DEPARTMENT OF MATHEMATICS

COURSE CURRICULUM & MARKING SCHEME

B.Sc. Part - III

MATHEMATICS

SESSION : 2023-24

ESTD : 1958

GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG, 491001 (C.G.)

(Former Name – Govt. Arts & Science College, Durg)

NAAC Accredited Grade A+, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)

Phone : 0788-2212030

Website - www.govtsciencecollegedurg.ac.in, Email – autonomousdurg2013@gmail.com

DEPARTMENT OF MATHEMATICS
GOVT. V.Y. T. PG. AUTONOMOUS COLLEGE, DURG
SYLLABUS
for
B.Sc. Part-III

The syllabus with the paper combinations and Marking Scheme for Session 2023-24.

Paper No.	Title of the Paper	Marks Allotted in Theory	
		Max	Min
I	Analysis	50	
II	Abstract Algebra	50	
III	Optional Paper (A) Discrete Mathematics (B) Application of Mathematics In Finance and Insurance (C) Mathematical Modelling (D) Computational Mathematics Laboratory	50	
	Total	**150**	**50**

Total Marks - 150

The syllabus for **B.Sc. Part-III** is hereby approved by the members of Board of Studies for the session 2023-24.

In case, any change or modification is prescribed by Central Board of Studies or Higher Education Deptt., Govt. of Chhattisgarh with respect to content or distribution of marks for Undergraduate syllabi, it will be implemented accordingly.

Name & Signature

Chairperson / H.O.D - Dr. Padmavati

Subject Expert - Dr. Madhu Srivastava

Subject Expert - Dr. Shabnam Khan

Subject Expert - Dr. S. K. Bhatt

Representative Members -

(1) Dr. Anil Kashyap -
(2) Shri A. K. Pandey -
(3) Dr. Mayur Puri Goswami -

Faculty members Dr. M.A. Siddiqui

Dr. Rakesh Tiwari

Dr. (Smt.) Prachi Singh

Ambalika Chauhan -

Chitra Kumar -

Gayatri Yadav -

Bijma Kumari -

B.Sc. Part – III (MATHEMATICS)

2023-2024

PAPER-I

ANALYSIS

Max. Marks. 50

Course Title	B. Sc. Part – III, Analysis
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Understand Series and their convergence, various test of convergent, Implicit function, Fourier series etc.
CO No. – 2	Apply Reimman integration, mean value theorem, Integral as a function of parameter etc.
CO No.- 3	Remember complex number, complex valued function, Analytic function, Conformal mapping etc.
CO No.- 4	Understand Metric spaces, Contraction principle, Complete metric space, various types of spaces.

METRIC SPACES:

UNIT-I Construction of real numbers as the completion of the incomplete metric space of rationals. Real numbers as a complete ordered field. Definition and examples of metric spaces. Neighborhoods. Limit points. Interior points. Open and closed sets. Closure and interior. Boundary points. Sub- Space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Contraction principle.

UNIT-II Dense subsets. Baire Category theorem. Separable space, second countable and first countable spaces. Continuous functions. Extension theorem. Uniform continuity. Isometric and homeomorphism. Equivalent metrices. Compactness, Sequential compactness. Totally bounded spaces. Finite intersection property. Continuous functions and compact sets. Connectedness. Components. Continuous functions and connected sets.

COMPLEX ANALYSIS:

UNIT-III Complex numbers as ordered pair. Geometric representation of Complex numbers. Stereographic projection. Continuity and differentiability of complex functions. Analytic functions. Cauchy-Riemann equations. Harmonic functions. Elementary functions. Mapping by elementary functions. Mobius transformations. Fixed point. Cross ratio. Inverse points and critical mappings. Conformal mappings.

REAL ANALYSIS:

UNIT-IV Riemann integral. Integrability of continuous and monotonic functions. The fundamental Theorem of integral calculus. Mean value theorems of integral calculus. Improper integrals and their

convergence, comparison tests, Abel's and Dirichlet's tests. Frullani's integral. Integral as a function of a parameter. Continuity, derivability and integrability of an integral of a function of a parameter.

UNIT-V Series of arbitrary terms. Convergence, divergence and oscillation. Abel's and Dirichlet's test. Multiplication of series. Double series. Partial derivation and differentiability of real valued functions of two variables. Schwarz and Youngs theorem. Implicit function theorem. Fourier series. Fourier expansion of piece wise monotonic function.

REFERENCES:

1. T.M. Apostol, Mathematical Analysis, Narosa Publishing House, New-Delhi,1985.
2. R.R. Goldberg, Real Analysis, Oxford & IBH Publishing Company New-Delhi,1970.
3. S. Lang, Undergraduate Analysis, Springer-Verlag, New-York ,1983
4. D.Somasunderam and B. Choudhary, A First Course in Mathematical Analysis, Narosa Publishing House, New Delhi,1997.
5. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Company New-Delhi.
6. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis , S. Chand & Company New-Delhi ,2000.
7. R.V. Churchill & J.W. Brown, Complex Variables and Applications , 5th Edition, Mc-Graw Hill,New-York ,1990.
8. Mark J. Ablowitz & A.S. Focas, Complex Variables : Introduction and Applications, Cambridge University Press South Asian Edition, 1998.
9. Shanti Narayan, Theory and Functions of a Complex Variable, S. Chand & Company New-Delhi. E.T. Copson. Metric Spaces Cambridge University Press , 1968.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** - (4) Dr. Anil Kashyap - (5) Shri A. K. Pandey - (6) Dr. Mayur Puri Goswami -	**Faculty members** Dr. M.A. Siddiqui Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Ambalika chauhan - Chitra Kumar - Gayatri Yadav - Bijma Kumari -

B.Sc. Part – III (MATHEMATICS)

2023-2024

Paper II

Abstract Algebra

Max.Marks.50

Course Title	B. Sc. Part – III, Abstract Algebra
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Understand Group Automorphism, Sylow's Theorems, Homomorphism of rings, Idea of Ideals, Euclidian rings, Modules etc..
CO No. – 2	Analyze Vector spaces and its property, Idea of dimension, dimension of sums of subspace.
CO No.- 3	Evaluate Linear transformation with their matrix representation, Rank and nullity, digonalization, bilinear quadratic Hamilton's forms etc.
CO No.- 4	Apply Inner product space, Orthogonal vectors, Gram Schmidt orthogonalization process etc.

UNIT-I Group – Automorphism, inner automorphism. Automorphism groups. Conjugacy relation. Normalizer. Counting principle and the class equation of a finite group. Center for groups of prime order. Abelianizing of a group and its universal property. Sylow's theorems. Sylow subgroup. Structure theorem for finite abelian groups.

UNIT-II Ring theory - Ring homomorphism. Ideals and Quotient rings. Field of quotients of an integral domain. Euclidean rings. Polynomial rings. Polynomials over the rational field. Eisenstien criterion. Polynomial rings over commutative rings. Unique factorization domain. R-unique factorization domain implies so is R $[x_1,x_2.....x_n]$. Modules, submodules. quotient modules. Homomorphism and isomorphism theorems.

UNIT-III Definitions and examples of vector space. Subspaces. Sum and direct sum of subspaces. Linear span. Linear dependence, independence and their basic properties. Basis. Finite dimensional vector spaces. Existence theorem for basis. Invariance of the number of elements of a basis set. Dimension. Existence of complementary subspace of a finite dimensional vector space. Dimension of sums of subspaces. Quotient space and its dimension.

UNIT-IV Linear transformation and their representation as matrices. The algebra of linear transformations. The rank-nullity theorem. Change of basis. Dual space, Bidual space and natural isomorphism. Adjoint of linear transformation. Eigen values and

eigenvectors of a linear transformation. Diagonolisation, Annihilators of a subspace. Bilinear, Quadratic and Hermilton forms.

UNIT-V Inner product spaces - Cauchy-Schwarz inequality. Orthogonal vectors. Orthogonal complements. Orthogonal normal sets and basis. Bessel's inequality and for finite dimensional spaces. Gram-Schmidt orthogonalization process.

REFERENCES:

1. I.N.Herstien, Topics in Algebra, Wiley Eastern Ltd. New-Delhi.
2. N. Jacobson, Basic Algebra Vols. I & II ,W.H. Freeman, 1980.
3. Shanti Narayan, A Text book of Modern Abstract Algebra, S. Chand & Company New-Delhi.
4. K.B. Dutta, Matrix and Linear Algebra ,Prentice Hall of India Pvt. Ltd. New-Delhi 2000.
5. P.B.Bhattacharya,S.K.Jain and S.R.Nagpal,Basic Abstract (2nd edition) Cambridge Univercity Press,Indian edition,1997.
6. K.Hoffman and R.Kunze,LinearAlgebra 2nd Edition,Prentice Hall Englewood Cliffs,New Jersey.1997.
7. S.K.Jain,A Gunawardena & P.B.Bhattacharya,Basic Linear Algebra with MATLAB.Key college publishing (Springer Verlag) 2001
8. S. Kumaresan,Linear Algebra,A Geeometric Approach, Prentice-Hall of India,2000.
9. Vivek Sahai and vivkas bist, Algebra Norosa Publishing House, 1997.
10. I.S. Luther and B.S:Passsi, Algebra Vol. 1-Groups,Vol. II-Rings.Norosa Publishing House (Vol.1-1996,Vol.II-1999)
11. D.S. Malik , J.N.Mordeson and M.K.Sen Fundamentals of Abstract Algebra,McGraw Hill International Edition, 1997.

Chairperson / H.O.D - Dr. Padmavati	**Faculty members** -Dr. M.A. Siddiqui
Subject Expert - Dr. Madhu Srivastava	Dr. Rakesh Tiwari
Subject Expert - Dr. Shabnam Khan	Dr. (Smt.) Prachi Singh
Subject Expert - Dr. S. K. Bhatt	Ambalika chauhan -
Representative Members -	Chitra Kumar -
(1) Dr. Anil Kashyap -	Gayatri Yadav -
(2) Shri A. K. Pandey -	Bijma Kumari -
(3) Dr. Mayur Puri Goswami -	

B.Sc. Part – III (MATHEMATICS)
2023-2024
Paper III
Discrete Mathematics

Max.Marks.50

Course Title	B. Sc. Part – III, Discrete Mathematics
CO No.	**Course Outcomes - This course will enable the student to :**
CO No. – 1	Understand of discrete graphs, connected and strongly connected graphs etc.
CO No. – 2	Analyze various graphs in which Eularian and Hamiltonian graph with special importance.
CO No.- 3	Apply finite state machine and their application, Boolean algebra in switching circuits.
CO No.- 4	Remember discrete numeric function its use in recurrence relation and generaticfuction.

UNIT -I Sets and proposition - cardinality. Mathematical induction. Principle of inclusion and exclusion. Computability and formal languages - Ordered sets. Languages, Phrase structure grammars. Types of grammars and languages. Permutations, Combinations and Discrete probability.

UNIT -II Relations and Functions - Binary relations, Equivalence relations and partitions. Partial order relation and lattices. Chains and anti chains. Pigeon hole principle. Graphs and planar graphs - Basic terminology, Multi graphs, Weighed graphs, Paths and circuits, Shortest paths, Eularian paths and circuits. Travelling salesman problem, Planar graphs. Trees.

UNIT –III Finite state machines - Equivalent machines. Finite state machines as language recognizers. Analysis of algorithms - Time complexity. Complexity of problems. Discrete numeric functions and Generating functions.

UNIT – IV Recurrence relations and Recursive algorithms – Linear recurrence relations with constant coefficients. Homogeneous solutions. Particular solution. Total solution. Solution by the method of generating functions. Brief review of Groups and Rings.

UNIT- V Boolean algebras - Lattice and Algebraic structures. Duality. Distributive and Complemented Lattices. Boolean lattices and Boolean algebras. Boolean functions and Expressions. Propositional calculus. Design and implementation of Digital Networks. Switching circuits

REFERENCES:

(1) C.L.Liu, Elements of Discrete Mathematics. [Second Edition], McGraw Hill, International edition, Computer Science series,1986.

Chairperson / H.O.D - Dr. Padmavati Subject Expert - Dr. Madhu Srivastava Subject Expert - Dr. Shabnam Khan Subject Expert - Dr. S. K. Bhatt **Representative Members** - (1) Dr. Anil Kashyap - (2) Shri A. K. Pandey - (3) Dr. Mayur Puri Goswami -	**Faculty members** - Dr. M.A. Siddiqui Dr. Rakesh Tiwari Dr. (Smt.) Prachi Singh Ambalika chauhan - Chitra Kumar - Gayatri Yadav - Bijma Kumari -

B.Sc. Part – III (MATHEMATICS)

2023-2024

Paper III (Optional)

Application of Mathematics in Finance and Insurance

Max.Marks.50

Application of Mathematics in Finance :

UNIT- I **Financial Management** – An Overview- Nature and Scope of Financial Management, Goals of Financial Management and main decisions of Financial Management, Difference between risk, speculation and gambling. Time value of Money-Interest rate and discount rate, Present value and future value discrete case as well as continuous compounding case, Annuities and its kinds.

UNIT- II Meaning of return, Return as Internal Rate of Return(IRR), Numerical Methods like Newton-Raphson Method to calculate IRR, Measurement of returns under uncertainty situations, Meaning of risk, Difference between risk and uncertainty, Types of risks, Measurement of risk, Calculation of security and Portfolio Risk and Return-Markowitz Model, Sharpe's Single Index Model Systematic Risk and Unsystematic Risk.

UNIT–III Taylor Series and Bond Valuation, Calculation of Duration and Convexity of bonds, Financial Derivatives – Futures. Forward, Swaps and Options, Call and Put Option, Call and Put Parity Theorem, Pricing of contingent claims through Arbitrage and Arbitrage Theorem.

Application of Mathematics in Insurance :

UNIT –IV Insurance Fundamentals –Insurance defined, Meaning of loss. Chances of loss, peril, hazard, and proximate cause in Insurance, Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance, Insurable loss exposures feature of a loss that is ideal for insurance, Life Insurance Mathematics – Construction of Mortality Tables, Computation of Premium of Life Insurance for a fixed duration and for the whole life.

UNIT- V Determination of clains for General Insurance–Using Poisson Distribution and Negative Binomial Distribution-the Polya Case Determination of the amount of claims in General Insurance-Compound Aggregate claim Model and its properties, and claims of reinsurance, Calculation of a compound claim density function, F-recursive and approximate formulae for F.

REFERENCES:

1. Aswath Damodaran, Corporate Finance – Theory and Practice, John Wiley & Son's Inc.
2. John C. Hull, Options, Futures and Other Derivatives, Prentice Hall of Indian Private Ltd.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.
4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.
5. C.D.Daykin, T. Pentikainen and M. Pesonen, Practical Risk Theory for Actuaries, Chapman & Hall.

Chairperson / H.O.D - Dr. Padmavati	**Faculty members** -
Subject Expert - Dr. Madhu Srivastava	Dr. M.A. Siddiqui
Subject Expert - Dr. Shabnam Khan	Dr. Rakesh Tiwari
Subject Expert - Dr. S. K. Bhatt	Dr. (Smt.) Prachi Singh
Representative Members -	Ambalika chauhan -
(1) Dr. Anil Kashyap -	Chitra Kumar -
(2) Shri A. K. Pandey -	Gayatri Yadav
(3) Dr. Mayur Puri Goswami -	Bijma Kumari -

B.Sc. Part III (MATHEMATICS)

2023-2024

Paper III (Optional)

MATHEMATICAL MODELLING

Max.Marks.50

UNIT-I The process of applied mathematics. Setting up first order differential equations–Qualitative solution sketching, Difference and differential equation growth models.

UNIT-II Single-species Population Models, Population growth-An age structure model, The spread of Technological Innovation.

UNIT-III Higher order Linear Models- A model for the detection of Diabetes, Combat modes, Traffic Models –Car-following models, Equilibrium speed distributions.

UNIT-IV Nonlinear Population growth models, Prey-Predator models, Epidemic growth models, Modelsfrom political science – Proportional representation-cumulative voting, comparison voting.

UNIT-V Applications in Ecological and Environmental subject Areas- Urban waste water management planning

REFERENCES:

1. Differential Equation Models, Eds. Martin Braun, C.S. Coleman, D.A. Drew.
2. Political and Related Models, Steven J. Brams, W.F. Lucas, P.D. Straffin (Eds.)
3. Discrete and System models, W.F. Lucas, F.S. Roberts, R.M. Thrall.
4. Life Science Models, H.M. Roberts & M. Thompson.
5. All volumes published as modules in Applied Mathematics, Springer-Verlag, 1982.
6. Mathematical Modeling, J.N. Kapur, New Age International, New Delhi.

Chairperson / H.O.D - Dr.Padmavati 17/3	**Faculty members** -
Subject Expert - Dr. Madhu Srivastava	Dr. M.A. Siddiqui
Subject Expert - Dr. Shabnam Khan	Dr. Rakesh Tiwari
Subject Expert - Dr. S. K. Bhatt	Dr. (Smt.) Prachi Singh
Representative Members -	Ambalika chauhan -
(1) Dr. Anil Kashyap -	Chitra Kumar -
(2) Shri A. K. Pandey -	Gayatri Yadav -
(3) Dr. Mayur Puri Goswami -	Bijma Kumari -

B.Sc. Part – III (MATHEMATICS)

2023-2024

Paper III (Optional)

Computational Mathematics Laboratory

Max.Marks.50

The student expected to familiarize himself / herself with popular software for numerical computation and optimization. Real life problems requiring knowledge of numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems, Finite difference methods, Interpolation, Differentiation, Integrations, Ordinary differential equations etc. should be attempted. Capabilities to deal with linear, integer and nonlinear optimization problems need to be developed. The objective of such a laboratory is to equip students to model and simulate large-scale systems using optimization modeling languages. (The concerned teacher is expected to provide the necessary theoretical background before the student does the corresponding practical). To this end software like MATLAB, LINDO, MATHEMATICA, MAPLE can be adopted. Following course outline is suggested based on MATLAB and LINDO.

UNIT 1: Plotting of functions, Matrix operations, vector and matrix manipulations, matrix function, Data analysis and curve fitting.

UNIT 2: Use of FFT algorithms, Numerical integrations.

UNIT 3: Nonlinear equations and optimization functions, Differential equations.

UNIT 4: 2-D Graphics and 3-D Graphics – general purpose graphics functions, color maps and color controls, Examples: Number theory, picture of an FFT, Function of a complex variable, chaotic motion in 3-D.

UNIT 5: Sparse matrices – iterative methods for sparse linear equations, Eigen values of sparse matrices, Game of life, Linear programming, integer programming and Quadratic programming – modeling and simulation techniques.

REFERENCES:

1. MATLAB – High performance numeric computation visualization software: Users guide.

2. MATHEMATICA – Stephen Wilfram, Cambridge.
3. Introduction to operations research, F. S. Hiller and G. J. Lieberman.
4. Optimization modeling with LINDO: Linus Schrage.

Chairperson / H.O.D - Dr. Padmavati	**Faculty members** -
Subject Expert - Dr. Madhu Srivastava	Dr. M.A. Siddiqui
Subject Expert - Dr. Shabnam Khan	Dr. Rakesh Tiwari
Subject Expert - Dr. S. K. Bhatt	Dr. (Smt.) Prachi Singh
Representative Members -	Ambalika chauhan -
(1) Dr. Anil Kashyap -	Chitra Kumar -
(2) Shri A. K. Pandey -	Gayatri Yadav -
(3) Dr. Mayur Puri Goswami -	Bijma Kumari -