Parishkar College of Global Excellence (Autonomous), Jaipur

CHOICE BASED CREDIT SYSTEM (CBCS)

B. Sc./B.A. (3 year Program)

MATHEMATICS

<u>**Faculty Members**</u>

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Title of the Program: B. Sc./B.A. with Mathematics

Department Overview:

Welcome to the Department of Mathematics which joins in **Parishkar College of Global Excellence (Autonomous), Jaipur.**

1. **Introduction**

   The current focus in higher education is to shift from teacher-centric approach to learner centric approach. For this as one of the aims, UGC has introduced the learning outcomes based curriculum framework for undergraduate education. The learning outcomes-based curriculum framework for B.Sc./B.A. Mathematics is prepared keeping this in view. The framework is expected to provide a student with knowledge and skills in mathematics along with generic and transferable skills in other areas that help in personal development, employment and higher education in the global world.

2. **Program Outcomes**

   The learning outcomes-based curriculum framework for B.Sc./B.A. Mathematics is based on the expected learning outcomes and graduate attributes that a graduate in mathematics is expectedto attain.

   The curriculum for B.Sc./B.A. Mathematics is prepared keeping in mind the needs and aspirations of students in mathematics as well as the evolving nature of mathematics as a subject. The course learning outcomes and the program learning outcomes specify the knowledge, understanding, skills, attitudes and values that a student completing this degree is expected to know.

3. **Nature and extent of the B.Sc./B.A. Mathematics**

   Mathematics is a powerful tool for global understanding and communication that organizes our lives and prevents chaos. Mathematics helps us understand the world and provides an effective way of building mental discipline. Mathematics encourages logical reasoning, critical thinking, creative thinking, abstract or spatial thinking, problem-solving ability, and even effective communication skills. Mathematics is necessary to understand the other branches of knowledge. All depend on mathematics in one way or another. There is no science, art, or specialty except mathematics was the key to it. The discipline and mastery of any other science or art are very much related to the size of mathematics.

   Mathematics is usually described as the abstract science of number, quantity and space along with their operations. The scope of Mathematics is very broad and it has a wide range of applications in natural sciences, engineering, economics and social sciences. B.Sc./B.A. Mathematics Program aims at developing the ability to think critically, logically and analytically and hence use mathematical reasoning in everyday life. Pursuing a degree in mathematics will introduce the students to a number of interesting and useful ideas in preparations for a number of mathematics careers in education, research, government sector, business sector and industry.

The course lays a structured foundation of **Calculus, Real & Complex analysis, Abstract Algebra, Differential Equations (including Mathematical Modelling), Number Theory, Graph Theory, and C++ Programming** exclusively for Mathematics.

An exceptionally broad range of topics covering **Pure & Applied Mathematics**: **Linear Algebra, metric Space, Optimization theory, Numerical Analysis, Mathematical Finance, Mechanics** cater to varied interests and Department of Mathematics. Also hand on sessions in Computer Lab using various Computer Algebra Systems (CAS) software's such as MATLAB, Maxima, R to have a deep conceptual understanding of the above tools are carried out to widen the horizon of students' self - experience.

4. Objective of Bachelor's degree program in Mathematics

The overall objective of B.Sc./B.A. Mathematics Program are to inculcate strong interest in learning mathematics.

• Evolve broad and balanced knowledge and understanding of definitions, key concepts, principles and theorems in Mathematics

• Enable learners/students to apply the knowledge and skills acquired by them during the program to solve specific theoretical and applied problems in mathematics.

• Develop in students the ability to apply relevant tools developed in mathematical theory to handle issues and problems in social and natural sciences.

• Provide students with sufficient knowledge and skills that enable them to undertake further studies in mathematics and related disciplines.

5. Graduate Attributes in Mathematics

Some of the graduate attributes in mathematics are listed below**:**

a. Disciplinary knowledge:

Capability of demonstrating comprehensive knowledge of basic concepts and ideas in mathematics and its subfields, and its applications to other disciplines.

b. Communications skills:

Ability to communicate various concepts of mathematics in effective and coherent manner both in writing and orally, ability to present the complex mathematical ideas in clear, precise and confident way, ability to explain the development and importance of mathematics and ability to express thoughts and views in mathematically or logically correct statements.

c. Critical thinking and analytical reasoning:

Ability to apply critical thinking in understanding the concepts in mathematics and allied areas; identify relevant assumptions, hypothesis, implications or conclusions; formulate mathematically correct arguments; ability to analyses and generalize specific arguments or empirical data to get broader concepts.

d. Problem solving:

Capacity to use the gained knowledge to solve different kinds of non-familiar problems and apply the learning to real world situations; Capability to solve problems in computer graphics using concepts of linear algebra; Capability to apply the knowledge gained in differential equations to solve specific problems or models in operations research, physics, chemistry, electronics, medicine, economics, finance etc.

6. Program Learning Outcomes in B.Sc./B.A. Mathematics

The completion of the B.Sc./B.A. Mathematics Program will enable a student to:

- Communicate mathematics effectively by written, computational and graphic means.
- Create mathematical ideas from basic axioms.
- Gauge the hypothesis, theories, techniques and proofs provisionally.
- Utilize mathematics to solve theoretical and applied problems by critical understanding,analysis and synthesis.
- Identify applications of mathematics in other disciplines and in the real-world, leading to enhancement of career prospects in a plethora of fields and research.

PROGRAM HIGHLIGHTS

Salient Features

- Approaching the subject from theoretical and practical points of view.
- Opportunity to attend seminars, workshops etc.
- Extra-curricular activities for peer interaction, growth of organizational skills and personalitydevelopment.
- Well-equipped and spacious laboratories.
- Well qualified and experienced staff.
- Industrial collaboration/training.
- Placement opportunities.
- Good library and internet facilities.
- Industrial /Institutional projects.
- Guest lectures by experts from the field.

Structure of B.Sc./B.A. Mathematics

The B.Sc./B.A. Mathematics program is a three-year (six semesters) course:

Proposed scheme for choice based credit system in B.Sc./B.A. Mathematics

Sem.	Core course (CC) (12)	Ability enhancement compulsory course (AECC)(2)	Additional Core Course (ACC) (4)	Discipline specific elective (DSE)(6)
I	Physics	English/Hindi Communication	**Discrete Mathematics**	
	Calculus			
II	Physics		**Numerical analysis**	
	Differential Equations			
	Chemistry			
III	Physics		**Complex analysis**	
	Real Analysis& metric space			
	Chemistry			
IV	Physics		**Mechanics**	
	Algebra & 3D Geometry			
	Chemistry			
V	Chemistry			DSE-1 A Physics
				DSE-2 A Mathematics
				DSE-3 A Chemistry
VI		EVS		DSE-1 B Physics/ Dissertation
				DSE-2 B Mathematics/ Dissertation
				DSE-3 B Chemistry/ Dissertation

Note: -

- Switch Dissertation with either of the Elective Paper (Only One).
- Freedom of selection of various subjects for industrial exposure.

Credits Scheme

S.No.	Course	Credits		Total Credits	
		Theory	Practical/ Tutorial		
1.	Core Paper-12	4	2	12×6	72
2.	Ability Enhancement-2	4		2×4	8
3.	Additional Core Course-4	4		4×4	16
4.	Elective Course-6	4	2	6×6	36
Total					132

B.Sc./B.A. with Mathematics:

Theory Papers:

Core papers Mathematics (Credit: 04 each) (CP 1-4):

S.No.	Paper Code	Core Papers (CP) Name
1.	CP/MAT-101	**Calculus**
2.	CP/MAT-201	**Differential Equations**
3.	CP/MAT-301	**Real Analysis& metric space**
4.	CP/MAT-401	**Algebra & 3 Dimensional Geometry**

Additional Core papers Mathematics (Credit: 04 each) (ACP 1-4):

S.No.	Paper Code	Core Papers (CP) Name
1.	ACP/MAT-102	**Discrete Mathematics**
2.	ACP/MAT-202	**Numerical Analysis**
3.	ACP/MAT-302	**Complex analysis**
4.	ACP/MAT-402	**Mechanics**

Discipline Specific Elective papers (Credit: 04 each): Choose 1 from each

DSE 2A

S.No.	Paper Code	Discipline Specific Elective (DSE) Papers Name
1.	DSE2A/MAT-1001	**Multivariate Calculus and vector calculus**
2.	DSE2A/MAT-1002	**Mathematical modeling**

DSE 2B

S.No.	Paper Code	Discipline Specific Elective (DSE) Papers Name
1.	DSE2B/MAT-2001	**Optimization Theory**
2.	DSE2B/MAT-2002	**Linear Algebra**

Practical Papers (Credit: 02 each) :

Sem.	Paper Code	Course Name (Computer Software)
I	**CP/MAT-102**	**SCILAB-I**
II	**CP/MAT-202**	**SCILAB-II**
III	**CP/MAT-302**	**C Programming**
IV	**CP/MAT-402**	**C ++ Programming**
V	**DSE2A/MAT-1006**	**Wolfram Mathematica**
VI	**DSE2B/MAT-2006**	**Power BI**

Assessment Pattern

Evaluation will be done on the basis of

1. Continuous internal assessment (CIA)
    - Group discussion
    - Assignments
    - Seminar
    - Presentation
    - Practical
    - Open Book Test
    - Quiz
    - Class Test
2. Mid Semester Examination (MSE)
3. Attendance
4. End Semester Examination (ESE)

Activities:

Evaluation:

Theory Exam- Mid Term, Semester

Practical Exam- Practical work, record, viva,

SYLLABUS

SEMESTER-I

Course Name: B.Sc./B.A. (Mathematics)

Core Paper - Calculus

Paper Code: CP/MAT-101 **Credits: 04**

Total Teaching Hours: 60

Course Objectives:-

- Explore the solution of problems from a mathematical perspective and help to prepare studentto succeed in upper level math, science, engineering and other courses that require calculus.
- Determine if an infinite series is convergent or divergent.
- Acquaint the students with fundamental concepts of single variable calculus.

Learning Outcomes:-

- Apply the concept and principles of differential and Integral calculus to solve geometric and physical problems.
- Evaluate various limit problems both algebraically and applicable in real life situation.
- Interpret the geometric meaning of differential and Integral calculus.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students:-

Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester

Syllabus Content:

UNIT-I

Basic: Limits, Functions, Derivatives, Roll theorem, Langrage's mean valuetheorem, Cauchy's mean value theorem**,** Generalized mean value theorem, Taylor and Maclaurin's theorem with different reminder**,** expansion of sin(x), cos(x) , **Log (1+x), $(1+x)^m$.**

Derivative of an arc, Pedal equation (Cartesian andPolar curves), curvature

UNIT-II

Infinite series, Infinite series of non-negative terms, definition of convergence, test of convergence without proof, comparison test, Cauchy root test, D'Alembert's ratio test, Rabbe test.

D'Morgan test, Cauchy condensation test, Logarithm ratio test, Gauss test, Alternating series-Leibnitz test, Absolute convergence.

UNIT-III

Partial differentiation, total derivative, Euler theorem for Homogeneous function, **Maxima and Minima of Functions of two variables, Envelopes**

Asymptotes (Cartesian and polar curves), Multiple points, Classification of double points, Node, Cusp and point of inflexion, tracing of Simple Cartesian and polar curves.

UNIT-IV

Double Integral in Cartesian and Polar Coordinates, Change of order of Integration, Triple Integrals. Application of Double and Triple Integrals.

Rectification, Areas, Volumes and Surface of Solid of revolution.

Suggested Books:

1. Differential calculus: Shanti Narayan & P.K. Mittal.
2. Differential calculus :Gorakh Prasad.
3. H. Anton, I. Bivens and S. Davis: Calculus.
4. G. Kalambauer: Aspects of calculus.
5. G.B .Thomas, Jr. J. Hass, C. Heil: Thomas's Calculus.
6. Lalji Prasad: Differential Calculus.
7. J.L. Bansal & H.S. Dhami: Differential Calculus.

Additional Core Paper – Discrete Mathematics

Paper Code: ACP/MAT-102 **Credits: 04**

Total Teaching Hours: 60

Course Objectives:-

1 To introduce the concepts of mathematical logic

2 To introduce the concepts of sets, relations, and functions.

3 To perform the operations associated with sets, functions, and relations.

4 To relate practical examples to the appropriate set, function, or relation model, and interpret the associated operations and terminology in context. To use Graph Theory for solving problems

Learning Outcomes:-

1 Understand sets, relations, functions and discrete structures

2 Able to use logical notations to define and reason about fundamental mathematical concepts such as sets relations and functions

3 Able to model and solve real world problems using graphs and trees

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students:-

Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester

Syllabus Content:

UNIT-I

Sets, Cardinality, Principal of inclusion and exclusion, Mathematical Induction.

Relations and Functions, Binary relations, Equivalence relations and partitions, Partial order relations and Lattices, and Anti-chains.

UNIT-II

Boolean Algebra-Lattices and algebraic structure, Duality, Distributive and Complemented Lattices, Boolean Lattices, Boolean functions and Boolean expression.

Fundamental theorem of arithmetic, Divisibility in Z, Congruence's, Chinese reminder theorem.

UNIT-III

Basic concepts of graph theory, Types of graph (Connected Graphs, Regular graphs, Planar graphs).

walk, Paths & Circuits, Shortest path problem. Operations on graphs (union, join, products)

UNIT-IV

Matrix representation of graphs, Adjacency matrices, Incidences matrices.

Tree, Spanning tree, Minimum spanning tree, Distance between vertices, Center of tree, Binary tree, Rooted tree. Hamiltonian and Eulerian graphs

Suggested Books:

1. K.H. Rosen Discrete Mathematics and it's Applications, McGraw Hill, 1999.
2. N.L. Biggs, Discrete Mathematics, Oxford Science Publication, 1985.
3. T. Koshy, Discrete Mathematics with Applications, Academic Press, 2005

Practical

SCILAB-I

Credit- 2 **Hours-30**

Objectives:

This Course will enable be students to:

1. Families with software SCILAB for numerical computations of the fundamental arithmetic operations.
2. Demonstrate plotting of 2D and 3D curves.
3. To study constructions of a vector/ matrix and operations.
4. Compute the Fundamental Concept of single variable and multivariable calculus.
5. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithm and trigonometric functions.
6. Produce and interpret graphs of basic functions of these types.
7. Solve equations and inequalities in both algebraically and graphically.

Learning Outcomes:-

1. Develop programs in SCILAB.
2. Evaluate analyses and plot results.
3. Good understanding of Linear algebra and signal processing concepts.

Learning and Teaching Strategies:-

Interactive lectures, Discussion, PPT presentations, Informative videos.

Assessment:

1. Performance in the Lab.
2. Practical Record
3. Viva

Syllabus content

1. Introduction of SCILAB.
2. Commands for managing a session input and output commands.
3. Some Primary Mathematical functions(Arithmetic functions ,trigonometric, logarithms, exponent function)
4. Commonly used operators and special characters.
5. Vector, Metrix and Array commands.
6. Constructions of a vector with operations on vectors.
7. Metrix representations and some of operations of Metrix.
8. Special Metrix and element operations on Metrix.

Reading Suggestions:

Introduction to SCILAB: JPH Publication.

Open Source of SCILAB: http//:www.scilab.org

Scilab-6.0.2(64 bit)/scilab-6.0.2 (32-bit

SEMESTER-II

Course Name: B.Sc./B.A. (Mathematics)

CORE PAPER: Differential Equations

Paper Code: CP/MAT-201 **Credits: 04**

Total Teaching Hours: 60

Course Objectives:-

- Explore the solution of problems from a mathematical perspective and help to prepare student to succeed in upper level math, science, engineering and other courses that require Differential equations.
- Determine types of differential equations.
- Apply the appropriate analytic techniques for finding the solution of first order and selected higher order ordinary differential equations.
- Evaluate first order differential equation including separable, homogeneous, exact and linear.

Learning Outcomes:-

- Distinguish between linear, nonlinear, partial and ordinary differential equations.
- Learn various techniques of getting exact solution of Cartesian solvable first order differential equations and linear differential equation of second order.
- Solve basic application problems described by second order linear differential equation with constant coefficients.

Learning and Teaching Strategies: - Interactive lectures, Discussion, PPT presentation. Teaching learning methodology

Learning activities for the students:-

Self-learning, peer learning, assignments.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester exams

Syllabus Content:

UNIT-I

Introduction of differential equations, order and degree of differential equations, **Linear equation and equations reducible to linear form, exact differential equation and equations which can be made exact**, first order higher degree differential equation solvable for x, y, p, Claurait form, Lagrange's equations, Charpit's method.

UNIT-II

Linear homogeneous equation with constant coefficients, Linear non-homogeneous equations, linear independence of solutions, **Complementary functions and particular integral homogeneous differential equation**, solution by transformation of the equation by changing the independent and dependent variable, **Factorization of operators, method of variation of parameters.**

UNIT-III

Simultaneous differential equations, Factorization of operators, method of variation of parameters, **exact linear differential equations of n^{th} order**.

UNIT-IV

Order and degree of Partial Differential Equation, Concept of Linear and non - linear partial differential equations, Formation of first order partial differential equations, Linear partial differential equations of first order, Lagrange's method, Charpit's method.

Suggested Books:

1. J.L. Bansal & H.S. Dhami: Differential equation.
2. D.A. Murray: Introductory Course on Differential equation.
3. K.K. Gupta & D.C. Agarwal: Linear Differential equations.
4. Dr. Gokhroo: Differential Equation.
5. M.D. Raisinghania: Differential equation.
6. J.L. Bansal & H.S. Dhami: Partial Differential equation.

Additional Core Paper – Numerical Analysis

Paper Code: ACP/MAT-202 **Credits: 04**

Total Teaching Hours: 60

Course Objectives:-

1. An understanding of numerical methods to obtain approximate solutions to mathematical problems.
2. An introduction to numerical methods to solve interpolation based problems, ordinary differential equations, various numerical root finding problems.

Learning Outcomes:-

1. Apply various interpolation methods and finite difference concepts to solve interpolation problems for equal intervals.
2. Describe the concept of central difference, Numerical differentiation and be able to solve interpolation problems for unequal intervals.
3. Understand the concept of Numerical Integration and able to solve related problems.
4. Apply numerical methods to find our solution of algebraic equations using different methods under different conditions
5. Solve the system of linear equations and ordinary differential equations by numerical methods.
6. Provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems.

Learning and Teaching Strategies:-

Approach in teaching: Interactive lectures, Discussion, PPT presentation.

Learning activities for the students:-

Self-learning, peer learning, assignments, effective questions, presentation.

Assessment Strategies:-

Quiz, Poster presentation, PPT, open book test, End Semester

Syllabus Content:

UNIT-I

Differences, Relation between differences and derivatives, Difference of polynomials, Factorial notation, Newton's forward and backward interpolation formula (with proof).

UNIT-II

Divided differences : Newton's and Lagrange's divided differences formulae. Central differences: Gauss's, Stirling's and Bessel's interpolation formulae, Numerical differentiation. Numerical integration: Newton-Cotes quadrature formula, Trapezoidal formula, Simpson's 1/3rd and 3/8th formulae, Gaussian integration.

UNIT-III

Inverse Interpolation, Numerical solution of algebraic and transcendental equations: Bisection method, Regula-falsi method, Method of iteration and Newton Raphson's Method, Newton's iterative formula for obtaining square and inverse square root.

UNIT-IV

Solution of a system of linear equations: Direct method (Gauss elimination method, LU-decomposition method), Iterative methods (Jacobi and Gauss Seidal method, SOR method), Theorems based on iterative methods, Solutions of first order ordinary differential equations: Picard's method, Euler's method, Runge-Kutta method.

Suggested Books:

1. J.L. Bansal and J.P.N. Ojha, Numerical Analysis, Jaipur publishing house, 2015.
2. M.C. Goyal, D.C. Sharma and Kavita Jain, Numerical Analysis, RBD, 2015.
3. M.K. Jain and Iyengar, Numerical Methods Problems and Solutions, New Age International Ltd., 2007.
4. James B. Scarborough, Numerical Mathematical Analysis, Oxford and IBH publishing 1966.

Practical

SCILAB-II

Credit- 2 **Hours-30**

Course Objectives:

This Course will enable be students to:

1. Families with software SCILAB for numerical computations of the fundamental arithmetic operations.
2. Demonstrate plotting of 2D and 3D curves.
3. To study constructions of a vector/ matrix and operations.
4. Compute the Fundamental Concept of single variable and multivariable calculus.
5. Demonstrate algebraic facility with algebraic topics including linear, quadratic, exponential, logarithm and trigonometric functions.
6. Produce and interpret graphs of basic functions of these types.
7. Solve equations and inequalities in both algebraically and graphically.

Learning Outcomes:-

1. Develop programs in SCILAB.
2. Evaluate analysis and plot results.
3. Good understanding of Linear algebra and signal processing concepts.

Learning and Teaching Strategies:-

Interactive lectures, Discussion, PPT presentations, Informative videos.

Assessment:

1. Performance in the Lab.
2. Practical Record
3. Viva

Syllabus content

1. Eigen values Eigen vectors.
2. Plotting Commands.
3. Create 2D graphs and customized line, plot multiple graphs.
4. Scaling and colouring the line, styles in 2D graphs.
5. Add title axis, labels and legend to graph.
6. 3D graph Plotting, Scaling and colouring and line style in 3D graphs
7. Add title axis labels and legend to graphs.

Reading Suggestions:

Introduction to SCILAB: JPH Publication.

Open Source of SCILAB: http//:www.scilab.org