St Aloysius College (Autonomous)

Mangaluru

Re-accredited by NAAC "A" Grade

Course structure and syllabus of

B.Sc.

MATHEMATICS

CHOICE BASED CREDIT SYSTEM

(2019 – 20 ONWARDS)

ಸಂತ ಅಲೋಶಿಯಸ್ ಕಾಲೇಜು
(ಸ್ವಾಯತ್ತ)
ಮಂಗಳೂರು– 575 003

ST ALOYSIUS COLLEGE
(Autonomous)
P.B.No.720
MANGALURU- 575 003, INDIA
Phone:+91-0824 2449700,2449701
Fax: 0824-2449705
Email: principal_sac@yahoo.com
principal@staloysius.edu.in
Website: www.staloysius.edu.in

Re-accredited by NAAC with 'A' Grade - CGPA 3.62
Recognised by UGC as "College with Potential for Excellence"
College with 'STAR STATUS' conferred by DBT, Government of India
3rd Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

No: SAC 40/Syllabus 2019-20 Date: 18-07-2019

NOTIFICATION

Sub: Syllabus of **B.Sc. Mathematics** under Choice Based Credit System.

Ref: 1. Decision of the Academic Council meeting held on 02-05-2019 vide Agenda No: 21(2019-20)
2. Office Notification dated 18-07-2019

Pursuant to the above, the Syllabus of **B.Sc. Mathematics** under Choice Based Credit System which was approved by the Academic Council at its meeting held on 02-05-2019 is hereby notified for implementation with effect from the academic year **2019-20**.

PRINCIPAL

ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office

ಸಂತಅಲೋಶಿಯಸ್ ಕಾಲೇಜು (ಸ್ವಾಯತ್ತ)
ಮಂಗಳೂರು– 575 003
www.staloysius.edu.in

ST ALOYSIUS COLLEGE(AUTONOMOUS)
MANGALURU – 575 003
Phone: 0824-2449700, 2449701
Fax: 0824-2449705
Email: principal@staloysius.edu.in

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Conferred "College with "STAR STATUS" by DBT, Government of India.
Centre for Research Capacity Building under UGC-STRIDE

3. Library

Date: 12-08-2021

NOTIFICATION

Sub: Syllabus of **B.Sc. Mathematics** under Choice Based Credit System.

Ref: 1. Academic Council meeting held on 19-06-2021 vide Agenda No: 17(2021-22)
2. Office Notification dated 12-08-2021

Pursuant to the above, the changes in CBCS III & IV semester of **B.Sc. Mathematics** under Choice Based Credit System which was approved by the Academic Council at its meeting held on 19-06-2021 is hereby notified for implementation with effect from the academic year **2021-22**.

PRINCIPAL

ST ALOYSIUS COLLEGE MANGALORE 575 003 AUTONOMOUS

REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

B.SC. MATHEMATICS	
PROGRAMME OUTCOMES	
P01.	**Acquisition of Knowledge:** be able to possess basic subject knowledge that is required for higher studies, professional and applied courses.
P02.	**Eligibility:** be eligible for various government exams conducted by UPSC, SSC etc.
P03.	**Application in Computer Sciences:** be able to solve computer oriented numerical problems as it offers computer courses for students
P04.	**Awareness:** be aware of and develop solution oriented approach towards various Social and Environmental issues.
P05.	**Skill development:** develop critical thinking, problem solving skills through practical application along with the domain knowledge in the subjects of science stream
P06.	**Entrepreneurship:** be equipped to start their own business as software developers, programmers, database administrators, and system analysts.
PROGRAMME SPECIFIC OUTCOMES	
PSO1:	Be familiar with suitable tools of mathematical analysis to handle issues and problems in mathematics and related sciences.
PSO2:	Acquire sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas on multiple disciplines concerned with mathematics.
PSO3:	Be well grounded in the basic manipulative skills of algebra and advanced calculus.
PSO4:	Develop a positive attitude towards mathematics as a technical language and valuable subject of study.

SCOPE OF THE SYLLABUS

This syllabus is framed in such a way that the students learn Calculus and Differential Equations and their applications, which help them to learn allied subjects like Physics, Computer Science, in a better way. Also, the students learn Number Theory and Algebra which can motivate the students to go for higher studies in Mathematics. A variety of optional papers are given so that the students can learn the subjects of their interest.

Course Pattern and Scheme of Examinations

Group II: Optional III B.Sc. Mathematics

Semester	**Paper**	**Hours per week**	**Duration of the Exam(hrs)**	**Semester Exams**	**Marks Internal Assessment***	**Total**
I	Paper1	6	3	100	50	150
II	Paper2	6	3	100	50	150
III	Paper3	6	3	100	50	150
IV	Paper4	6	3	100	50	150
V	Paper5(a)	5	3	100	50	150
	Paper5(b) Elective*	5	3	100	50	150
VI	Paper6(a)	5	3	100	50	150
	Paper6(b) Elective*	5	3	100	50	150
					Total	1200

*For each paper Internal Assessment marks shall be awarded based on the marks scored in two tests and projects/assignment/Surprise tests.

*During the V & VI semester, a student can opt for any one of the special papers offered in the syllabus, except that a student studying statistics in B. Sc. cannot opt for the paper ‘distribution theory’.

Semester	Paper	Paper Code	Title of the Paper
I	Paper1	G 503.1	Calculus
		G 503.1E	**Functions and Applications**
II	Paper 2	G 503.2	Calculus, Number Theory And Differential Equations
		G 503.2E	**Vector Calculus**
III	Paper 3	G 503.3	Number Theory, Group Theory & Multivariate Calculus
		G 503.3E	**Introduction to LaTeX**
IV	Paper 4	G 503.4	Functions of A Complex Variable, Number Theory, Group Theory and Real Analysis
		G 503.4E	**Applications of Basic Arithmetic**
V	Paper5(a)	G 503.5(a)	Differential Equations, Laplace transform and Algebra
	Paper5(b) Special Paper	G 503.5(b)i G 503.5(b)ii G 503.5(b)iii G 503.5(b)iv G 503.5(b)v G 503.5(b)vi	5(b)i Discrete Mathematics 5(b)ii Numerical Methods 5(b)iii Graph Theory 5(b)iv Linear programming 5(b)v Mathematical Modeling 5(b)vi Distribution Theory
VI	Paper6(a)	G 503.6(a)	Partial Differential Equations, Fourier Series and linear algebra.
	Paper6(b) Special Paper	G 503.6(b)i G 503.6(b)ii G 503.6(b)iii G 503.6(b)iv G 503.6(b)v G 503.6(b)vi	6(b)i Discrete Mathematics 6(b)ii Numerical Methods 6(b)iii Graph Theory 6(b)iv Linear programming 6(b)v Mathematical Modeling 6(b)vi Distribution Theory

A Student has to opt a special paper in paper 6(b) which is different from what was opted earlier in paper 5(b).

Question Paper Pattern For Open Electives A, B, C , D

External Exam 40 marks + Internal Assessment 10 marks = 50 Total marks

Duration:2hours Max. Marks:40

PART -A	
I. Answer any 5 questions (5 × 2 = 10)	
Question Number	Unit Number
1 to 4	Unit -1
5 to 8	Unit -2
PART -B	
II. Answer any 3 questions (3 × 5 = 15)	
Question Number	Unit Number
1 to 5	Unit -1
III. Answer any 3 questions (3 × 5 = 15)	
6 to 10	Unit -2

QUESTION PAPER PATTERN FOR B.SC. MATHEMATICS

(Credit based Semester Scheme for End Semester Examination)

Each Question Paper shall consist of two parts: PART A and PART B.

The number of Questions in each part is tabulated below for different papers.

Papers	Part A Short Answer Questions No. of Questions	Part B Long Answer Questions No. of full Questions
Paper 1	15	5
Paper 2	15	5
Paper 3	15	5
Paper 4	15	5
Paper 5	15	5
Paper 6	15	5
Paper 7	15	5
Paper 8	15	5

Note 1: Fifteen Questions in part A shall equally cover all the units of the syllabus.
Any ten questions shall be answered. Each question carries two and a half marks
for paper 1 to paper 8.
Note 2: In part B, all papers shall have the five units. Each unit shall be answered, choosing 2(out of 4) or 3 (out of 5) sub-questions.
Each question in part B carries 15 marks for paper 1 to paper 8.

V SEMESTER – PAPER 5(b)

G 503.5(b)i Discrete Mathematics

G 503.5(b)ii Numerical Methods

G 503.5(b)iii Graph Theory

G 503.5(b)iv Linear programming

G 503.5(b)v Mathematical Modeling

G 503.5(b)vi Distribution Theory

SIXTH SEMESTER

G 503.6(A) - PAPER 6(A)

PARTIAL DIFFERENTIAL EQUATIONS, FOURIER SERIES AND LINEAR ALGEBRA

UNIT I

Total Differential equations : Conditions for integrebility of Pdx + Qdy + Rdz =0, methods of solving Pdx + Qdy + Rdz=0 by (1) inspection method , (2) One variable regarded as constant , (3) Method of Auxiliary Equations , (4) Homogeneous Equations, Solutions of Simultaneous total Differential equations.

UNIT II

Fourier Series:

Introduction, Periodic functions, Euler's Formulae, Definite integrals.

Dirichlet's conditions for a Fourier Series expansion, Even and Odd functions, Half Range Series Complex Fourier Coefficients, Finite Fourier Transforms.

Unit III

Linear Algebra:-

Vector Spaces , properties , Subspaces intersection of subspaces, (L(S)- subspace generated by a subset, nature of elements of L(S) , Sum of subspaces, Direct sum of two subspaces , Characterization of direct sum , direct sum of n subspaces.

Linear Dependence, Independence and Bases **:** basis, generating set , linear independence, minimal generating set , dimension , dimensions of subspaces, dimension of a sum of subspaces .

Inner Product Spaces **:** Inner product, norm, Schwarz inequality , orthogonal vectors, normal vectors , orthonormal basis and set independence of orthonormal sets , existence of orthonormal basis in an inner product space, (Orthogonal complements .

Unit IV

Linear Transformations: -

Linear transformation , kernel , isomorphism , isomorphism of $f^{(n)}$ with any n-dimensional space, quotient space , first Isomorphism Theorem , dimension of a quotient space , non singular transformation , (L(V, V')), dimension of L(V,V') .

Matrices: identity, idempotent, nilpotent, non singular, diagonal, triangular and block matrices .

Matrices and Linear transformations:

matrix associated with a linear transformation ,isomorphism of l(V,V') with $M_{mn}(F)$) , matrix of a product of linear transformations , Relation between matrices of a L.T. with respect to different bases , similar matrices .

Rank : row rank, column rank, rank, rank of a linear transformation , rank of a composition of linear transformations , rank of a product of matrices,.

Unit V

Elementary Row Operations : Elementary matrices, non singularity of elementary matrices , inverse of an elementary matrix, inverse of a matrix as a product of elementary matrices , equivalent matrices .

Linear Equations**:** Homogeneous linear Equations, condition for existence of non trivial solutions, Non Homogeneous Equations, condition for existence of solutions) and 5 condition for existence of unique solution.

Minimal polynomial: existence, minimal polynomial, Uniqueness, (Min. poly. of non singular matrices, min. poly. of similar matrices, Min. poly. of a transformation.

Characteristic roots**:** Ch. roots of f(A) for a polynomial f and matrix A , number of distinct Characteristic Roots, Characteristic polynomial of a matrix, Characteristic polynomial of similar matrices , Characteristic polynomial of a linear transformation , Cayley Hamilton theorem, Characteristic polynomial of the transpose.

Text books:

1) University Algebra by Gopalakrisnan – 2nd revised edition
2) A Text book of B.Sc. Mathematics Vol 2by G K Ranganath, S Chand and Company Ltd.

Reference:

1. Advanced Engineering Mathematics (8th Edition) – E.Kreyszig, John Wiley and Sons.
2. Algebra T.K.M. Pilay & Natarajan, publishers S.Kumerasan.
3. Topics in algebra by – I. N. Herstein Wiley student Edition – 2nd edition.
4. A brief survey of modern algebra – Birkoff and MacLane, Macmilan - 1965

VI SEMESTER – PAPER 6(b)

G 503.6(b)i Discrete Mathematics

G 503.6(b)ii Numerical Methods

G 503.6(b)iii Graph Theory

G 503.6(b)iv Linear programming

G 503.6(b)v Mathematical Modeling

G 503.6(b)vi Distribution Theory

DISCRETE MATHEMATICS

60 hours; 5hrs/week; 150marks

UNIT 1: (12 hours)

Introduction: Sets Countability, Mathematical induction, Principles of inclusion and exclusion, propositions, computability and formal languages: Russel's phrase structures, grammars and Languages. Permutations, combinations and discrete probability, conditional probability.

Relations and functions : Introduction, a relational model for data bases, properties of binary relations, equivalence relations and partitions, partial orderings relations and lattices, chains and anti – chains. A job scheduling problem, functions and Pigeon – hole principle.

UNIT 2 :(12 hours)

Graphs and planar graphs: introduction, basic terminology, multigraphs and weighted graphs, paths and circuits, shortest paths in weighted graphs.

Eulerian paths and circuits, Hamiltonian paths and circuits, factors of a graph, planar graphs.

UNIT 3: (12 hours)

Trees, paths, length in rooted trees. Prefix codes, Binary search trees, spanning trees and cutsets, minimum spanning trees, Transport Networks.

UNIT 4 (12hours)

Finite state Machines: Introduction, Finite State Machines, Finite State Machines as models of physical systems. Equivalent machines.

Finite State Machines language recognisers. Analysis algorithms; Introduction, time complexity of algorithms a shortest path algorithm, Complexity of problems, Tractable and intractable problems.

UNIT 5: (12hours)

Discrete numeric functions and generating functions: Introduction numeric functions, Asymptotic behavior of Numeric functions.

Generating functions. Combinatorial problems. Revenue relations and recursive algorithms: recurrence relations, linear recurrence relations with constant coefficients.

Text Book: Elements of Discrete Mathematics (second edition), C.L.Liu, Mcgraw-Hill 1985, ch.1 to 10 – Relavant Sections.

Reference Books:

1. Discrete Mathematical structures with applications to computer science by J.P.Tremblay R.Manohar.
2. Discrete Mathematics structures by Besnard Kolman, Robert C. Bushy, Sharan Ross (third edition).

NUMERICAL METHODS

60 hours; 5hrs/week; 150marks

UNIT 1 (12 hours)

Errors in numerical calculations, absolute, relative and percentage errors, a general error formula, errors in series approximation.

Solution of Algebraic and transcendental equations : Bisection method, iteration method, acceleration of convergence : Aitken's process, the method of false position, Newton Raphson method, Generalized Newton's method, solution of system of nonlinear equations, the method of iteration and Newton Raphson method.

UNIT 2: (12 hours)

Interpolation: Errors in polynomial interpolation, finite differences: forward differences, backward differences, symbolic relations, detection of errors by use of difference tables, differences of a polynomial, Newton's formulae for interpolation, interpolation with unevenly spaced points: Lagrange's interpolating formula.

UNIT 3: (12hours)

Divided difference and their properties, Newton's general interpolation formula, Interpolation by iteration, inverse interpolation, Numerical differentiation, Max. and min. values of a tabulated function.

Numerical integration; Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

UNIT 4 :(12hours)

Matrices and linear system of equations: Basic definitions: Matrix operations, transposes, inverse, rank of a matrix, consistency of a linear system of equations, vector and matrix norms.

Direct methods of solving linear systems: matrix inversion method, Gauss elimination method, modification Gauss elimination method to compute the inverse.

Iterative methods of solving Linear systems: Jacobi's method, Gauss – Seidal method.

UNIT 5 :(12 hours)

Numerical solution of ordinary differential equations: Solution by Taylor series, Picards method of successive approximation.
Euler's method, Runge Kutta Method, Predictor corrector methods, Adams- Bashforth method, Adams Moulton method.

Text Book: Introductory methods of Numerical Analysis by S.S.Sastry. Third Edition. Prentice Hall of India.
Relevant sections from the Text Book

Reference Book: Numerical Methods for scientists and Engineers, M.K.Jain, S.B.W.Publishers, Delhi 1971.

GRAPH THEORY

60 hours; 5hrs/week; 150marks

UNIT 1: (12hours)

Definition of a graph, Konigsberg bridge problem. Finite and infinite graphs, incidence and degree, isolated vertex, pendent vertex and null graph, isomorphism, sub graphs, walks, paths, circuits, connected graphs, components. Euler graphs, operation on graphs. Hamiltonian paths and circuits. Trees: properties, pendent vertices, Distance and center, rooted and binary tree. Spanning trees, Fundamental circuits.

UNIT 2: (12hours)

Cut sets, properties, cutsets in a graph. Fundamental cut sets and circuits. Connectivity and seperability.

Kuratowski's two graphs, Different representation of planar graphs, Detection of planarity, Geometrical dual.

UNIT 3: (12hours)

Incidence matrix, submatrices of A(G), Circuit matrix. Fundamental circuit matrix and rank. Cutest matrix. Pathmatrix, Adjacency matrix. Chromatic number, Chromatic partitioning, Chromatic polynomial coverings.

UNIT 4: (12hours) Directed graphs, Definition, types of digraph, binary relations and Directed paths and connectedness. Euler digraphs, trees and digraphs. Fundamental circuits in digraphs, matrices A, B, C of digraphs, adjacency matrix of a graph

UNIT 5: (12hours)

Enumeration of Graphs, labeled graphs, Counting labeled graphs, Rooted Labeled graphs, Counting unlabeled graphs, Rooted unlabeled Trees, Counting Series for U_n. Free Unlabeled trees. Polya's counting theorem.

.**Text Book:** Graph Theory with application to Engineering and Computer science –Narsingh Deo, Prenticehall India.

Chap 1 to 9-Relevant Sections

LINEAR PROGRAMMING

60 hours; 5hrs/week; 150marks

UNIT 1: (12hours)

Geometric linear programming: Polyhedral convex sets, Geometric method – Simplex Algorithms: Canonical slack forms for linear programming problems – Tucker Tableaus, The Pivot transformation, The simplex algorithm for maximum basic feasible tableaus, Simplex algorithm for maximum tableaus.

UNIT 2: (12hours)

Negative Transposition: The Simplex Algorithm for minimum Tableaus, Cycling, Noncanonical Linear Programming problems: Introduction, Unconstrained variables, Equations of constraint. Duality theory: Introduction, Duality in Canonical Tableaus, The Dual Simplex Algorithm, matrix Formulation of canonical Tableaus, The Duality Equation.

UNIT 3: (12hours)

The Duality Theorem, Duality in Noncanonical Tableaus.

Matrix Games: Introduction, An Example: Two Person Zero – Sum Matrix Games, Linear Programming Formulation of Matrix Games, The Von Neumann Minimax Theorem, concluding remarks.

UNIT 4: (12hours)

Transportation and Assignment problems: Introduction. The Balanced Transportation problem, The Vogel Advanced Start method (VAM). The transportation algorithm, Unbalanced transportation problems, the assignment problems.

UNIT 5: (12hours)

Network – Flow problems: Introduction, Graph Theoretic preliminaries, The Maximal flow network problem. The Max – flow Min- cut theorem: The maximal – flow Algorithm, The shortest path network problem. Dijkstra's Algorithm Only.

Text Book: Linear Programming and its Applications – James K.Strayer, Narosa publishing House – Relevant Sections.

MATHEMATICAL MODELING

60 hours, 5hrs/week; 150marks

UNIT 1: (12hours)

Scope of Mathematical Modeling;

Models, mathematical and otherwise, steps in building a mathematical model, Approximate and limited models – Gravity, Rockets and raindrops, Macro and Micro population models I – exponential growth.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 1: Sections 1,2,3,4.

UNIT 2: (12 hours)

Macro and Micro population models II - The Leslie Matrix;

Macro and Micro population models I - Family planning models;

Descriptive and prescriptive models - Inventory policy;

The relation of models to data: Sources of error – Underground exploration of the Earth;

Adjusting data I (the easy way) – The mean the maximum likelihood.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 1: Section 5, 6, 7.

Chapter 2: Section 1, 2.

UNIT 3: (12 hours)

Adjusting data II (The hard way) – miscellaneous methods and examples. Evaluation of Mathematical models: A birds eye view of evaluation – college enrollment; Descriptive realism – Simple linear regression; Descriptive realism – correlation is not causation; Accuracy – Multiple linear regression ;

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 2: Section 3

Chapter 3: Section 1,2,3,4.

UNIT 4: (12hours)

Precession – Maltus and the Dismal theorem;

Robustness – The ups and downs of ancient astronomy.

Optimization – Classical optimization; Linear programming. Formulation and graphical solution; An outline of the simplex method.

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 3: Section 5, 7.

Chapter 4: Section 1, 2, 3.

UNIT 5: (12hours)

Inter Programming – The Knapsack and Traveling salesman problem;

The Transportation problem; Combinatorial Optimization. The Chinese Postman Problem. Discrete verses continuous models; and introduction to difference equations. Exponential population growth difference and differential equation;

Text Book: "Concepts of Mathematical Modeling – Walter J.Mayer".

Chapter 4: Section 4, 5, 6;

Chapter 4: Section 2, 2A, 2B.

Reference Book: Mathematical Modeling by J.N.Kapur.

Distribution Theory

60 hours, 5hrs/week; 150marks

Unit I: Definition of discrete and continuous random variables, cumulative distribution function (c.d.f.) and its properties (with proof), probability mass function (p.m.f) and probability density function (p.d.f.), Expectation, correlation, Properties of expectation, Theorems on sum and product of expectations of random variables.

12 hours

Unit II: Univariate Discrete distributions: uniform, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric distributions, properties, mean, variance, MGF and mode of Binomial and Poisson distribution (with proof). Genesis and Applications.

12 hours

Unit III: Univariate Continuous Distributions: Rectangular distribution: Mean, variance and moments, Median, Normal distribution: Normal approximation to Binomial and Poisson distribution, Median, Mode, moments and additive property of Normal distribution, Exponential, Gamma, Beta distribution of first and second kind, Distribution function, Mean and variance. Genesis and Applications.

12 hours

Unit IV: Bivariate Normal distribution and its properties, marginal and conditional distribution.

12 hours

Unit V: Markov's inequality (statement only), Central Limit Theorem, Sequence of random variables, Convergence in probability, Basic results (without proof), WLLN for i.i.d. random variables and applications, Convergence in distribution.

12 hours

Reference books

1. S.C. Gupta and V.K. Kapoor (2011): Fundamentals of Mathematical Statistics, Sultan Chand and sons.
2. Goon A.M. Gupta and Das Gupta (2008): Fundamentals of Statistics, vol. II World Press, Kolkata.
3. Parimal Mukhopadhyay (2011): Mathematical Statistics, Books and Allied (p) Ltd. Kolkata.
4. R.V. Hogy and E.A. Tansis (2001): Probability and Statistics, Pearson Education Asia.

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