss Jordan, Cholesky, Partition methods of successive, approximate –conjugate Gracient, Gauss and Jacobi iteration, Gauss seidal iteration & Relaxation methods.

Unit-III

Eigen value problem, basic properties of eigen values and eigen vectors, power methods for finding all eigen pairs of a matrix, complex eigen values.

Curve fitting and function approximation, least square error criterion, linear regression, polynomial fitting and other curve fitting, approximation of functions by Taylor series and Chebyshev polynomials.

Unit-IV

Numerical solution of ordinary differential equations, Taylor series methods, Euler's and modified Euler's method, Runge-Kutta method upto fourth order, multi step method (Predictor –Corrector Strategies), stability analysis –single and multi step methods.

Unit-V

Difference methods for Boundary value problems, ordinary differential equations, boundary value problems, shooting methods, finite difference methods, difference scheme for non linear boundary value problems of the type.

Books recommended :

1- Jain, Iyengar & Jain : Numerical Analysis
2- Jain M.K. : Numerical Solution of differential equations.

M. A. / M. Sc. (Final) Examination, 2022

Papers	Nomenclature	Duration	Max.Marks
	Compulsory Papers		
VI	Topology and Functional Analysis	3 Hrs.	100
VII	Continuum Mechanics	3 Hrs.	100
	Optional Papers (Any THREE of the following) :		
Opt Paper I	Generalized Hyper-geometric Functions	3 Hrs.	100
Opt Paper II	Advance Discrete Mathematics	3 Hrs.	100
Opt Paper III	Mechanics	3 Hrs.	100
Opt Paper IV	Fluid Dynamics	3 Hrs.	100
Opt Paper V	Operations Research	3 Hrs.	100
Opt Paper VI	Topology	3 Hrs.	100
Opt Paper VII	Mathematical theory of Statistics	3 Hrs.	100
Opt Paper VIII	Computer Applications (Only for regular students)	3 Hrs.	100
Opt Paper IX	Relativity and Cosmology	3 Hrs.	100

Paper - VI (Topology and Functional Analysis)

3 Hrs. duration **100 Marks**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I (Topology)

Topological spaces: Neighbour hood and neighbourhood system, coarser and finer topologies, relative topologies, equivalent definitions of topologies. open and closed functions, Continuity and topological equivalence:. Homeomorphic spaces, topological properties, topologies induced by functions.

Unit II(Topology)

Separation axioms: T_1 space, Hausdorff spaces, regular spaces, Functions that separate points. Completely regular spaces sequentially compact sets, countably compact sets. Locally compact spaces, compactness in metric spaces.

Unit III (Banach Spaces)

Normed Vector spaces, Banach Spaces and their examples, Continuous linear transformations, The Hahn-Banach theorem and its application, The open mapping theorem , the closed graph theorem ,the uniform boundedness theorem.

Unit IV (Hilbert Spaces)

Inner product spaces, Hilbert space and their examples, Cauchy Schwarz's inequality, Parallelogram Law, Orthogonal complements, Orthonormal sets. Bessel's inequality,Gram Schmidt orthogonlization process, Riesz representation theorem

Unit V (Hilbert Spaces)

Adjoint of an operator, Self adjoint, Normal and Unitary Operators and their properties, Projections.

Recommended:

1. L.A. Luesternik and L.J. Soboler : Elements of Functional Analysis, Hindustan Publishing Company (1974).
2. A.E. Taylor : Introduction to Functional Analysis (1958), John Wiley and Sons.
3. J.Dieudonne : Foundations of Modern Analysis (1969), Academic Press.
4. Kosaku Yosida : Functional Analysis (1974), Narosa Publishing House, New Delhi.
5. B. Choudhary : Functional Analysis with Application (1989), Wiley Eastern Limited and Sudarshan Nanda
6. Nahar, T.S : Metric Spaces, Navkar Publications, AJMER
7. Nahar, T.S. : Functional Analysis, Navkar Publications, AJMER
8. Sharma, J.N.. : Functional Analysis, Krishana Prakashan Mandir, Meerut
9. S.Lipsechutz : General topology. The any problem, MCgraw Hill Co. (ch.V,VI,X,Xi)
10. G.F.Summous : Introduction of topology and modern Analysis.

Paper - VII (Continuum Mechanics)

3 Hrs. duration **100 Marks**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Cartesian Tensors, Index notations and transformation, Laws of Cartesian tensors, Addition, Subtraction and multiplication of Cartesian tensor, Gradient of a scalar function, Divergence of a vector function and curl of a vector function using the Index notation, The identity stokes, Gauss and Green's theorems.

Unit II

The continuum approach classification of continuous media, Body forces and surface forces, Components of stress tensor, Force and moment equation of equilibrium, The stress quardric, Principle stresses and Principle axes, Stress invariants and the stress deviator tensor, Maximum shearing stress.

Unit III

Lagrangian and Eulerian description of deformation of flow, the comoving derivative, Velocity and acceleration, The continuity equation.

Strain tensors, The linear rotation tensor and rotation vector, Analysis of rotation displacement, Geometrical meaning of the components of the linear strain tensor, Principle axis theory for the linear strain tensor, properties of Linear strain tensors, The linear cubical dilatation, Compatibility equations for the linear strain components.

Unit IV

The rate of strain tensors and the vorticity tensor, The rate of rotation vector and the vorticity, Properties of the rate of strain tensor, Rate of cubical dilatation.

Law of conservation of mass and Eulerain Continuity equation, The momentum integral theorem and the equation of motion, Kinetic equation of state, The first and the second law of thermodynamics and the dissipation function.

Unit V

Application: (Linear elasticity): Assumption and basic equations, Generalized Hooke's Law for an isotropic Homogeneous solid, Compatibility equations. Classification of types of problems in linear elasticity, The Principle of superposition, The strain energy function, The uniqueness theorem P.I. Relationship and the work kinetic energy equation,

Irrotational flow and the velocity potential, Kinetic equation of state and the First Law of Thermodynamics. The equation of continuity, the equations of motion, Vorticity-Strema Surface for inviscid flow, Bernoulli's equations, Irrotational flow and the velocity potential, Similarity parameters and fluid flow.

Books for Reference :

1. D. Frederic and T.S. Chang : Continuum Mechanics, Ally and Bacon. Inc. Boston.
2. Mase. G.E. : Continuum Mechanics (Schaum series)
3. Sommefield A. : Mechanics Deformable bodies.

4. Mortone E. gurtin : AnIntroduction to Continuum Mechanics, (Academic Press)

5. Sharma, K.D. : Continuum Mechanics, Navkar Publications, AJMER

Optional Papers (ANY THREE of the following)

Opt. PAPER - I (Generalized Hypergeometric Functions)

Duration 3 Hrs. **Max. Marks : 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

UNIT- 1

Generalized Hypergeometric Functions: Definition, Convergence conditions for ${}_pF_q$ differential equation and its solution, Watson's, Dixon's, Whipple's and Saalschutz theorems for the series ${}_3F_2$ with unit argument, Fundamental theorem due to thomae.

UNIT-2

Contour integral representation for ${}_pF_q$, Euler's type integrals involving ${}_pF_q$. Special cases, Product formulas due to Ramanujan, Preece and Bailey.

Meijer's G function: Definition, Nature and convergence conditions for the contours, special cases, Identities.

UNIT-3

Transformation formulas, differentiation formulas, recurrence relations, Contiguous functions, relations. Simple finite and infinite integrals involving G-function, Mellin and Laplace transforms of G-function.

UNIT-4

H-function: Definition, Convergence conditions, Series representations, Special cases, Transformation formulas, Identities, Differentiation formulas, Multiplication formulas.

UNIT-5

Recurrence relations, Contiguous function relations, finite and infinite integrals involving H-functions.

Books Recommended :

1. Bailey, W. N., : Generalised Hypergeometric Series, Cambridge University Press, Cambridge, (1935)
2. Mathai A.M.and : Generalised Hypergeometric functions with applications in
3. R.K.Saxena, Statistics and Physical Sciences, Lecture Notes in Mathematics, 348 Springer verlag, New York, (1973). (Chapters 1 to 4).

4. Mathai A.M.and other : The *H*-fuction with applications in Statistics.
5. Saxena, R.K disciplines, Wiley Eastern Ltd., New Delhi, (1978) (Chapters 1to3)
6. Raninville E.D. : Special functions, The MacMaillan Co., (1960)
7. Saran, N.,Sharma, S.D. et.al. : Special functions, Pragati Prakashan, Meerut. Chapter 4

Opt. Paper II (Advance Discrete Mathematics)

Duration : 3 Hrs. Max. Marks: 100

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Formal logic-Structures symbolic representation, propositional logic, equivalence, Contradictions and tautologies, Argument and validity, predicates and quantifiers. Semi groups and monoids-definition and examples of semi group and monoid, congruence relations and semi groups, and sub monoids, direct products, basic homomorphism theorem.

Unit II

Lattices: Lattices as partially ordered sets, their properties, lattices as algebraic system, sub lattices, direct products and homomorphism, some special lattices e.g. complete, complemented and distributive lattices. join-irreducible elements, atoms.

Boolean Algebras: Boolean Algebras as lattices. Various Boolean identities, the switching algebra example, sub algebras, and minterms and maxterms Boolean forms and their quivalence, minimization of Boolean functions, application of Boolean algebra to switching theory (using AND,OR, NOT gates), the Karnaugh map method.

Unit III

Graph theory: definition of undirected graphs, direct graphs, paths, circuits, cycles and sub graphs, induced sub graphs, degree of a vertex, weighted undirected graphs, matrix representations of graphs , connectivity, strong connectivity, complete and complete bipartite graphs, isomorphic graphs, planar graphs and their property, Euler's formula for connected planar graphs, Eulers theorem on the existence of Eulerian path and circuts, Kuratowski's theorem (Statement only) and its use , cut sets , fundamental cut sets and cyles, Dijksta' algorithm and Warshall's algorithm

Unit IV

Tree , Spanning tree, Minimal spanning trees and Kruskal and Prim algorithms, binary search tree. Tree traversals. Notation of syntax analysis, polish notation, conversions of infix expression to polish notations. The reverse polish notation.

Unit V

Introductory computability theory: finite State machines and their transition table, diagrams. Equivalence of finite state machine. Reduced machine homomorphism. Finite automaton. Acceptors non-deterministic finite automata and equivalence of its power to that of deterministic finite automata. Moore and mealy machines. Turning machine and partial recursive functions.

Grammars and languages: Phrase structure grammars, rewriting rules, derivations and sentential forms. Language generated by a grammar, regular, context free and context sensitive grammar sand languages, regular sets and regular expressions and the pumping lemma, Kleen's theorem.

Books Recommended:

1. J.P. Tremblay and R. Mamohar : Discrete mathematical structures with applications to Computer Science, McGraw Hill Book Co. 1997
2. Seymour, Lepschtz : Finite Mathematics Intonations edition, 1983 McGraw Hill Book Co. New York
3. C.L. Liv : Elements of Discrete Mathematics McGraw Hill Book Co. New York
4. N.Deo : Graph Theory with Application to Engineering Computer Science.Prentice hall of India.

Opt. Paper III (Mechanics)

3 Hrs duration **Max. Marks 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Moment and product of Inertia, parallel axes. Momental Ellipsoid, D'Alembert's principle. Motion about a fixed axis, General equation of motion of a rigid body, Moment about a fixed axis, The compound pandulum, Centre of percussion.

Unit II

Motion of a rigid body in two dimensions under finite and impulsive forces, Conservation of Momentum and Energy.Lagrange's equations, Initial Motions, Generalized coordinates, Holonimic and Non-holonomic systerms. Scleronomic and Rheonomic systems. Generalized potential

Unit III

Lagrange's equation of first kind, Lagrange's equations of second kind. Hamilton's variables. Hamilton cononical equations cyclic coordinates, Poisson's Bracket. Poisson's identity. Jacobi-Poisson Theorem. Hamilton Jacobi Equations.

Unit IV

(Partial Differantial Equations)

Examples of PDE. Classification. Nonlinear first order PDE, Transport Equation - Initial value Problem. Non-homogeneous Equation.

Unit V

(Partial Differantial Equations)

Laplace's Equation-Fundamental Solution. Mean Value Formulas. Heat Equation -Fundamental Solution, Mean Value Formula, Properties of Solutions. Wave Equation - Fundamental Solution, Solution by spherical means (polar forms), Non-homogeneous wave equations.

Books Recommended :

1.	Classical Mechanics	:	Goldstien
2.	Engineering Mathematics	:	Erwin Kreyszig
3.	Dynamics of Rigid Bodies	:	M. Ray
4.	Rigid Body Dynamics	:	Gokhroo et.al.
5.	Advanced Differential Equations	:	M.D. Raisinghania

Opt. Paper IV (Fluid Dynamics)

3 Hrs duration **Max. Marks 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Kinematic of ideal fluid, Lagrange's and Euler's method, Equation of continuity in cartesian, Polar and cylinderical co-ordinales, Boundary surfaces, stream lines, Path lines, Velocity potential, Rotational and Irrotational motion, Equation of motion, Bernoulli's theorem, D'Alember's paradox, Euler's momentum theorem, Helmholtz, Cauchy's integrals, Motion due to impulsive forces.

Unit II

Motion in two dimensions, Stream function, Irrotational motion, Complex potential, Sources, Sinks, Doublets and images, Motion of circular and elliptical cylinder, Motion of a sphere

Unit III

Viscosity, Analysis of stress, Relation between stress and rate of strain, Dynamical similarity and inspection and dimensional analysis, Buckinghemt theorem, Physical importance of non-dimensional parameters, Reynolds number, Fruoude number, Mach number, Prandtl number and Grashoff number, Navier- Stoke's equations, some exact solutions of Navier-stoke's equations, Plane couete flow, Plane posiseulle flow, Generalised plane couetel flow, Hagan-Poiseuille flow, Flow in tubes in uniform cross-section

Unit IV

Flow in convergent and divergent channels, Stagnation point flows, Flow due to a rotating disc, Flow due to a plan wall suddently set in motion (stokes first problem), Flow due to an oscillating plane wall (Stoke's second problem), Starting flow in a pipe

Unit V

Theory of very slow motion, Stoke's flow pas a sphere, Oseen's flow past a sphere, Lubricandtion theory.

Books Recommended :

1. A Text book on Hydrodynamics : M.Ray
2. A Treatise on Hydrodynamics : Ram Say and Besant
3. Viscous Fluid Dynamics : J.L.Bansal
4. Fluid Dynamics : Shanti Swaroop

Opt. Paper V (Operations Research)

3 Hrs. duration **100 Marks**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

The theory of simplex method, Simplex algorithm, Duality, Degeneracy, Variation of the simplex method

Unit II

Dual Simplex method, Revised simplex method, Sensitivity analysis (Post optimal solution)

Unit III

Integer programming, Bounded variable problem, Convex function, Saddle point.

Unit IV

Conditions for non-linear programming problem, Kuhn Tucker conditions for optimization for non-linear programming problem.

Convex programming with separable convex objectives.

Unit V

Quadratic programming method for quadratic programmes due to Wolfe and Frank, Duality theorem for quadratic programming,

Dynamic programming its notion and formulation.

Books Recommended :

1. Hadley : Linear Programming
2. Gass : Linear Programming
3. Hadley : Non-linear Programming
4. Satty : Mathematical Methods of Operational Research
5. Sadieni, Friendmand and Yaspann : Operations Research

6. Bellmen R. : Dynamic Programming

7. Vajda : Mathematical Programming

Opt. Paper – VI (Topology)

3 Hrs. duration **100 Marks**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system,Continous mapping and Homeomorphism bases, and sub basis, Cauchy's sequences

Unit II

Nets, Filters,Complete Metric spaces, Product spaces, Quotient spaces, Compact and locally compact spaces, Tychonoff's One point compactifications. Separation axioms, Normal spaces

Unit III

Connected and locally connected spaces, Continuity and connectedness and compactness, Hausdra spaces,

Unit IV

Regular spaces, Topological groups, Closed subgroups and the topology on the Spaces of right / left cosets

Unit V

Locally compact group and compact groups. Left / Right Haar measures on locally compact groups, existence and uniqueness of left / right Haar measure.

Books Recommended :

1. Topological Spaces. : Kowalsky
2. General Topology. : Kelly
3. Introduction to Topology : G.F. Simmons and Mordern Analysis
4. Introduction to General Topology : K.D. Joshi
5. General Topology. : Gautam and Santi Naryan

Opt. Paper VII (Mathematical theory of Statistics)

3 Hrs duration **Max. Marks 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Sample spaces, Combination of events, Statistical independence, Conditional probability-Bays theorem Repeated trials, Random Variable, Distribution function, Probability function, Density function, Mathematical expectation, Generating function (mfg and pgf) continuous probability distribution characteristic function, Fourier's Inversion, Cheby-Shev and Kolomogrovea inequality, Weak and Strong laws of large numbers,

Unit II

Normal, Hyper-geometric, Rectangular, Negative Binominal, Beta, Gamma and Cauchy's distribution.

Methods of least square and curve fitting, correlation and regression coefficient.

Unit III

Index numbers, Introduction, Price-relatives, Quantity relatives, Value relatives, Link and Chain relatives, Aggregate methods, Fisher's Ideal Index, Change of the base period of the index numbers.

Elementary sampling theory, Distribution of means of samples from Binomial, Cauchy, Rectangular and normal distributions, Distribution of second order moments in samples from normal population, Exact distributions of X^2, t, z and F, Statistics in samples from a normal population, Their simple properties and applications.

Unit IV

Test of significance of difference between two means and two standard deviations for large samples with modification for small samples and taken from normal population.

Association of attributes, Analysis of variance, simple cases (one criteria and two criteria of classification), Elementary statistical

Unit V

Theory of Estimation, Fisher's criteria for the best estimator, Consistent, Efficient and sufficient estimator, Method of Maximum Likelihood estimators and other methods of estimation, Method of least squares.

Books Recommended :

1. Kapur and Saxena : Mathematical Theory of Statistics.
2. Weatherburn : A First Course in Mathematical Statistics.
3. M.G. Kendall : The Advanced Theory of Statistics.
4. Uspensky : Introduction of Mathematical Probability.

Opt. Paper VIII (Computer Applications)

(To be offered by Regular Students only)

3 Hrs duration	**Theory Paper**	**Max. Marks 70**
2 Hrs duration	**Practical**	**Max. Marks 30**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 01 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 03 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 15 Mark each (01 question from each unit) attempt any 03 questions

Unit I

Introduction to computers, computer organization, Input-Output devices, memory systems. Hardware and Software. Operating system. Computer languages, system software and application software, algorithems and flow charts.

Unit II

Programming languages and problems solving on computers. Object Oriented System, Difference Between Procedural and Object Oriented Languages, Object Oriented Paradigm, Inheritance, Polymorphism, Abstraction, Encapsulation, Benefits and Application of Oops.

(Programming with C++)

Unit III

Introduction to C++, Character set,Constant,Variables and Data Types,Operator, Arithmetic Expression, Operator Precedence and Associatively, Input, conditional Statements, Conditional Operator, Scope of Variables, Type Conversion.

Unit IV

Iteration: While, do while, for, Break, Continue, Goto Function-standard and User-Defined Function, Recursive function, Passing By Value And Reference, Pointers and Functions, Reference and Functions. Array: One Two And Multidimensional, Passing Array to a Function.

Unit V

Class: Definitions, Declaring Members and Methods in Functions, Functions Returning Objects, Static Data Members and Methods, Inline Function, Offline (Outline), Function Overloading and Overriding. Constructors-Needs and its Usage

Types of Constructors, Destructor, Pointer to Object, Pointers to Members, Dynamic Class Objects, Friend Functions and its Usage, Inheritance-Needs of Inheritance, Usage, Type of Inheritance.

P R A C T I C A L

Note: 1. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed by the University through BOS and internal examiner will be appointed by the Head of the Department / Principal of the College.

2. Each candidate has to prepare his / her practical record.

3. Each candidate has to pass in Theory and Practical examinations separately.

Simple C++ Programming of problems of numerical analysis, solution of quadratic equations, mean and standard deviation, fitting of curves, correlation coefficient, applications into matrices, sorting of numerical character string data etc.

Distribution of Marks:

Two Practicals - 10 Marks each	=	20 Marks
Practical Record	=	05 Marks
Viva - Voce	=	05 Marks
Total Marks	=	30 Marks

Opt. Paper IX (Relativity and Cosmology)

3 Hrs duration **Max. Marks 100**

Note : The paper consists of three sections

Section A : This section contain 10 questions of 02 Mark each (02 question from each unit) all questions are compulsory

Section B : This section contain 05 questions of 04 Mark each (01 question from each unit) all questions are compulsory

Section C : This section contain 05 questions of 20 Mark each (01 question from each unit) attempt any 03 questions

Unit– I

Relative Character of space and time, Principle of Relativity and its postulates, Derivation of special Lorentz transformation equations, Composition of Parallel velocities, Lorentz-Fitzgerald contraction formula, Time dilation, Simultaneity, Relativistic transformation formulae for velocity, Lorentz contraction factor, Particle acceleration, Velocity of light as fundamental velocity, relativistic aberration and its deduction to Newtonian theory.

Unit-II

Variation of mass with velocity, Equivalence of mass and energy, Transformation formulae for mass, Momentum and energy, Problems on conservation of mass, Momentum and energy, Relativistic Lagrangian and Hamiltonian, Minkowski space, Space-like, Time-like and Light-like intervals, Null come, Relativity and Causality, Proper time, World line of a particle.

Unit-III

Principles of Equivalence and General Covariance, Geodesic postulate, Mach's principle, Newtonian approximation of equation of motion, Einstein's field equation for matter and empty space, Reduction of Einstein's field equation to Poisson's equation, Schwarzschild exterior metric, its isotropic form and singularity, Relativistic differential equation for orbit of the planet.

Unit-IV

Three crucial tests in general Relativity and their detailed descriptions, Analogues of Kepler's laws in General Relativity, Trace of Einstein tensor and energy-momentum tensor for perfect fluid, proof of its expression for perfect fluid, Schwarzs child interior metric and boundary conditions, Radar Echodelay (Fourth test).

Unit-V

Lorentz invariance of Maxwell's equations and their tensor form, Lorentz force on charged particle, Energy-momentum tensor for electromagnetic field, Reissner-Nordstrom metric for spherically charged particle.

Cosmology- Einstein's field equation with cosmological term, static cosmological models(Einstein and de-Sitter) and their physical and geometrical properties, Red shift in non-static form of de-sitter line-element, Einstein-space, Hubble's law, Weyl's postulate.

Reference Books:

1. J.V. Narlikar, Lectures on General Relativity and Cosmology, Macmillan Co. Ltd. India, N. Delhi, 1978
2. C. Moller, The theory of Relativity, Oxford Clarendon Press, 1952.
3. P.G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.
4. J.I. Anderson, Principles of Relativity Physics, Academic Press, 1967.
5. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.
6. V.A. Ugarov, Special theory of Relativity, Mir Publishers, 1979.
7. Raj Bali, Theory of Relativity, Jaipur Publishing House, Jaipur.
8. Goyal and Gupta, Theory of Relativity, Krishna Prakashan Mandir, Meerut.