M. C. E. Society's
Abeda Inamdar Senior College
Of Arts, Science and Commerce, Camp, Pune-1
(Autonomous) Affiliated to SavitribaiPhule Pune University
NAAC accredited 'A' Grade

Three Year B.Sc. Degree Program in Mathematics
(Faculty of Science & Technology)

Syllabus of

S.Y. B.Sc Mathematics

Choice Based Credit System Syllabus
To be implemented from the academic year 2022-2023

Title of the Course: B. Sc (Mathematics)

Preamble:

Department of Mathematics, Abeda Inamdar Senior College is implementing the first syllabus of B.Sc. under autonomy in June 2021. Taking into consideration the rapid changes in Science and Technology and new approaches in different areas of Mathematics and related subjects, the Board of studies in Mathematics has prepared the syllabus of B.Sc Semester-III and Semester-IV (w.e.f. 2022-23) Mathematics course under the Choice Based Credit System (CBCS).

The model curriculum was developed by U.G.C. is used as a guideline for the present syllabus.

Aims:

Sr. No.	Aims
1.	Give the students a sufficient knowledge of fundamental principles, methods, and a clear perception of innumerous powers of mathematical ideas and tools and know-how to use them bymodeling, solving, and interpreting.
2.	Reflecting the broad nature of the subject and developing mathematical tools for continuingfurther study in various fields of science and technology.
3.	Enhancing student's overall development and equipping them with mathematical modelingabilities, problem solving skills, creative talent, and power of communication necessary for various kinds of employment.
4.	Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

Sr. No.	Objectives
1.	A student should be able to recall basic facts about mathematics and should be able to displayknowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies.
2.	A student should get a relational understanding of mathematical concepts and concernedstructures and should be able to follow the patterns involved, mathematical reasoning.
3.	A student should get adequate exposure to global and local concerns that explore manyaspects of Mathematical Sciences.
4.	A student should get adequate exposure to global and local concerns that explore manyaspects of Mathematical Sciences.
5.	A student should be able to apply their skills and knowledge that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae ortechniques to process the information, and draw the relevant conclusion.
6.	A student should be made aware of the history of mathematics and hence of its past, present,and future role as part of our culture.

Course Outcome:

Sr. No.	Outcome
1.	The mathematical maturity of students in their current and future courses shallDevelop.
2.	The student develops theoretical, applied, and computational skills.
3.	The student gains confidence in proving theorems and solving problems.

For Continuous Internal Evaluation (CIE), Evaluation will be done continuously. Internal assessment will be of **20** marks for a paper of 50 Marks. These 20 marks are divided as follows:
CIE for 2 Credits Theory Paper: It will be divided as follow:

Sr. No.	Components		Marks
1.	CIE I	There will be a compulsory Test on Demand MCQ Examination of **20** marks of each subject which would be converted into **5 Marks.**	5
2.	CIE II	Two Class Tests 10 Marks Each. Converted to 5 Marks.	5
3.	CIE III	Mid Sem Exam of 20 Marks converted to 05 Marks.	5
4.	CIE IV	Participation in two activities at department/ college level 05 Marks	5
		In case of students failing to score under category (d), the attendance can be considered to give marks	
		Total	20

CIE for 2 Credits Practical Paper: It will be divided as follow:

Sr. No.	Components		Marks
1	CIE I	There will be a compulsory Mock Practical Examination, Viva Voce of subjects mentioned in for **20 Marks**.	20

Methods of Internal Assessment

Written exam	Quiz
Presentations	Projects
Assignments	Tutorials
Oral examination	Open Book Test and Others

Structure of the F.Y.B.Sc Mathematics course:

	Semester-I		**Semester-II**		**Continuous Internal Evaluation (CIE) (Internal Marks)**	**End Semester Exam (External Marks)**	**Total Marks**	**Credits**
Paper-I	21SBMT111	Foundation of Mathematics	21SBMT121	Co-ordinate Geometry	20	30	50	2
Paper-II	21SBMT112	Calculus-I	21SBMT122	Calculus-II	20	30	50	2
Paper-III	21SBMT113	Operation Research and Software Maxima	21SBMT123	Abstract Algebra and Software Maxima	20	30	50	1.5

Structure of S. Y. B. Sc. Mathematics Courses:

	Semester-III		**Semester-IV**		**Credit**
Paper-I	21SBMT231	Calculus of Several Variables	21SBMT241	Linear Algebra	2
Paper-II	21SBMT232A	Laplace Transform	21SBMT242A	Vector Calculus	2
	21SBMT232B	Computational Geometry	21SBMT242B	Combinatorics	2
Paper-III	21SBMT233	Numerical Analysis and Software Maxima	21SBMT243	Ordinary Differential Equation and Software Maxima	2

- All three above courses are compulsory.
- In Semester-III, select any one from 21SBMT232A and 21SBMT232B.
- In Semester-IV, select any one from 21SBMT242A and 21SBMT242B.

Structure of T. Y. B. Sc. Mathematics Courses:

Semester-V		**Semester-VI**		**Credit**
21SBMT351	Metric Spaces	21SBMT361	Complex Analysis	2
21SBMT352	Real Analysis-I	21SBMT362	Real Analysis-II	2
21SBMT353	Problem Course on 21SBMT351and 21SBMT352	21SBMT363	Problem Course on 21SBMT361and 21SBMT362	2
21SBMT354	Group Theory	21SBMT364	Ring Theory	2
21SBMT355	Partial Differential Equations	21SBMT365	Number Theory	2
21SBMT356	Problem Course on 21SBMT354 and 21SBMT355	21SBMT366	Problem Course on 21SBMT364 and 21SBMT365	2
Select Any Two Out Of Six Courses				
21SBMT357A	Operations Research	21SBMT367A	Optimization Technique	2
21SBMT357B	C- Programming	21SBMT367B	C-Programming	2
21SBMT357C	Python Course - I	21SBMT367C	Python Course - II	2
21SBMT357D	Machine Learning Course - I	21SBMT367D	Machine Learning Course - II	2
21SBMT357E	Lattice Theory	21SBMT367E	Differential Geometry	2
21SBMT357F	Graph theory	21SBMT367F	Lebesgue Integration	2

21SBMT358	Practical based on papers selected from 21SBMT357Ato 21SBMT357F	21SBMT368	Practical based on papers selected from 21SBMT367A to 21SBMT367F	2
Skill Enhancement course				
21SBMT359	Skill Enhancement course in mathematics	21SBMT369	Skill Enhancement course in mathematics	2
21SBMT3510	Skill Enhancement course in mathematics	21SBMT3610	Skill Enhancement course in mathematics	2

All three above courses are compulsory.

Details of Syllabus:

Semester-III

Course/ Paper Title	Calculus of Several Variables
Course Code	21SBMT231
Semester	III
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Limits and Continuity**	**06**
	1.1 Functions of Several Variables :- Functions of two variables, Domain and Range, Graphs, Level Curves, Functions of Three or More Variables	03
	1.2 Limits and Continuity.	03
Unit II	**Partial Derivatives and Differentiability**	**10**
	2.1 Definition and examples.	02
	2.2 Higher Derivatives, Clairaut's Theorem (Statement Only), Partial Differential Equations, Wave equation.	02
	2.3 Differentiable function, Differentials	03
	2.4 Chain Rule, Homogeneous Functions, Euler's theorem	03
Unit III	**Extreme Values**	**08**
	3.1 Extreme values of functions of two variables.	02
	3.2 Necessary conditions for extreme values.	02
	3.3 Second Derivative Test (without proof).	02
	3.4 Lagrange Multipliers (with one constraints)	02
Unit IV	**Multiple Integrals**	**12**
	4.1 Iterated Integrals, Fubini's Theorem (Statement only)	02
	4.2 Double integral over general regions, Change of order of	02

	Integration for two variables.	
	4.3 Double integral in Polar coordinates.	02
	4.4 Triple integrals, Evaluation of triple integrals. Triple integrals in spherical coordinates	03
	4.5 Jacobians, Change of variables in multiple integrals. (Results without proofs)	03

Text book: Multivariable Calculus 7th Edition by James Stewart, Brooks/Cole, Cengage Learning, 2012, 2008.

Unit 1:- Chapter 14: Sec- 14.1, 14.2

Unit 2:- Chapter 14: Sec- 14.3(except the Cobb-Douglas production function), 4.4 (except Tangent Planes and Linear Approximations), Sec-14.5

Unit 3:- Chapter 14: Sec 14.7, 14.8 (except two constraints)

Unit 4:- Chapter 15: Sec 15.2, 15.3, 15.4, 15.7 (without Riemann sum and Application), 15.9, 15.10

Reference Books:

1. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba, A. Weinstein, Springer Verlag (Indian Edition).
2. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S. Chand and Company.
3. D.V. Widder, Advanced Calculus (2nd Edition), Prentice Hall of India, New Delhi(1944).
4. T.M. Apostol, Calculus Vol. II (2nd Edition), John Wiley, New York, (1967).

Website:

1. https://www.youtube.com/watch?v=0ph5PU3Fsdc&list=PLFW6lRTa1g8174RC1q88PCU7VszfJWfg9
2. https://www.youtube.com/watch?v=XzaeYnZdK5o&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy

Course/ Paper Title	Laplace Transform
Course Code	21SBMT232A
Semester	III
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**The Laplace Transform**	**18**
	1.1 Definition, Laplace Transform of some elementary functions.	03
	1.2 Some important properties of Laplace Transform.	03
	1.3 Laplace Transform of derivatives, Laplace Transform of Integrals.	04
	1.4 Methods of finding Laplace Transform, Evaluation of Integrals.	04
	1.5 The Gamma function, Unit step function and Dirac delta function.	04
Unit II	**The Inverse Laplace Transform**	**18**
	2.1 Definition, some inverse Laplace Transform.	04
	2.2 Some important properties of Inverse Laplace Transform.	04
	2.3 Inverse Laplace Transform of derivative, Inverse Laplace Transform of integrals.	05
	2.4 Convolution Theorem, Evaluation of Integrals.	05

Textbooks: 1.Schaum's Outline of Theory and Problems of Laplace Transform by Murray R. Spiegel.

Unit I: Chapter 1

Unit II: Chapter 2

Reference Books:

1. Joel L. Schiff: The Laplace Transforms - Theory and Applications, SpringerVerlag New York 1999.
2. Dyke: An Introduction to Laplace Transforms and Fourier Series, Springer International Edition, Indian Reprint 2005.

Website:

1.https://www.youtube.com/watch?v=EDVJotmT584&list=PLU6SqdYcYsfILCRFpIM3fQdVIzOo71snJ

2. https://www.youtube.com/watch?v=7Rg7WpCZr-g

Course/ Paper Title	Computational Geometry
Course Code	21SBMT232B
Semester	III
No. of Credits	02

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Two Dimensional Transformations**	**12**
	1.1 Introduction; Representation of points.	01
	1.2 Transformations and matrices; Transformation of points, Straight lines.	01
	1.3 Midpoint Transformation; Transformation of – parallel lines, Intersecting lines.	01
	1.4 Transformation: rotations; Reflections, scaling.	01
	1.5 Combined transformations.	01
	1.6 Transformation of a unit square.	01
	1.7 Solid body transformations.	01
	1.8 Translations and homogeneous coordinates.	01
	1.9 Rotation about an arbitrary point, Reflection through an arbitrary line.	01
	1.10 Projection – A Geometric Interpretation of Homogeneous Coordinates.	01
	1.11 Overall Scaling.	01

	1.12 Points at Infinity	01
Unit II	**Three Dimensional Transformations**	**08**
	2.1 Introduction. 2.2 Three dimensional – Scaling, shearing, rotation, reflection, translation. 2.3 Multiple transformations. 2.4 Rotation about – an axis parallel to coordinate axes, an arbitrary axis in space. 2.5 Reflection through an arbitrary plane.	01 01 02 02 02
Unit III	**Projection**	**08**
	3.1 Orthographic projections. 3.2 Axonometric projections. 3.3 Oblique projections. 3.4 Perspective Transformations.	02 02 02 02
Unit IV	**Plane and Space Curves**	**08**
	4.1 Introduction. 4.2 Curve representation. 4.3 Parametric curves. 4.4 Parametric representation of a circle. 4.5 Bezier Curves – Introduction, definition, properties (without proof), Curve fitting (up to n = 3), equation of the curve in matrix form (up to n = 3).	01 01 02 02 02

Textbook:

1. D. F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, Tata McGraw Hill, Second Edition.

Unit I: Chapter 2: Sec. 2.1 to 2.20,

Unit II: Chapter 3: Sec. 3.1 to 3.10.

Unit III: Chapter 3: Sec. 3.12 to 3.15.

Unit IV: Chapter 4: Sec. 4.1, 4.2, 4.4, 4.5. Chapter 5: Sec. 5.1, 5.8.

Reference Books:

1. Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition).
2. Schaum Series, Computer Graphics by Zhigang Xiang and Roy A. Plastock.

Website:

1. https://www.youtube.com/watch?v=3Uxw7F75_-8&list=PLE1010BEDB031C039
2. https://www.youtube.com/watch?v=_vfCXMSLMAU&list=PLNPbxFpuCy0-6GIUmiHCvj0H0hNxstOie

Course/ Paper Title	Numerical Analysis and Software Maxima
Course Code	21SBMT233
Semester	III
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Practicals
Unit I	**Solution of Algebraic and Transcendental Equations**	**02**
	1.1 Errors and their computations 1.2 Bisection method. 1.3 The method of False position 1.4 Newton- Raphson method	
Unit II	**Interpolation**	**03**
	2.1 Finite Difference Operators and their relations (Forward, Backward difference and Shift operator). 2.2 Differences of a polynomial 2.3 Newton's Interpolation Formulae (Forward and Backward) 2.4 Lagrange's Interpolation Formula.	
Unit III	**Numerical Differentiation and Integration**	**03**
	3.1 Numerical Differentiation (Derivatives using Newton's forward difference formula) 3.2 Numerical Integration, General quadrature formula. 3.3 Trapezoidal rule. 3.4 Simpsons's 1/3rd rule. 3.5 Simpsons's 3/8th rule.	
Unit IV	**Practical based on Maxima software**	**04**

Text book: 1. S.S. Sastry, Introductory Methods of Numerical Analysis, 5th edition, Prentice Hall of India.

Unit I: Chapter 1: section 1.3, Chapter 2: section 2.2, 2.3, 2.5

Unit II: Chapter 3: section 3.3, 3.5, 3.6, 3.9(3.9.1 only)

Unit III: Chapter 4: section 6.2 (excluding 6.2.1 to 6.2.3), 6.4

Reference Books:

1. C.F. Gerald and O.P. Wheatley, Applied Numerical Analysis, Addison Wesley; 7th edition (2003).

2. K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.

3. T. Sauer, Numerical analysis, 3rd edition, Pearson.

4. M. K. Jain, SRK Iyengar and R.K. Jain, Numerical Methods For Scientific & Engg 5e, New Age International (P) Ltd (2008).

Website:

1. https://www.youtube.com/watch?v=zT83sJ5IrEE&list=PLyqSpQzTE6M-QT7PvEBHV0iNMvZk9mocO

Semester-IV

Course/ Paper Title	Linear Algebra
Course Code	21SBMT241
Semester	IV
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Linear Equations**	**12**
	1.1 Fields	02
	1.2 System of Linear Equations	02
	1.3 Matrices and Elementary Row Operations	02
	1.4 Row- Reduced Echelon Matrices	02
	1.5 Matrix Multiplication	02
	1.6 Invertible Matrices	02
Unit II	**Vector Spaces**	**12**
	2.1 Vector Spaces	02
	2.2 Subspaces	02
	2.3 Bases and Dimension	02
	2.4 Coordinates	02
	2.5 Summary of Row –Equivalence	02
	2.6 Computation of Concerning Subspaces	02
Unit III	**Linear Transformations**	**12**
	3.1 Linear Transformation	03
	3.2 The Algebra of Linear Transformation	03
	3.3 Isomorphism	03
	3.4 Representation of Transformation by Matrices	03

Text Book:

K. Hoffman and R. Kunze, Linear Algebra, 2nd edition(2014), Prentice Hall of India, New Delhi

Unit I: Chapter-1: Sec. 1.1 to 1.6.

Unit II: Chapter-2: Sec. 2.1 to 2.6

Unit III: Chapter-3: Sec. 3.1 to 3.4

Reference Books:

1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Application Version, Ninth Edition, Wiley, 11th edition.
2. Steven J. Leon, Linear Algebra with Applications, 4th edition(1994), Prentice Hall of India. New Delhi
3. Vivek Sahai, Vikas Bist, Linear Algebra, 4th Reprint 2017, Narosa Publishing House, New Delhi
4. Promode Kumar Saikia, Linear Algebra, 2009, Pearson, Delhi
5. S. Lang, Introduction to Linear Algebra, 2nd edition,1986, Springer-Verlag, New York, Inc.

Website:

1.https://www.youtube.com/watch?v=LJLoJhbBA4&list=PLbMVogVj5nJQ2vsW_hmyvVfO4GYWaaPp7

2. https://www.youtube.com/watch?v=JnTa9XtvmfI

Course/ Paper Title	Vector Calculus
Course Code	21SBMT242A
Semester	IV
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**Vector-Valued Functions**	**08**
	1.1 Curves in Space, Limits and Continuity, Derivatives and Motion, Differentiation Rules for Vector Function, Vector Functions of Constant Length.	02
	1.2 Integrals of Vector Functions.	02
	1.3 Arc Length along a Space Curve, Speed on a Smooth Curve,	02

	Unit Tangent Vector. 1.4 Curvature of a Plane Curve, Circle of Curvature for Plane Curves, Curvature and Normal Vectors for a Space Curve.	02
Unit II	**Integrals**	**12**
	2.1 Line Integral of Scalar Functions, Additivity, Line integral in the Plane. 2.2 Vector Fields, Gradient Fields, Line Integral of Vector Fields, Line Integrals with respect to dx, dy, dz . 2.3 Work done by a Force over a Curve in Space, Flow Integrals and Circulation for Velocity Fields, Flow across the Simple Closed Plane Curve. 2.4 Path Independence, Conservative and Potential Functions. 2.5 Divergence, Two forms for Green's Theorem, Green's Theorem in the Plane (Proof for special regions)	02 02 02 03 03
Unit III	**Surface Integrals**	**08**
	3.1 Parameterizations of Surfaces, Implicit surfaces. 3.2 Surface integrals, Orientation of Surfaces. 3.3 Surface Integrals of Vector Fields.	02 03 03
Unit IV	**Applications of Integrals**	**08**
	4.1 The Curl Vector Field, Stokes' Theorem (without proof), Conservative Fields and Stokes' Theorem. 4.2 Divergence in three Dimensions, Divergence Theorem (without proof). 4.3 Unifying the Integral Theorems.	02 03 03

Text Book: Thomas' Calculus (14th Edition) by Hass, Heil, Weir, Pearson Indian Education Services Pvt. Ltd.

Unit I: Chapter 13: Sec- 13.1, 13.2, 13.3, 13.4

Unit II: Chapter 16: Sec-16.1, 16.2, 16.3, 16.4

Unit III: Chapter 16: Sec- 16.5, 16.6

Unit IV: Chapter 16: Sec- 16.7, 16.8

Reference books:

1. Basic Multivariable Calculus by J.E.Mardson, A.J.Tromba, A. Weinstein, Sppriger Verlag (Indian

Edition)

2. Advanced Calculus by M.R. Spiegel, Schaum Series.

3. Advanced Calculus (IInd Edition) byD.V. Widder, Prentice Hall of India, New Delhi(1944).

4. Advanced Calculus by John M. H. Olmsted, Eurasia Publishing House, New Delhi(1970)

5. Calculus Vol. II (IInd Edition) by T.M. Apostol, John Wiley, New York (1967).

Website:

1. https://www.youtube.com/watch?v=ma1QmE1SH3I

2.https://www.youtube.com/watch?v=ma1QmE1SH3I&list=RDCMUC640y4UvDAlya_WOj5U4pfA&start_radio=1&rv=ma1QmE1SH3I&t=

Course/ Paper Title	Combinatorics
Course Code	21SBMT242B
Semester	IV
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Lectures
Unit I	**General Counting Methods For Arrangements And Selections**	20
	1. Two basic Counting Principles: Addition Principle and Multiplication Principle. 2. Simple Arrangements and Selections. 3. Arrangements and Selections with repetition. 4. Distributions. 5. Binomial Identities: Binomial identities and Multinomial theorem.	04 04 04 04 04
Unit II	**Inclusion- Exclusion**	10
	1. Inclusion-Exclusion Principle. 2. Counting with Venn diagrams. 3. Inclusion Exclusion formula.	03 03 04
Unit III	**Pigeonhole Principle**	06

Textbooks: 1. Alan Tucker, Applied Combinatorics, Wiley, 1995

Unit I: Chapter 5: Sec.5.1 to 5.5

Unit II: Chapter 8: Sec.8.1, Sec. 8.2

Unit III: Appendix: A4

Reference Books:

1. Richard A. Brualdi, Introductory Combinatorics, Elsevier, North-Holland, New York, 1977.

2. V. K. Balakrishnan, Combinatorics, Schuam Series, 1995.

Website:

1. https://www.youtube.com/watch?v=FfO9ZaKRyDA

2. https://www.youtube.com/watch?v=FfO9ZaKR

Course/ Paper Title	Ordinary Differential Equation and Software Maxima
Course Code	21SBMT243
Semester	IV
No. of Credits	2

Syllabus

Unit No	Title with Contents	No. of Practicals
Unit I	**Review of First Order Linear Differential Equation**	**02**
	1. Separable equations. 2. First-order linear equations. 3. Exact equations. 4. Homogeneous equations, Integrating factors.	
Unit II	**What is a differential equation**	**01**
	1. Orthogonal trajectories and families of curves 2. Reduction of order: (1) dependent variable missing, (2) Independent variable missing.	

Unit III	**Second-Order Linear Equations:**	**03**
	1. Second-order linear equations with constant coefficients. 2. The method of undetermined coefficients. 3. The method of variation of parameters. 4. The use of a known solution to find another.	
Unit IV	**Power Series Solutions and Special Functions:**	**02**
	1. Introduction and review of power series 2. Series solutions of first-order differential equations 3. Second-order linear equations	
Unit V	**Practical based on Maxima Software**	**04**

Textbook:

1. Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGraw-Hill.

Unit I: Chapter 1: Sec.1.3 to 1.5, 1.7, 1.8.

Unit II: Chapter 1: Sec.1.6, 1.9.

Unit III: Chapter 2: Sec. 2.1 to 2.4.

Unit IV: Chapter4: Sec. 4.1 to 4.3.

Reference Books:

1. W.R. Derrick and S.I. Grossman, A First Course in Differential Equations with Applications. CBS Publishers and distributors, Delhi-110 032. Third Edition.
2. Rainville, Bedient: Differential Equations.

Website:

1.https://www.youtube.com/watch?v=NBcGLLU90fM&list=PLbMVogVj5nJSGlf9sluucwobyr_zz6glD

2.https://www.youtube.com/watch?v=Kk5SEzASkZU&list=PL9m2Lkh6odgKbfY03TFRhwjOqW79UdzK8