BANGALORE UNIVERSITY

DEPARTMENT OF MATHEMATICS

Syllabus for I and II Semester
B.Sc. - Mathematics
(Framed according to State Education Policy-2024)

Effective from Academic Year 2024-2025

JULY-2024

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

PO 1	**Disciplinary Knowledge:** Bachelor degree with Mathematics as one of major subject 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 physics, computer science and other allied subjects.
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**: Enhances the 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 4	**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 5	**Problem Solving techniques**: 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 modelling ability, problem solving skills.
PO 6	**Research related skills:** The completing this programme develop the capability of inquiring about appropriate questions relating to the Mathematical concepts in different areas of Science and Social Science.
PO 7	**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. Gives the knowledge of FOSS tools and its application in Mathematics learning.
PO 8	**Self – directed learning**: The student completing this program will develop ability of working independently and to make an in-depth study of various branches of Mathematics.
PO 9	**Moral and ethical awareness/reasoning:** The student completing this program will develop an ability to identify unethical behavior suchas fabrication, falsification or misinterpretation of data and adopting objectives, unbiased and truthful actions in all aspects of life in general and also in Mathematical studies in particular.
PO 10	**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 world problems.
PO 11	**Higher studies:** Ability to peruse advanced studies and research in pure and appliedMathematical sciences
PO 12	**Employability:** Study of Mathematics enhances employability for jobs in banking, insurance companies, investing sectors and data analysis and also in various public and private enterprises

SEMESTER – I

MATT 1.1: MATHEMATICS - I	
Teaching Hours: 4 Hours/Week	Credits: 4
Total Teaching Hours: 56 Hours	Max. Marks: 100 (SA 80 + IA 20)

Course Objectives: This course will enable the students to

1. Understand the algebraic concepts of Matrices and elementary transformation of Matrices.
2. Analyze the Eigen values and Eigen vectors, Cayley-Hamilton theorem
3. Comprehend the fundamental concepts of successive differentiation and partial derivatives of two or more variables of Differential Calculus
4. Analyze the concepts of reduction formulae of Integral Calculus and its applications and the concepts of length, area, surface area and volume of solids of revolution.
5. Understand the concepts of analytical geometry in three dimension and equations of sphere, right circular cylinder and cone.

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

CO1: Recall basic concepts of algebra, formulae and rules of calculus

CO2: Describe the process of reduction formulae in Integration, interpretation of successive derivatives, properties of matrices.

CO3: Apply techniques of calculus in various physical and geometrical situations. Application of Matrices in fields like economics, statistics and other science subjects

CO4: Illustrate the applications of algebra, calculus and analytical geometry

CO5: Determine the method of solving problems on calculus and analytical geometry.

Unit-I: 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.

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. **14 Hours**

Unit-II: Differential Calculus-I

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 Hours**

Unit-III: Integral Calculus

Recapitulation of definite integrals and its properties.
Reduction formulae - $\int \sin^n x\,dx$, $\int \cos^n x\,dx$, $\int \tan^n x\,dx$, $\int \cot^n x\,dx$, $\int \sin^m x\ \cos^n x\,dx$, $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$, $\int_0^{\pi/2} \cos^n x\,dx$, $\int_0^{\pi/2} \sin^m x\ \cos^n x\,dx$ and 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 Hours**

Unit-IV: 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 Hours**

Practical	MATP 1.1: MATHEMATICS PRACTICAL- I
Teaching Hours: 4 Hours/Week	Credits: 2
Duration of Exam: 03 Hours	Maximum Marks: 50 (SA 40 + IA 10)

Course Learning Outcomes: This course will enable the students to

1. Learn Free and Open Source Software (FOSS) tools for computer programming mainly Python
2. Learn the program language and its algorithms.
3. Acquire knowledge of applications of python codes to solve problems of Algebra, Calculus and Analytical Geometry.

Practical/Lab Work to be performed in Computer Lab using Python

1. Introduction to Python

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

COURSE ARTICULATION MATRIX

MATT 1.1: MATHEMATICS -I												
Course Outcomes	**Program outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	2	2	-	1	-	1	1	-
CO2	2	1	-	1	2	1	-	1	-	-	-	-
CO3	2	1	1	1	1	1	1	2	-	1	-	-
CO4	2	2	1	1	-	-	-	-	-	-	1	-
CO5	2	2	-	2	1	-	-	-	-	-	1	-

MATP 1.1: MATHEMATICS PRACTICAL-I												
Course Outcomes	**Program outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	2	3	2	2	2	-	1	1	2
CO2	2	-	-	2	3	1	2	1	-	2	2	1
CO3	1	1	1	-	2	2	1	2	-	1	2	1

Pedagogy: Lectures by conventional method, problem solving, group discussions, use of ICT and conducting competitions like quiz, seminars etc. Visit to libraries of higher educational institutes.

Formative Assessment

Types of Course	Internal Assessment Type	
Theory	C1: Sessional tests	10 Marks
	C2: Attendance	5 Marks
	C2: Assignments/Seminars	5 Marks
	Total	**20 Marks**
Practical	C1: Sessional tests	5 **Marks**
	C2: Attendance	5 Marks
	Total	**10 Marks**

REFERENCES

1) *Matrices*, Shanthi Narayan & P K Mittal, 5th edition, New S Chand and Co. Pvt. Ltd., 2013.
2) *Theory of Matrices*, B S Vatssa, New Delhi: New Age International Publishers, 2005.
3) *Matrices*, A R Vashista, Krishna Prakashana mandir, 2003.
4) *Differential Calculus* - Shanti Narayan & P K Mittal, S. Chand & Company, New Delhi, 2014.
5) *Applications of Calculus*, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6) *Calculus* – Lipman Bers, Holt, Rinehart & Winston, 1969.
7) *Calculus* - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol. I & II, 1996.
8) *Schaum's Outline of Calculus* - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill., 2008.
9) *Integral Calculus* - Shanti Narayan & P K Mittal, S. Chand & Company, New Delhi, 2013.
10) *Analytical solid geometry* - Shanti Narayan & P K Mittal, S. Chand & Company, New Delhi, 2014.
11) *Higher Engineering Mathematics*- B.S. Grewal, Khanna Publishers, Delhi.
12) *Comprehensive solid geometry*- SP Mahajan & Ajay Aggarwal, 1st edition, Anmol Publications, 2000.
13) *Higher Engineering Mathematics*-B V Ramana, McGraw Hill Publications, Noida,2006
14) *Python: The complete Reference*, 4th Edition, Martin C Brown, Mc. Graw Hill, 2018.

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://www.geeksforgeeks.org/python-math-library-gamma-function/*

SEMESTER – II

MATT 2.1: MATHEMATICS II	
Teaching Hours : 4 Hours/Week	Credits: 4
Total Teaching Hours: 56 Hours	Max. Marks: 100 (SA 80 + IA 20)

Course Objectives: This course will enable the students to

1. Understand the algebraic concepts of Mathematical logic and Boolean algebra.
2. Analyze the polar co-ordinates and its dimensions to trace the standard curves.
3. Understand the concepts of limits, continuity and differentiability in depth and mean value theorems and its importance.
4. Analyze the concepts and methods to solve first order first degree and higher order ordinary differential equations.

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

CO1: Recall basic concepts of formulae and rules of calculus and partial derivatives

CO2: Concepts of Mathematical logic, mean value theorems of differential calculus.

CO3: Application of differential equations in various fields by mathematical modeling. Application of Mathematical logic in switching networks /circuits.

CO4: Illustrate the applications of differential calculus

CO5: Determine the method of solving problems on differential calculus and equations.

Unit-I: 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, Methods of proof: Direct proofs, indirect proofs, Contradiction method, contrapositive 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. **14 Hours**

Unit-II: Polar Co-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 Hours**

Unit-III: Differential Calculus-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 Hours**

Unit-IV: Ordinary Differential Equations-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 Hours**

Practical	MATP 2.1: MATHEMATICS PRACTICAL- II
Teaching Hours: 4 Hours/Week	Credits: 2
Duration of Exam: 03 Hours	Maximum Marks: 50 (SA 40 + IA 10)

Course Outcomes: This course will enable the students to

1. Learn Free and Open Source Software (FOSS) tools for computer programming mainly Python
2. Learn the programming language and its algorithms.
3. Acquire knowledge of applications of python codes to solve problems of Algebra, Calculus and Differential equations.

Practical/Lab Work to be performed in Computer Lab using Python

1. Construction of truth tables for compound propositions
2. Verifying whether given proposition is tautology or contradiction
3. Problems on Karnaugh map theorem for reducing logical circuits
4. Finding the angle between the radius vector and tangent
5. Finding the angle between two curves
6. Finding the radius of curvature of the given curve
7. Plotting of standard Cartesian, polar and parametric curves
8. Program to find limit and continuity of functions
9. Program to verify Rolle's, Lagrange's and Cauchy's mean value theorem
10. Program to find Maclaurin's expansion.
11. Program to find limits by L'Hospital's rule.
12. Solution of Linear differential equation.
13. Solution of Exact differential equation.
14. Solving non- linear differential equations for p, x and y
15. Finding the general and singular solutions of Clairaut's equation.

COURSE ARTICULATION MATRIX

MATT2.1: MATHEMATICS -II												
Course Outcomes	**Program outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	2	-	1	-	1	1	-
CO2	2	1	-	1	2	1	-	1	-	-	-	-
CO3	2	1	1	1	1	1	1	2	-	1	-	-
CO4	2	2	1	1	-	-	-	-	-	-	2	-
CO5	2	2	-	2	1	-	-	-	-	-	1	-

MATP 2.1: MATHEMATICS PRACTICAL-II												
Course Outcomes	**Program outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	2	3	2	2	2	-	2	1	2
CO2	2	-	-	2	3	1	2	1	-	2	2	1
CO3	1	1	1	-	2	2	1	2	-	1	2	1

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	C2: Attendance	5 Marks
	Total	**10 Marks**

REFERENCES

1. *Discrete Mathematics and its applications,* Kenneth H Rosen, Tata McGraw Hill Publications, 2017.
2. *The tools of Mathematical Reasoning,* Tamara J Lankins, American Mathematical Society, 2016.
3. *A beginner's Guide to Discrete Mathematics,* W D Wallis, Second Edition, Birkhauser, 2012.
4. *Differential Calculus* - Shanti Narayan, S. Chand & Company, New Delhi, 2005.
5. *Applications of Calculus*, Debasish Sengupta, Books and Allied (P) Ltd., 2019.
6. *Calculus* – Lipman Bers, Holt, Rinehart & Winston, 1969.
7. *Calculus* - S Narayanan & T. K. Manicavachogam Pillay, S. Viswanathan Pvt. Ltd.,vol. I & II, 1996.
8. *Schaum's Outline of Calculus* - Frank Ayres and Elliott Mendelson, 5th ed. USA:Mc. Graw Hill., 2008.
9. *Advanced differential equations,* M D Raisinghania, S. Chand & Company, New Delhi, 2013.
10. *Higher Engineering Mathematics*, B.S. Grewal, Khanna Publishers, Delhi.
11. *Differential equations with Applications and historical notes,* G F Simmons, 2nd ed: Mc Graw-Hill Publishing Company, Oct 1991.
12. *Differential equations*, S Narayanan & T K Manicavachogam Pillay, S V Publishers pvt. Ltd., 1981.
13. *Python: The complete Reference*, 4th Edition, Martin C Brown, Mc. Graw Hill, 2018.

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://www.geeksforgeeks.org/python-math-library-gamma-function/*