BANGALORE UNIVERSITY

DEPARTMENT OF MATHEMATICS

Syllabus for Bachelor of Science (B.Sc., Degree)
I, II, III & IV Semesters Mathematics Courses
(Under-Graduate (UG) Program with Mathematics as one of the three Major subjects)

Framed according to the State Education Policy (SEP-2024)

EFFECTIVE FROM ACADEMIC YEAR 2025-26

BANGALORE UNIVERSITY
Department of Mathematics

Date: 21-06-2025

PROCEEDING OF THE BOARD OF STUDIES (BOS) IN UG- MATHEMATICS

The meeting of the Board of Studies (BOS) in UG Mathematics for the year 2025-26 was held on Saturday, **21st June 2025,** at 11.00am in the Department of Mathematics, Jnanabharathi Campus, Bangalore University, Bengaluru.. The following members attended the meeting:

Sl. No.	Name	Signature
1	Dr. B. CHALUVARAJU, Chairman	
2	Mr. H. S. MAHESH, Member	
3	Dr. SHAILAJA M., Member	
4	Mrs. JYOTHI D. K., Member	
5	Mrs. MAMATHA H. K., Member	21/06/2025
6	Dr. JAGADEESH R., Member	21/06/2025
7	Mr. T. R. MARULASIDDAPPA, Member	21/06/25
8	Dr. BALBHEEM SAIBANNA, Member	21/06/2025
9	Dr. SHOBHAN KUMAR D. M., Member	

Agenda and Resolutions:

1. Final draft of the **UG-Mathematics (I to VI Semester B. Sc.,)** was checked and discussion held. The suggestions given by the BOS members and subject experts were incorporated.
2. The syllabus framed as per UGC, KSHEC-State Education Policy (SEP) – 2024 and Bangalore University guidelines. The syllabus prepared by teachers with a Mathematics practical component, by using Free/Libre and Open Source Software (FLOSS) packages. The BOS also resolved to change the list of practical experiments each year. Finally, the syllabus was approved by all the members.
3. The committee approved the updated panel of examiners for UG (Mathematics).

The Chairman thanked the members for their cooperation.

[Dr. B. CHALUVARAJU]
CHAIRMAN
BU-BOS in UG-Mathematics

Professor & Chairman
Department of Mathematics
Bangalore University
Jnanabharathi, Bengaluru-560 056.

Copy to:

1. The Registrar, Bangalore University, Bengaluru.
2. The PS to the Vice-Chancellor, Bangalore University, Bengaluru.

MISSION AND VISION OF THE NEW SYLLABUS IN MATHEMATICS

MISSION

- Improve retention of mathematical concepts in the student. Also,develop a spirit of inquiry in the student.
- To improve the perspective of students on mathematics as per modern requirement.
- To initiate students to enjoy mathematics, pose and solve meaningful problems, to use abstraction to perceive relationships and structure and to understand the basic structure of mathematics.
- To enable the teacher to demonstrate, explain and reinforce abstract mathematical ideas by using concrete objects, models, charts, graphs, pictures, posters with the help of Free/Libre and Open-Source Software (FLOSS) tools on a computer.
- Exploit techno-savvy nature in the student to overcome math-phobia.
- To orient students towards relating Mathematics to applications.

VISION

- To remedy Math phobia through authentic learning based on hands-on experience with computers.
- To show that ICT can be a panacea for quality and efficient education when properly integrated and accepted.
- To provide greater scope for individual participation in the process of learning and becoming autonomous learners.
- To provide scope for greater involvement of both the mind and the hand this facilitates cognition.
- To ultimately see that the learning of mathematics becomes more alive, vibrant, relevant and meaningful; a program that paves the way to seek and understand the world around them. A possible by-product of such an exercise is that math-phobia can be gradually reduced amongst students.
- To help the student build interest and confidence in learning the subject.

Support system for Students and Teachers learning FLOSS TOOLS:

As a national-level initiative towards learning **FLOSSE** (Free/Libre and Open-Source Software for Education) promotes the use of FLOSS tools in academia and research. The **FOSSEE** project is part of the National Mission on Education through Information and Communication Technology (ICT), Ministry of Education (MoE) and IIT Bombay for MHRD, Government of India is giving free training to teachers interested in learning open-source software's like **SCILAB, WXMAXIMA, PYTHON, OCTAVE, GEOGEBRA** and others.

Name of the Degree Program : Bachelor of Science-B. Sc., (with three Major)

Discipline/Subject : Mathematics

Scheme : State Education Policy (SEP) - 2024

PROGRAMME OUTCOMES (POs)

By the end of the program the students will be able to

PO 1	**Disciplinary Knowledge**: The capability of demonstrating comprehensive knowledge of mathematics and understanding of one or more disciplines that form a part of an UG program of study.
PO 2	**Nature of Mathematics**: Understanding the concise, precise and rigorous nature of Mathematics and its applications in real-world problems.
PO 3	**Communication Skills**: Ability to (i)arrange and link their mathematical thinking through communication; (ii) communicate their logical and clear mathematical thinking to their friends, teachers, and others; (iii) analyze and assess mathematical thinking and strategies used by others; and (iv) use mathematical language to express mathematical ideas correctly.
PO 4	**Critical &Analytical thinking:** Ability to (i) employ critical thinking in understanding the concepts in every area of mathematics; (ii) performing some mathematical operation on the given statement to find the probable result. Questions based on analytical reasoning test the logical reasoning and analytical ability of a candidate**.**
PO 5	**Problem Solving:**

	Ability to analyze the problems, and define appropriate computing requirements for its solutions. This enhances students' overall development and equips them with modeling ability, and problem-solving skills.
PO 6	**Research-related skills:** Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics. Further, to know about the advances in various branches of mathematics.
PO7	**Information&DigitalLiteracy:** Ability to (i) find, evaluate, organize, use, and communicate information in all its various formats, most notably in situations requiring decision-making, problem solving, or the acquisition of knowledge; (ii) the skills associated with using technology to enable users to find, evaluate, organize, create, and communicate information. Also, capability to use appropriate softwares to solve the mathematical problems.
PO 8	**Self–directed learning**: Ability to working independently and to make an in-depth study of various notions of Mathematics.
PO 9	**Lifelong learning:** Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.
PO 10	**Professional and Applicational skills:** (i) Include students' habits, characteristics, and abilities that influence the candidate work style, mainly time-management, organization and communication; (ii) Ability to understand, verify and solve the mathematical problems by using the various methodologies within the mathematics. Also, the mathematical concepts are linked to other allied topics.
PO 11	**Higher studies:** Ability to peruse advanced studies and research in pure, applied, and computational mathematical sciences.
PO 12	**Employability:** Ability to work in finance, technology, research, or any other fields that relies on mathematical 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 %

COURSE PATTERN & SCHEME EXAMINATION

Sem. Name	Paper Code	Subjects	Instruction hrs / Week	Duration of Exam (hrs)	Marks			Credits
					IA	Exam	Total	
I	MATDSCT-1.1	Mathematics-I	4	3	20	80	100	3
	MATDSCP-1.1	Mathematics Practical-I	4	3	10	40	50	2
II	MATDSCT-2.1	Mathematics-II	4	3	20	80	100	3
	MATDSCP-2.1	Mathematics Practical-I	4	3	10	40	50	2
III	MATDSCT-3.1	Mathematics-III	4	3	20	80	100	3
	MATDSCP-3.1	Mathematics Practical-III	4	3	10	40	50	2
IV	MATDSCT-4.1	Mathematics-IV	4	3	20	80	100	3
	MATDSCP-4.1	Mathematics Practical-IV	4	3	10	40	50	2

Abbreviation for **MAT**–Mathematics; DSC–Discipline Subject Core; **T**–Theory; **P**–Practical; **I.A**-Formative/Internal Assessment; **S.A**. - Summative Assessment; E–Elective.

FIRST SEMESTER

MATDSCT 1.1: MATHEMATICS-I	
Teaching Hours :4 Hours / week	**Credits** :3
Total Teaching Hours :56 Hours	**Max. Marks** : **100 (SA 80 + IA 20)**

COURSE OBJECTIVE:

The primary objective of teaching matrix theory in an UG syllabus is to equip students with the fundamental concepts and tools of matrices and their applications in various fields. Comprehend the fundamental concepts of Differential and Integral calculus. Also, Geometry in 3D involves understanding how to represent geometric objects like lines, planes, and curves using equations and how to solve geometric problems by translating them into algebraic equations.

COURSE OUTCOMES (COS):

By the end of the program the students will be equipped with the following aspects:	
CO 1	Understand the solving techniques of elementary transformations, find the Eigenvalues and Eigenvectors of a given matrix, verify and analyze the consequences of the Cayley – Hamilton theorem of a given matrix.
CO 2	Explain the basic skills of differentiation, nth derivatives of standard functions, and apply the Leibnitz theorem to find the solutions to given problems. Also, solve problems on partial and total derivatives. Knowing the Jacobians and related properties.
CO 3	Find the reduction formulae and apply Leibnitz Rule. Also, applying the methods of differentiation and integration to study the geometric properties of curves and surfaces.
CO 4	Understand and recognize the concepts of analytical geometry in three dimensions and equations of the sphere, right circular cylinder and cone.

CONTENTS		**Teaching Hours**
Unit 1	**MATRICES** Recapitulation of Symmetric and Skew Symmetric matrices, Elementary row and column transformations, Row reduced echelon form, Rank of a matrix, Normal form of a matrix, Inverse of a matrix by elementary operations.	**14**

	Solution of system of linear equations; Criteria for existence of non- trivial solutions of homogeneous system of linear equations, Solution of non-homogeneous system of linear equations. Eigen values and Eigen vectors of square matrices of order 2 and 3, Cayley-Hamilton theorem (with proof), Finding A^2,A^3, A^4 and inverse of matrices by Cayley-Hamilton theorem.	
Unit 2	**DIFFERENTIALCALCULUS-I** **Ordinary Derivatives:** Successive Differentiation**,** nth Derivatives of Standard functions e^{ax+b}, $(ax+b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, Leibnitz theorem (with proof) and examples based on Leibnitz theorem. **Partial Derivatives:** Functions of two or more variables-explicit and implicit functions, partial derivatives of higher order, Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and problems.	**14**
Unit 3	**INTEGRALCALCULUS** Recapitulation of definite integrals and its related properties. Reduction formulae $-\int \sin^n x dx$, $\int \cos^n x\, dx$, $\int \tan^n x\, dx$, $\int \cot^n x\, dx$ $\int \sin^m x \cos^n x\, dx$, $\int_0^{\pi/2} \sin^n x dx$, $\int_0^{\frac{\pi}{2}} \cos^n x dx$, $\int_0^{\pi/2} \sin^m x \cos^n x\, dx$ and its related problems. Differentiation under integral sign by Leibnitz rule and problems. Computation of length of an arc, area of plane curves, surface area and volume of solids of revolution for standard curves in Cartesian and polar forms.	**14**
Unit 4	**ANALYTICAL GEOMETRY** Direction cosines and ratios, Equation of spheres in different forms (general, standard, central and diametric forms in both Cartesian and Vector forms), tangent plane to a sphere, derivation of condition for orthogonal of spheres and problems, standard equation of right circular cone and right circular cylinder in both Cartesian and Vector forms and problems, Derivations of paraboloid, ellipsoid, Hyperboloid of one and two sheets.	**14**

TEXT/ REFERENCE BOOKS

1. Shanthi Narayan and P.K. Mittal, Matrices, 5th edition, New S. Chandand Co.Pvt.Ltd., 2013.
2. B. S. Vatssa, Theory of Matrices, New Age International Publishers, New Delhi, 2005.
3. A. R. Vashista, Matrices, Krishna Prakashanamandir,2003.
4. Shanthi Narayan and P.K. Mittal, Differential Calculus - S. Chand & Co., New Delhi, 2014.
5. Debasish Sengupta, Applications of Calculus, Books and Allied (P) Ltd.,2019.
6. Shanthi Narayan and T. K. Manicavachogam Pillay, Calculus.: S. Viswanathan Pvt. Ltd., Vol. I & II, 1996.
7. Shanthi Narayan and P.K. Mittal, Integral Calculus S. Chand & Company, New Delhi, 2013.
8. Shanthi Narayan and P.K. Mittal, Analytical Solid Geometry- S. Chand & Co., New Delhi, 2014.
9. B. S. Grewal, Higher Engineering Mathematics, 45 Edition, Khanna Publishers, Delhi.2020.
10. S. P. Mahajan and Ajay Aggarwal, Comprehensive solid geometry -,1st edition, Anmol Publications, 2000.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/
6. https://www.doabooks.org/

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCT 1.1: MATHEMATICS-I												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	3	3	2	3	3	3
CO2	2	3	2	2	3	3	2	2	3	2	2	3
CO3	1	2	3	2	2	2	2	3	2	2	2	3
CO4	2	2	3	3	2	3	3	2	1	2	3	3

*Low correlate-1; Moderate correlate-2; High (Substantial) correlate-3.

MATDSCP 1.1: MATHEMATICS PRACTICAL-I	
Teaching Hours :4 Hours / week	**Credits :**2
Total Teaching Hours :56 Hours	**Max. Marks : 50 (SA 40 + IA 20)**

COURSE OBJECTIVES:

Mathematics-I with Python skill is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

Course Outcomes	This practical course will enable the students to:
CO1	Understand the textbook companion activity aims to port solved examples from standard textbooks using Free/Libre and Open Source Software (FLOSS).
CO2	Identify the given problem with the help of logic/aim/motivation to narrate the Matrix theory by using FLOSS.
CO3	Apply fundamental differential and integral calculus concepts to solve problems, and their proficiency in using FLOSS for computation and visualization.
CO4	Provide a huge database of Companions as a learning resource by adopting FLOSS for learning analytical geometry in 3D.

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-IV)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 15 programs must be done from the following list **of suggested programs**:

1. Introduction to Python
2. Program to basics of software with simple examples.
    i. compare two numbers using if statements
    ii. sum of natural numbers using while loop
    iii. finding the factors of a number using for loop
    iv. to check the given number is prime or not
    v. find the factorial of a number
    vi. simple programs to illustrate logical operators (and or not)
3. Program to Computation of a rank of matrix by row reduced and normal forms.

4. Program to Solving the system of homogeneous linear equations.
5. Program to Solving the system of non-homogeneous linear equations
6. Program to Computation of inverse of a matrix by using Cayley-Hamilton theorem.
7. Program to finding the n^{th} derivative of a function without Leibnitz theorem.
8. Program to finding the n^{th} derivative of a function with Leibnitz theorem.
9. Program to Partial differentiation of some standard functions and Jacobian.
10. Program to Verification of Euler's theorems with examples.
11. Program to find the Jacobians.
12. Program to find reduction formula with limits.
13. Program to find reduction formula without limits.
14. Program to compute surface area of solids.
15. Program to compute Volume of solids of revolution
16. Program to find equation and plot sphere, cone, cylinder.
17. Program to find equation and plot paraboloid, ellipsoid and hyperboloid.

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

TEXT / REFERENCE BOOKS

1. Sandeep Koranne, Handbook of Open-Source Tools, Springer US, 2015.
2. Philip N. Klein, Coding the Matrix: Linear Algebra through Computer Science Applications, Newtonian Press, 2013.
3. Brian Heinold, A Practical Introduction to Python Programming, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
4. J. C. Bautista, Mathematics and Python Programming, Lulu Press, Incorporated, 2014.
5. Eric Ayars, Computational Physics with Python, California State University, 2013.
6. Martin C. Brown, Python: The complete Reference,4thEdition, Mc.GrawHill, 2018.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCP 1.1: MATHEMATICS PRACTICAL-I												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	3	3	2	3	2	3	3
CO2	2	2	3	2	1	3	2	2	2	2	1	3
CO3	1	1	2	2	2	2	2	1	3	2	2	3
CO4	2	2	1	3	2	3	3	2	1	2	3	3

*Low correlate-1; Moderate correlate-2; High (Substantial) correlate-3.

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation, etc.

Formative Assessment:

Types of Course	Internal Assessment (I.A.)	
Theory	C1: Sessional Tests	10 Marks
	C2: Assignments / Seminar	10 Marks
	Total	**20 Marks**
Practical's	C1: Sessional Tests	10 Marks

SECOND SEMESTER

MATDSCT 2.1: MATHEMATICS-II			
Teaching Hours	:4 Hours / week	**Credits**	: 3
Total Teaching Hours	:56 Hours	**Max. Marks**	: 100 (SA 80 + IA 20)

COURSE OBJECTIVE:

The primary objectives of a mathematical logic and Boolean algebra course are to equip students with a foundational understanding of logical reasoning and its application to digital systems. The polar coordinates and plane curves are helps the students with the ability to represent and analyze curves using a different coordinate system. Also, the present content includes learning techniques for solving different types of differential equations, understanding their solutions, and applying them to real-world problems.

COURSE OUTCOMES (COS):

By the end of the program the students will be equipped with the following aspects:	
CO 1	Understanding the propositional logic, mastering various proof methods, and applying Boolean algebra to logic circuits.
CO 2	Knowing and summarize the basic knowledge on the notions of Cartesian, parametric and polar forms, curvature of plane curve, center of curvature, asymptotes, singular points and double points. Also, tracing of Standard curves.
CO 3	Illustrate and evaluate the fundamental concepts of Limits, Continuity and Differentiability. Also, solve the problems on Rolle's, Lagrange's mean value and Cauchy 's mean value theorems.
CO 4	Determine the method of solving problems on differential equations. Also, know how to apply differential equations in various fields.

CONTENTS		Teaching Hours
Unit 1	**MATHEMATICAL LOGIC AND BOOLEAN ALGEBRA** **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,	**14**

	Methods of proof: Direct proofs, indirect proofs, Contradiction method, contra positive method and mathematical induction (explanation with simple examples). **Boolean algebra:** Definition, examples, laws of Boolean algebra, normal disjunctive form, prime implicants, Karnaugh map theorem for reducing logical circuits.	
Unit 2	**POLARCO-ORDINATES** Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms. Curvature of plane curve - radius of curvature formula (in Cartesian, parametric, polar and pedal forms), Centre of curvature, asymptotes, singular points and double points. Tracing of Standard curves (Cartesian, polar and parametric).	**14**
Unit 3	**DIFFERENTIALCALCULUS-II** Limits, Continuity, Differentiability and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem & Maclaurin's series of one variable, indeterminate forms and evaluation of limits using L'Hospital rule.	**14**
Unit 4	**ORDINARYDIFFERENTIALEQUATIONS-I** Recapitulation of differential equations of first order and first degree, Linear Differential equations and equations reducible to linear form (Bernoulli's equation),Exact Differential equations, Necessary and sufficient condition for the equations to be exact, Equations reducible to exact form. Differential equations of the first order and higher degree: Equations solvable for p, x, y. Clairaut's equation; general and singular solution. Orthogonal trajectories of Cartesian and polar curves.	**14**

TEXT/ REFERENCE BOOKS

1. Kenneth H Rosen, Discrete Mathematics and its applications, Tata McGraw Hill Publications, 2017.

2. Tamara J. Lankins, The tools of Mathematical Reasoning, American Mathematical Society, 2016.
3. W. D. Wallis, A beginner's Guide to Discrete Mathematics, Second Edition, Birkhauser, 2012.
4. Shanti Narayan, Differential Calculus, S. Chand & Company, New Delhi, 2005.
5. Debasish Sengupta, Applications of Calculus, Books and Allied (P) Ltd., 2019.
6. Frank Ayres and Elliott Mendelson, Schaum's Outline of Calculus, 5th Edition, USA: Mc. Graw Hill, 2008.
7. M. D. Raisinghania, Advanced differential equations, S.Chand & Company, New Delhi,2013.
8. B. S. Grewal, Higher Engineering Mathematics, 45th Edition, Khanna Publishers, Delhi, 2020.
9. G. F. Simmons, Differential equations with Applications and historical Notes, 2nded: McGraw-Hill Publishing Company, 1991.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/
6. https://www.doabooks.org/

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCT 2.1: MATHEMATICS-II												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	3	3	3	3	2	3	3	3
CO2	2	1	2	1	3	3	3	2	1	2	2	3
CO3	1	2	3	2	1	2	2	3	2	1	2	3
CO4	2	2	3	3	2	3	1	2	1	2	3	3

*Low correlate-1; Moderate correlate-2;High (Substantial) correlate-3.

MATDSCP 2.1: MATHEMATICS PRACTICAL-II			
Teaching Hours	:4 Hours / week	**Credits**	:2
Total Teaching Hours	:56 Hours	**Max. Marks**	**: 50 (SA 40 + IA 20)**

COURSE OBJECTIVES:

Mathematics-II with Python skill is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

Course Outcomes	This practical course will enable the students to:
CO1	Identify the given problem logic/aim/motivation to narrate the Algorithms and computer programming of available FLOSS. Particularly, Propositional logic, various proof methods, and Boolean algebra.
CO2	Apply fundamental differential and integral calculus concepts to solve problems, and their proficiency in using FLOSS for computation and visualization.
CO3	Solve and describe the problems of Limits, Continuity, and Differentiability. Also, analyze the Rolle's, Lagrange's mean value and Cauchy's mean value theorems. Further, identify the nature of Indeterminate forms.
CO4	Provide a huge database of companions as a learning resource by adopting FLOSS for learning and solve the problems of differential equations.

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-IV)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 15 programs must be done from the following list**of suggested programs**:

1. Program to construction of truth tables for compound propositions.
2. Program to verifying whether given proposition is tautology.
3. Program to verifying whether given proposition is contradiction.
4. Program to verifying whether given proposition is nether tautology nor contradiction.
5. Program to problems on Karnaugh map theorem for reducing logical circuits
6. Program to finding the angle between the radius vector and tangent.

7. Program to finding the angle between two curves
8. Program to finding the radius of curvature of the given curve
9. Program to Plotting of standard Cartesian, polar and parametric curves
10. Program to find limit and continuity of functions.
11. Program to verify the Rolle's ,theorem.
12. Program to verify the Lagrange's theorem.
13. Program to verify the Cauchy's mean value theorem.
14. Program to find the Maclaurin's expansion.
15. Program to find limits by the L'Hospital's rule.
16. Program to Solution of Linear differential equation.
17. Program to Solution of Exact differential equation.
18. Program to Solving non-linear differential equations for p, x and y.
19. Program to finding the general and singular solutions of Clairaut's equation.

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

TEXT / REFERENCE BOOKS

1. Sandeep Koranne, Handbook of Open-Sourcetools, Springer US, 2015.
2. Martin C. Brown, Python: The complete Reference,4thEdition, Mc.GrawHill, 2018.
3. Brian Heinold, A Practical Introduction to Python Programming, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
4. J. C. Bautista, Mathematics and Python Programming, Lulu Press, Incorporated, 2014.
5. Eric Ayars, Computational Physics with Python, California State University, 2013.
6. John Kerl, Concrete abstract algebra in Python, 2013.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCP 2.1: MATHEMATICS PRACTICAL-II												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	3	2	2	3	3
CO2	2	3	2	2	2	3	2	2	2	1	1	2
CO3	1	1	2	2	2	3	3	3	2	2	2	3
CO4	2	2	1	1	2	3	3	2	1	2	3	3

*Low correlate-1; Moderate correlate-2; High (Substantial) correlate-3.

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation, etc.

Formative Assessment:

Types of Course	Internal Assessment (I.A.)	
Theory	C1: Sessional Tests	10 Marks
	C2: Assignments / Seminar	10 Marks
	Total	**20 Marks**
Practicals	C1: Sessional Tests	10 Marks

THIRD SEMESTER

MATDSCT 3.1: MATHEMATICS-III	
Teaching Hours :4 Hours / week	**Credits** :3
Total Teaching Hours :56 Hours	**Max.Marks:100 (SA 80 + IA 20)**

COURSE OBJECTIVE:

The axioms of a group, exploring various examples of groups, to identify subgroups, understand their relationships to the parent group, and apply theorems like Lagrange's theorem and its consequences. The fundamental properties of the sequence and series are leads to exploring their properties, and mastering techniques for analyzing their convergence and divergence. The vector algebra emphasizes rigorous proofs and logical reasoning, helping students develop critical thinking and problem-solving abilities.

COURSE OUTCOMES (COS):

By the end of the program the students will be equipped with the following aspects:	
CO 1	Explain and appraise the beauty of the abstract nature of an elementary group theory, which is a solid foundation of theoretical mathematics.
CO 2	Learn the fundamental concept of convergence and divergence of a sequence of real numbers along with nature of sequences such as limits of sequence, monotonic sequence and others.
CO 3	Apply and evaluatethe comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy root test and Alternate series-Leibnitz test.
CO 4	A deeper understanding of core vector algebra concepts, mastering techniques for handling more complex functions, and applying these concepts to solve problems in scalar and vector fields.

CONTENTS		Teaching Hours
Unit 1	**GROUP-I** Algebraic structures,Definition of Binary Operation, Groups and its properties, Abelian groups, Sub groups and its properties, order of an elements, Coset decomposition, Cyclic groups and its properties, Index of a group, Lagrange's theorem, and its consequences (Fermat theorem	**14**

	and Euler theorem).	
Unit 2	**SEQUENCES OF REAL NUMBERS** Definitionand examples of sequences, Bounded sequences, and its properties (some theorems), Limit of a sequence, Nature of sequences, Algebra of limits of sequence, Monotonic sequences (theorems and problems), Behavior of standard sequences.Cauchy's general principle for convergence of a sequence	**14**
Unit 3	**SERIES OF REAL NUMBERS** Series of real numbers (Infinite series), Definition and examples of Convergence, Divergence, Oscillatory series, Geometric, p-series, Comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy root test, Alternate series-Leibnitz test.Absolute convergence and conditional convergence of a series. Summation of series: Binomial, exponential and logarithmic.	**14**
Unit 4	**VECTOR ALGEBRA** Multiple product – scalar triple product, vector triple product, geometrical interpretation, related problems, vector function of a scalar variable – interpretation as a space curve. **Scalar Field:** Gradient of a scalar field, geometrical meaning, directional derivative, unit normal to the surfaces - tangent plane and normal to the surface. **Vector Field**: Divergence and curl of a vector field, solenoidal and irrotational fields, Laplacian of a scalar field, Vector identities.	**14**

TEXT/ REFERENCE BOOKS

1. V. K. Khanna and S. K. Bhambri. *A Course in Abstract Algebra*, 5th Edition. Vikas Publishing House Pvt. Ltd. New Delhi, 2016.
2. I. N.Herstein, *Topics in Algebra*, 4th ed. Vikas Pub. House Pvt. Ltd, New Delhi, India, 1991.
3. Gerald G. Bilodeau, Paul R. Thie, G. E. Keough, *An Introduction to Analysis*, 2nd Ed., Jones & Bartlett, 2010.
4. K. A. Ross, *Elementary Analysis: The Theory of Calculus*,2nd Ed, Springer, 2013.
5. M. L. Khanna and L. S. Varhiney, *Real Analysis*, Jai Prakash Nath& Co. Meerut, 2014.
6. M. D. Raisinghania, Vector Calculus, S. Chand Co. Pvt.Ltd., 2013.

7. M. Spiegel, Vector Analysis, 2ndEd., Schaum's Outline Series, Mc-Graw Hill Pub. House Edition, 2017.
8. C. E. Weatherburn, Elementary Vector Analysis, Alpha ed., 2019.
9. Frank Ayres and Elliott Mendelson, *Schaum's Outline of Calculus*, 5th Edition,USA: Mc. Graw Hill., 2008.
10. G. B.Thomson, R. L. Finney, *Calculus*, 9th Edition, Pearson Education, Delhi, 2005

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/
6. https://www.doabooks.org/

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCT 3.1: MATHEMATICS-III												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	3	3	2	3	3	3
CO2	2	3	2	2	3	3	2	2	3	2	2	3
CO3	1	2	3	2	2	2	2	3	2	2	2	3
CO4	2	2	3	3	2	3	3	2	1	2	3	3

*Low correlate-1; Moderate correlate-2;High (Substantial) correlate-3.

MATDSCP 3.1: MATHEMATICS PRACTICAL-III			
Teaching Hours	**:**4 Hours / week	**Credits**	**:**2
Total Teaching Hours	**:**56 Hours	**Max. Marks**	**: 50 (SA 40 + IA 20)**

COURSE OBJECTIVES:

Mathematics-III with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

Course Outcomes	This practical course will enable the students to:
CO1	Apply and illustrate the fundamental concepts of group theory and their proficiency in using FLOSStools for problem solving and visualization.
CO2	Solve and analyze the problem of convergence and divergence of a sequence of real numbers via FLOSS packages.
CO3	Solve and analyze the problem of convergence and divergence of a series of real numbers along with the comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy root test and Alternate series-Leibnitz test via FLOSS tools.
CO4	Understand and Analyze theGradient and Laplacian of a scalar field, Divergence and Curl of a vector field. Also, estimate the solenoidal and irrotational of a vector field by using the FLOSS packages.

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-IV)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program / Python code and output. The minimum 15 programs must be done from the following list**of suggested programs**:

1. Program to verifying weather given operator is binary or not.
2. Program to find identity and inverse element of a group
3. Program to find the order of an element.
4. Program to find left and right cosets
5. Program to verify Lagrange's theorem for a finite group.
6. Program to find the limit of a sequence.

7. Program to verify the convergence of a sequence.
8. Program to check whether the sequences is monotonically increasing or decreasing.
9. Program to check whether the sequences is bounded or not
10. Program to test the convergence of series using partial sums.
11. Program to test the convergence of series by using comparison test
12. Program to test the convergence of series by using D'Alembert's ratio Test
13. Program to test the convergence of series by using Raabe's Test
14. Program to test the convergence of alternating series using the Leibnitz's theorem.
15. Program to find Gradient of a scalar field.
16. Program to find Divergence of a vector field.
17. Program to find Curl of a vector field.
18. Program to find Laplacian of a scalar field.
19. Program to verify whether the given vector field is solenoidal or not.
20. Program to verify whether the given vector field is irrotational or not.

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

TEXT / REFERENCE BOOKS

1. Sandeep Koranne, Handbook of Open-Source Tools, Springer US, 2015.
2. Philip N. Klein, Coding the Matrix: Linear Algebra through Computer Science Applications, Newtonian Press, 2013.
3. Brian Heinold, A Practical Introduction to Python Programming, Department of Mathematics and Computer Science, Mount St. Mary's University, 2019.
4. J. C. Bautista, Mathematics and Python Programming, Lulu Press, Incorporated, 2014.
5. Eric Ayars, Computational Physics with Python, California State University, 2013.
6. John Kerl, Concrete abstract algebra in Python, 2013.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCP 3.1: MATHEMATICS PRACTICAL-III												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	3	3	2	3	3
CO2	2	3	3	2	1	3	2	2	2	2	1	3
CO3	1	2	2	2	2	3	3	3	3	3	2	3
CO4	2	2	1	3	2	3	3	2	1	2	3	3

*Low correlate-1; Moderate correlate-2;High (Substantial) correlate-3.

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation, etc.

Formative Assessment:

Types of Course	Internal Assessment (I.A.)	
Theory	C1: Sessional Tests	10 Marks
	C2: Assignments / Seminar	10 Marks
	Total	**20 Marks**
Practicals	C1: Sessional Tests	10 Marks

FOURTH SEMESTER

MATDSCT 4.1: MATHEMATICS-IV			
Teaching Hours	:4 Hours / week	**Credits**	:3
Total Teaching Hours	:56 Hours	**Max. Marks**	**: 100 (SA 80 + IA 20)**

COURSE OBJECTIVE:

The main learning objectives of Normality, Quotient group, homomorphism and isomorphism of a group and its applications are explored. To understand, apply, and analyze the Laplace transform and its inverse. The Fourier series and Fourier transforms, applying them to solve problems, and appreciating their applications in various fields. Also, to equip students with the tools and techniques to solve and analyze differential equations that involves second and higher-order derivatives.

COURSE OUTCOMES (COs):

By the end of the program the students will be equipped with the following aspects:	
CO 1	Understand the concepts of Normality, Quotient group, Homomorphism group, Isomorphism groupand learn the nature of kernel and image of Homomorphism groups.
CO 2	Identify the Laplace transform, understand its properties, and determine the Laplace transforms of standard functions.
CO 3	Learn to represent periodic functions using Fourier series, understand the concept of convergence, Fourier Coefficients and Half range sine and cosine series. Also, knowing the basic properties of Fourier transform.
CO 4	The ordinary differential equation (second and higher order) is to equip students with the knowledge and skills to analyze, solve, and model various phenomena using different types of equations.

CONTENTS		**Teaching Hours**
Unit 1	**GROUP-II** Normal subgroups-Examples and problems, Quotient group, Homomorphism of groups, Kernel and Image of a homomorphism, Normality of the kernel, Fundamental theorem of homomorphism and its	**14**

	related problems.	
Unit 2	**LAPLACE TRANSFORM** Definition and basic properties Laplace transform of some common functions and Standard results, Inverse Laplace transforms. Laplace transform of periodic functions- Laplace transforms of derivatives and the integral of functions, Laplace transforms of Heaviside function convolution theorem (without proof) and related problems, solution of second order differential equations	**14**
Unit 3	**FOURIER SERIES AND FOURIER TRANSFORM** Periodic functions. Fourier Coefficients. Fourier series of functions with period 2L. Fourier series of even and odd functions. Half rangesine and cosine series. Fourier transform, Finite Fourier sine and cosinetransform.	**14**
Unit 4	**ORDINARY DIFFERENTIAL EQUATIONS-II** Ordinary Differential Equations (Second and higher order), Linear Differential Equations of n^{th} order with constant coefficient (Complementary Function and Particular Integral) of standard functions, Cauchy-Euler equations, Legendre's solving second order linear differential equations by applying - 5 different methods (i) When a part of complementary function is given (ii) Changing the independent variable (iii) Changing the dependent variable (iv) Variation of parameters (v) Conditions for exactness and the solution when the equation is exact	**14**

TEXT/REFERENCE BOOKS

1. V. K. Khanna and S. K. Bhambri. *A Course in Abstract Algebra*, 5th Edition. Vikas Publishing House Pvt. Ltd. New Delhi, 2016.
2. I. N.Herstein, *Topics in Algebra*, 4th ed. Vikas Pub. House Pvt. Ltd, New Delhi, India, 1991.
3. Raisinghania M.D., *Laplace and Fourier Transforms*, S. Chand and Co. Ltd., New Delhi, India 1995.
4. J. K. Goyal and K.P. Gupta, *Laplace and Fourier Transforms,* Pragati Prakashan, India, 2016.
5. B. V. Ramana,*Higher Engineering Mathematics*, Tata McGraw-Hill, 2006.

6. A. R. Vasistha and R.K. Gupta, *Laplace Transforms*, Krishna Prakashan Media Pvt. Ltd. Meerut,India 2023,
7. M. R. Spiegel,*Laplace transforms*, Schaum's Outlines series,McGraw Hill Education, 2005.
8. M. D. Raisinghania, *Ordinary Differential Equations & Partial Differential Equations*, S. Chand &Company,New Delhi, 2013.
9. W. T. Reid, *Ordinary Differential Equations*, John Wiley, New Delhi, 2010.
10. S. L. Ross, *Differential Equations*, 3rd Edition, John Wiley and Sons, 1984.

WEB RESOURCES:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. https://www.my-mooc.com/en/categorie/mathematics
3. http://ocw.mit.edu/courses/mathematics/
4. https://ndl.iitkgp.ac.in/
5. http://cec.nic.in/cec/
6. https://www.doabooks.org/

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCT4.1: MATHEMATICS - IV												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	2	3	2	3	3	3
CO2	2	3	1	2	2	2	3	2	2	3	2	3
CO3	1	2	2	2	3	2	2	3	2	2	2	3
CO4	2	2	2	3	2	3	1	2	1	1	3	3

*Low correlate-1; Moderate correlate-2;High (Substantial) correlate-3.

MATDSCP 4.1: MATHEMATICS PRACTICAL-IV			
Teaching Hours	**:**4 Hours / week	**Credits**	**:**2
Total Teaching Hours	**:**56 Hours	**Max. Marks**	**: 50 (SA 40 + IA 20)**

COURSE OBJECTIVES:

Mathematics-IV with Python skill, is helpful for Employability in IT industries, Entrepreneurship in Produce innovative IT solutions and services based on global needs and trends.

COURSE OUTCOMES (COs):

Course Outcomes	This practical course will enable the students to:
CO1	Provide a huge database of companions as a learning resource by adopting FLOSS for learning algebraic structures through groups such as normality, homomorphism and isomorphism of a group.
CO2	To analyze and solve the problems of Laplace transform and it's inverse of some standard functions. Also, to solve first and second order ordinary differential equation with constant coefficients using Laplace transforms via FLOSS.
CO3	Ability to formulate, analyze and solve the problems of Fourier series, half range Fourier sine and cosine series of some standard functions. Also, understand the nature of Fourier sine and cosine transforms by using FLOSS packages.
CO4	Able to find the complete solution of a differential equation with constant coefficients by variation of parameters and described by second order linear differential equations with constant coefficients by adoptingFLOSS tools.

Mathematics Practical with Free/Libre and Open-Source Software (FLOSS)tool for computer programs (i. e., Theory Based Practical-IV)

Note-1: Before the execution, all problems must be solved manually and the same should also be written in the records along with Aim / Motivation, Algorithm, Computer Program/ Python code and output. The minimum 15 programs must be done from the following list**of suggested programs**:

1. Program to verify the Normality of a given subgroup.
2. Program to verify the given function is homomorphism or not.
3. Program to verify the given function is isomorphism or not.
4. Program to find the Laplace transform of some Standard functions.
5. Program to find an inverse Laplace transform of some Standard functions.

6. Program to solve first order ordinary linear differential equation with constant coefficients using Laplace transform.
7. Program to solve second order ordinary linear differential equation with constant coefficients using Laplace transform.
8. Program to find the Fourier series of some functions withperiod2L.
9. Program to find half range Fourier sine series of some functions.
10. Program to find half range Fourier cosine series of some functions.
11. Program to find the Fourier sine Transform
12. Program to find the Fourier cosine Transform
13. Program to find the complimentary function of linear homogeneous differential equations with constant coefficients.
14. Program to find the particular integral of linear homogeneous differential equations with constant coefficients.
15. Program to find the solution of second order ordinary linear differential equations with variable coefficients by the method of changing independent variable.
16. Program to find solution of second order ordinary linear differential equations with variable coefficients by the method of changing dependent variable.
17. Program to find solution of second order ordinary linear differential equations with variable coefficients by the method of variation of parameters.
18. Program to verify the exactness of second order ordinary linear differential equations.

Note-2: The above list may be changed annually with the approval of the BOS in UG (Mathematics).

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1. Sandeep Koranne, Handbook of Open-Source Tools, Springer US, 2015.
2. Philip N. Klein, Coding the Matrix: Linear Algebra through Computer Science Applications, Newtonian Press, 2013.
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4. J. C. Bautista, Mathematics and Python Programming, Lulu Press, Incorporated, 2014.
5. Eric Ayars, *Computational Physics with Python*, California State University, 2013.
6. John Kerl, *Concrete abstract algebra in Python*, 2013.

WEB RESOURCES:

1. http://www.univie.ac.at/future.media/moe/galerie.html
2. http://faculty.msmary.edu/heinold/python.html
3. https://kitchingroup.cheme.cmu.edu/pycse/pycse.html
4. https://www.vlab.co.in/
5. https://fossee.in/
6. http://www.python.org

COURSE ARTICULATION MATRIX MAPPING OF POs v/s COs*

MATDSCP 4.1: MATHEMATICS PRACTICAL-IV												
Course Outcomes (COs)	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	3	2	3	3	2	2	3
CO2	2	3	1	2	1	3	2	2	2	2	1	3
CO3	1	2	2	2	2	3	1	3	3	1	2	3
CO4	2	2	3	1	2	3	2	2	1	2	1	3

*Low correlate-1; Moderate correlate-2; High (Substantial) correlate-3.

Pedagogy: Lectures by conventional method, use of ICT and conducting competitions like Quiz, Seminars, Desk Work, Book Chapter, Problem Solving, Power Point Presentation etc.

Formative Assessment:

Types of Course	Internal Assessment (I.A.)	
Theory	C1: Sessional Tests	10 Marks
	C2: Assignments / Seminar	10 Marks
	Total	**20 Marks**
Practical's	C1: Sessional Tests	10 Marks

BANGALORE UNIVERSITY
B. Sc. Degree (Mathematics)

FORMAT OF QUESTION PAPER OF MATHEMATICS -THEORY
(I to IV Semester B.Sc.,)

Time: 3 Hours **Max.Marks: 80**

SECTIONS	PATTERN UNIT WISE	MARKS
A	Answer any **TEN** (12 questions are given from all units-each unit cover 3 questions)	10 x 2 = 20
B	Answer any **THREE** (05 questions are given from Unit-I)	3x 5 = 15
C	Answer any **THREE** (05 questions are given from Unit-II)	3 x 5 = 15
D	Answer any **THREE** (05 questions are given from Unit-III)	3 x 5 = 15
E	Answer any **THREE** (05 questions are given from Unit-IV)	3 x 5 = 15
	TOTAL MARKS	**80**

FORMAT OF QUESTION PAPER OF MATHEMATICS- PRACTICAL
(I to IV Semester B.Sc.,)

Time: 3 Hours **Max. Marks: 40**

SECTIONS	PATTERN UNIT WISE	MARKS
A	Answer any **ONE** (02 questions are given from Unit-I)	01 x 07 = 07
B	Answer any **ONE** (02 questions are given from Unit-II)	01 x 07 = 07
C	Answer any **ONE** (02 questions are given from Unit-III)	01 x 07 = 07
D	Answer any **ONE** (02 questions are given from Unit-IV)	01 x 07 = 07
	Viva-Voce	06
	Lab Record	06
	TOTAL MARKS	**40**

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