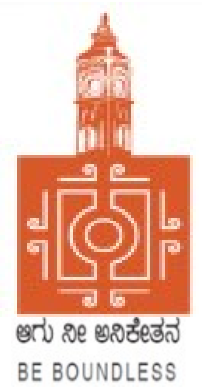

BENGALURU CITY UNIVERSITY

CHOICE BASED CREDIT SYSTEM
(As per SEP)

Syllabus for Mathematics

2025-26

PROCEEDINGS OF THE BOS MEETING IN MATHEMATICS FOR UG CONDUCTED ON 05 MARCH 2025 IN THE DEPARTMENT OF MATHEMATICS, BENGALURU CITY UNIVERSITY, CENTRAL COLLEGE CAMPUS, BENGALURU

The following members attended the BOS meeting to finalize the syllabi of Mathematics papers of BSc Third and Fourth semesters under SEP 2024 for BSc Mathematics 2025-26

1.	Medha Itagi Huilgol	Chairperson
2.	Latha P	Member
3.	Chandrashekharappa A S	Member
4.	Dr. Sushma V Jakati	Member
5.	Shobha T	Member
6.	Pushpalatha A	Member
7.	Dr. Anuradha S	Member
8.	Dr. Sumithra R	Member

The esteemed members discussed in depth the contents of the syllabi of Mathematics and finalized syllabi of both semesters third and fourth for UG for the academic year 2025-2026 onwards.

The Chairperson thanked all the members for their cooperation.

Medha Itagi Huilgol

Chairperson, BOS (UG)

Professor & Chairperson
Department of Mathematics
Bengaluru City University
Jnanajyoti Central College Campus
Bengaluru - 560 001.

Name of the Degree Program : Bachelor of Science- BSc

Discipline Course : Mathematics

Starting Year of Implementation :2025-26 (III & IV Semesters)

Programme Outcomes (PO): By the end of the program the students will be able to achieve:

PO 1	**Disciplinary Knowledge:** Bachelor degree with Mathematics as one of subjects in chosen combination is the culmination of in-depth knowledge of Algebra, Calculus, Geometry, differential equations and several other branches of pure and applied mathematics. This also leads to study the related areas such as computer science and other allied subjects.
PO 2	**Communication Skills**: Ability to communicate various mathematical concepts effectively using examples and their geometrical visualization. The skills and knowledge gained in this program will lead to the proficiency in analytical reasoning which can be used for modeling and solving of real life problems.
PO 3	**Critical thinking and analytical reasoning:** The students undergoing this programme acquire ability of critical thinking and logical reasoning and capability of recognizing and distinguishing the various aspects of real life problems.
PO 4	**Problem Solving**: The Mathematical knowledge gained by the students through this programme develop an ability to analyze the problems, identify and define appropriate computing requirements for its solutions. This programme enhances students overall development and also equip them with mathematical modeling ability, problem solving skills.
PO 5	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Mathematics.
PO 6	**Information/digital Literacy**: The completion of this programme will enable the learner to use appropriate software's to solve system of algebraic equation and differential equations.
PO 7	**Self – directed learning**: The student completing this program will develop ability of working independently and to make an in-depth study of various notions of Mathematics.
PO 8	**Moral and ethical awareness/reasoning:** : The student completing this program will develop an ability to identify unethical behavior such as fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and Mathematical studies in particular.

PO 9	**Lifelong learning**: This programme provides self-directed learning and lifelong learning skills. This programme helps the learner to think independently and develop algorithms and computational skills for solving real word problems.
PO 10	Ability to peruse advanced studies and research in pure and applied Mathematical sciences.
PO 11	Students will be able to formulate LPP and solve.problem. Students will be able to build and solve transportation and assignment models.
PO 12	Enable students to understand and apply foundational concepts,construct valid arguments and potentially pursue advanced studies or research in related fields. Understanding of axioms and their role in mathematical reasoning. Students should be familiar with Boolean algebra, propositional calculus and their application in digital circuitsdesign and other fields

ASSESSMENT

Weightage for the Assessments (in percentage)

Type of Course	Formative Assessment/ I.A.	Summative Assessment (S.A.)
Theory	20%	80 %
Practical	20%	80 %

Syllabus for B.Sc. with Mathematics as one of the Major Subjects

SEMESTER – III

Theory	Algebra-III , Real Analysis-I & Differential Equations-I
Teaching Hours : 04 Hours/Week	Credits: 03
Duration of Exam: 03 Hours	Maximum Marks:100 (Exam 80 + IA 20)

Course Learning Outcomes:

The overall expectation from this course is that the student builds a basic understanding on Algebra, Analysis and Differential Equations . The broader course outcomes are listed as follows. At the end of this course, the student will be able to achieve:

- Link the fundamental concepts of groups and symmetries of geometrical objects.
- Explain the significance of the notions of cosets
- Understand the fundamental properties of the real numbers that lead to define sequence and series, the formal development of real analysis.
- Learn the concept of Convergence and Divergence of a sequence.
- OIbtain the skills of analyzing the concepts and applying appropriate methods for testing convergence of a sequence/ series
- Apply the ratio, root, alternating series, and limit comparison tests for convergence and absolute convergence of an infinite series
- Solve first-order non-linear differential equations and linear differential equations.
- To model problems in nature using Ordinary Differential Equations.
- Formulate differential equations for various mathematical models

ALGEBRA - III

Unit I : Groups - I

Order of an element of a group – properties and theorems, subgroup generated by an element of a group – coset decomposition of a group, Cyclic groups, properties- modulo relation- index of a group –Lagrange's theorem- consequences, Fermat's theorem and Euler's ϕ function.

(14 lecture hours)

REAL ANALYSIS – I

Unit II : Sequences

Sequences of real numbers, Bounded sequences– properties and theorems, Limit of a sequence, Convergent, divergent and oscillatory sequences– properties and theorems, Algebra of the limits of the sequences, Monotonic sequences– problems and theorems, Behaviour of standard sequences- $\{x^{1/n}\}$, $\{n^{1/n}\}$,$\{(1+\frac{1}{n})^n\}$,$\{x^n\}$, Cauchy's general principle for convergence of a sequence.

(14 lecture hours)

Unit III : Infinite Series

Definition of convergent, divergent and oscillatory series. Series of nonnegative terms, Geometric series, p-series (Harmonic series). Comparison tests for positive term series: D'Alembert's ratio test, Raabe's test, Cauchy's Root test. Alternating series: Leibnitz's test. Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic.

(14 lecture hours)

DIFFERENTIAL EQUATIONS - I:

Unit IV : Ordinary Differential Equations

Recapitulation of differential equations of first order and first degree, Exact Differential equations. Solutions of Differential equations of first order and higher degree: Equations solvable for p, x, y. Clairaut's equation. Orthogonal trajectories of Cartesian and polar curves.

(14 lecture hours)

Reference Books:

1. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi.
2. J. Sinha Roy and S Padhy: A course of Ordinary and Partial Differential Equation, Kalyani Publishers, New Delhi.
3. D. Murray, Introductory Course in Differential Equations, Orient Longman (India)
4. 4. W. T. Reid, Ordinary Differential Equations, John Wiley, New Delhi.
5. M. L. Khanna, Differential Equations, Jai Prakash Nath & Co. Meerut.
6. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
7. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2015.
8. Gerald G. Bilodeau, Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
9. S. K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
10. T. Apostol, Mathematical Analysis, Narosa Publishing House
11. M.L Khanna and L.S. Varhiney, Real Analysis by, Jai Prakash Nath & Co. Meerut.
12. Kreyzig, Advanced Engineering Mathematics, John Wiley, New Delhi.
13. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri,Vikas Publications.

Web links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. www.python.org
6. www.rosettacode.org
7. http://www.univie.ac.at/future.media/moe/galeri.html
8. http://tutorial.math.lamar.edu/classes/de/de.aspx
9. http://www.sosmath.com/diffeq/diffeq.html

Practical	Algebra-III , Real Analysis-I & Differential Equations-I
Teaching Hours : 03Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Maximum Marks: 50 (Exam 40 + IA 10)**

Course Learning Outcomes: This course will enable the students to gain hands-on experience of

- Free and Open Source software (FOSS) tools or computer programming.
- Finding complementary function and particular integral of linear and homogeneous differential equations.
- Acquire knowledge of applications of real analysis and differential equations.
- Verification of convergence/divergence of different types of series

Practicals list

1. Program to find all possible cosets of the given finite group.
2. Program to find generators and corresponding possible subgroups of a cyclic group.
3. Program to verify Lagrange's theorem with suitable examples.
4. Program to verify Euler's φ Function for a given finite group.
5. Convergence of sequences.
6. Convergence of geometric series.
7. Convergence of p-series and D'Alembert's Test.
8. Examples on alternating series using Leibnitz's theorem.
9. Summation of exponential and logarithmic series.
10. Summation of binomial series.
11. Verification of exactness of a differential equation.
12. Solutions of differential equations that are solvable for p.
13. Solutions of differential equations that are solvable for x, y.
14. To find the singular solution by using Clairaut's form.

SEMESTER – III

Theory	Elective – I Linear programming
Teaching Hours : 02 Hours/Week	**Credits: 02**
Duration of Exam: 90 minutes	**Maximum Marks:50 (Exam 40 + IA10)**

Course Learning Outcomes:

1.Apply mathematical and statistical methods to solve real world problems.
2.Develop and implement optimization models.
3. Communicate complex technical information effectively.

Unit-1

Linear Programming Problems
Introduction to LPP-Graphs of linear inequalities, classification of solutions, Formulation of LPP in standard form, solution by Graphical Method, Simplex Method (Maximization with two and three variables, minimization with two variables) (14 lecture hours)

Unit-2

Transportation problems
Mathematical formulation of the Transportation problem(TP), finding initial basic feasible solution of TP using the North-West Corner Rule, Least Cost method, Matrix minima method, Vogel's Approximation Method for finding the optimal solution for TP, and formulation and solutions of the Assignment problem by using the Hungarian method.

(14 lecture hours)

References /Suggested Readings:

1. G. Hadley: Linear Programming. Narosa, Reprint, 2002.
2. G. Hadley: Linear Algebra, Narosa, Reprint, 2002.
3. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition, 2010.
4. A. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.
5. F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.

SEMESTER – IV

Theory	Algebra-IV,Integral Transforms & Differential Equations- II
Teaching Hours : 04 Hours/Week	**Credits: 03**
Duration of Exam: 03 Hours	**Maximum Marks:100 (Exam 80 + IA20)**

Course Learning Outcomes: This course will enable the students to:

- Explain the significance of, normal subgroups and factor groups.
- Learn the quotient groups, concepts of homomorphism, isomorphism and properties
- Solve the ordinary differential equations of the first order and second order
- Solve linear and non-linear differential equations using various methods; and apply these methods to solving some physical problems.Evaluate Laplace transforms of certain functions, find Laplace transforms of derivatives and of integrals.
- Understand properties of inverse Laplace transforms, find inverse Laplace transforms of derivatives and of integrals.
- Solve ordinary differential equations with constant/ variable coefficients by using Laplace transform method.
- Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms.

ALGEBRA - IV

Unit I : Groups - II

Normal Subgroups, Quotient groups, Homomorphism and Isomorphism of groups, kernel and image of a homomorphism, Normality of the kernel, Fundamental theorem of homomorphism, Properties related to isomorphism, Permutation group, Cayley's Theorem.

(14 lecture hours)

DIFFERENTIAL EQUATIONS - II:

Unit II : Linear Differential Equations

Linear differential equations of n^{th} order with constant coefficients. Particular Integrals when the RHS is of the form e^{ax} , $sin(ax+b)$, $cos(ax+b)$, x^n , e^{ax} V, where V is a function of x. Cauchy–Euler equations ,Solving second order ODE by changing independent variable , by changing dependent variable and Method of variation of parameters.

(14 lecture hours)

Integral Transforms

Unit III: **Laplace transforms**

Definition, Basic Properties. Laplace transforms of some standard functions, Inverse Laplace transforms, Convolution theorem, Laplace transform of periodic functions. Laplace transform of derivative and integral of a function. Heaviside function. Dirac-delta function.. Solutions of differential equations by using Laplace transforms.

(14 lecture hours)

Unit IV: **Fourier series and Fourier Transforms**

Periodic functions. Fourier Coefficients. Fourier series of functions with period $2L$. Fourier series of even and odd functions. Half range Cosine and Sine series. Fourier Transforms - Finite Fourier cosine and sine transform.

(14 lecture hours)

Reference Books:

1. D. A. Murray, Introductory Course in Differential Equations, Orient and Longman
2. H. T. H. Piaggio, Elementary Treatise on Differential Equations and their Applications, CBS Publisher & Distributors, Delhi,1985.
3. G. F. Simmons, Differential Equations, Tata McGraw Hill.
4. S. L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004.
5. M. D. Raisinghania, Ordinary Differential Equations & Partial Differential Equations, S. Chand & Company, New Delhi.
6. R. Murray and L. Spiegal, Laplace Transforms, Schaum's Series
7. Sudhir Kumar, Integral Transform Methods in Science & Engineering, CBS Engineering Series, 2017.
8. Murray R. Spiegal L, Fourier Transforms, Schaum' Series,
9. Earl David Rainville and Philip Edward Bedient–A short course in Differential Equations, Prentice Hall College Div; 6th Edition.
10. Sathya Prakash, Mathematical Physics, S Chand and Sons, New Delhi.
11. A Course in Abstract Algebra, Vijay K Khanna and S K Bhambri,Vikas Publications

Web links:

1. http://www.the mathpage.com
2. http://www.abstractmath.org
3. http://ocw.mit.edu/courses/mathematics/
4. http://planetmath.org/encyclopedia/TopicsOnCalculus.html
5. www.python.org
6. www.rosettacode.org
7. http://www.univie.ac.at/future.media/moe/galeri.html
8. http://tutorial.math.lamar.edu/classes/de/de.aspx
9. http://www.sosmath.com/diffeq/diffeq.html

Practical	Algebra-IV, Integral Transforms & Differential Equations- II
Teaching Hours : 03 Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Maximum Marks: 50 (Exam 40 + IA 10)**

Course Learning Outcomes: This course will enable the students to write python code

- Solve problems on Partial Differential Equations and Integral Forms
- To find Laplace transform of various functions
- To find the Fourier Transform of periodic functions
- To solve differential equations by using Integral transforms.

Practicals list

1. Verification of Normality of a given subgroup
2. Program to verify the given function is homomorphism.
3. Program to verify the given function is isomorphism.
4. Finding complementary function of ordinary differential equations with constant coefficients
5. Finding complementary function and particular integral of ordinary differential equations with constant coefficients .
6. Solution of second order ordinary differential equations with variable coefficients by the method of variation of parameters
7. Finding the Laplace transforms of some standard and periodic functions.
8. Finding the inverse Laplace transform of simple functions.
9. Solution of ordinary linear differential equation using Laplace transform.
10. To find Fourier series of some simple functions with period $2L$
11. To find half range sine and cosine series of some simple functions
12. To find cosine and sine Fourier transform

SEMESTER – IV

Theory	Elective – II Mathematical logic
Teaching Hours : 02 Hours/Week	**Credits: 02**
Duration of Exam: 90 minutes	**Maximum Marks:50 (Exam 40 + IA 10)**

Course Learning Outcomes: On completion of this course, students are able to:

- Understand the algebraic concepts of Mathematical logic and Boolean algebra
- Concepts of Mathematical logic
- Application of Mathematical logic in switching networks /circuits.

Unit-I: Mathematical Logic

Propositions, logical connectors, truth tables, logical equivalences, tautology, contradiction, contingent statements, negations, inverse, converse and contra positive statements. Open sentences and quantifiers, truth sets connectives involving quantifiers.

Methods of proof: Direct proofs, indirect proofs, Contradiction method, contrapositive method and mathematical induction (explanation with simple examples). Rules of Inference (for quantified statements), Validity of Arguments, Principal disjunctive normal forms and Principal conjunctive normal forms.

(14 lecture hours)

Unit-II: Fuzzy Logic

Vocabulary of Fuzzy logic- Boolean sets- operators- Fuzzy sets- Fuzzy Quantifiers- Fuzzy set operators- Operations on Fuzzy sets – Illustrations – Applications.

(14 lecture hours)

Text Books:

1. Discrete Mathematics, Kenneth Rosen, 2001.

Reference Books:

1. J.P. Tremblay and R.P. Manohar: Discrete Mathematical Structures with applications to computer science, McGraw Hill (1975).
2. C.L. Liu: Elements of Discrete Mathematics, Tata McGraw-Hill, 2000.

SEMESTER – IV

Practical	SEC – I Mathematical Statistics
Teaching Hours : 03 Hours/Week	**Credits: 02**
Duration of Exam: 03 Hours	**Maximum Marks:50 (Exam 40 + IA10)**

Course Learning Outcomes: This course will enable students to

CO1 Acquire knowledge of statistical methods such as tests of hypothesis correlation and regression.

CO2 Identify types of data and visualization, analysis and interpretation.

CO3 Know about elementary probability and probability models.

CO4 Employ suitable test procedures for given data set.

CO5 Use resources available on open source (R programming)

CONTENTS:

1. Introduction to R Language
2. Measures of central tendency- Mean, Median and Mode
3. Measures of Dispersion-I
4. Measures of Dispersion-II
5. Curve fitting- Scatter plot
6. Correlation-I
7. Correlation-II
8. Linear Regression
9. Multiple Linear Regression
10. Probability- Baye's theorem
11. Probability distributions-Binomial distribution
12. Probability distributions-Poisson distribution
13. Probability distributions-Normal distribution
14. Testing of Hypothesis- t Test
15. Testing of Hypothesis-Chi square Test

Reference Books:

1. Fundamentals of Mathematical Statistics, S C Gupta, V K Kapoor, Sultan Chand, 2020.
2. Statistical Methods, S P Gupta, Sultan chand, 2020.
3. Mathematical Statistics, J N Kapur, H C Saxena, S Chand, 2020.
4. Openintro Statistics, Diez, Barr, Cetinkaya-Rundel, Openintro, Inc, 2019.
5. Elementary Statistics, Mario F Triola, Pearson, 2018.