Maharashtra Education Society's

Abasaheb Garware College

(Autonomous)

(Affiliated to Savitribai Phule Pune University)

Three-year B. Sc. Degree Program in Mathematics

(Faculty of Science and Technology)

Syllabi under Autonomy

S. Y. B. Sc. (Mathematics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2023-2024

Title of the Course: B. Sc. (Mathematics)

Preamble:

Taking into consideration the rapid changes in science and technology and new approaches in different areas of Mathematics and related subjects board of studies in Mathematics with concern of teachers of Mathematics and industry has prepared the syllabus of S.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Program Outcomes:

1. To give knowledge of fundamental principles, methods, Mathematical ideas and tools.
2. Reflecting the broad nature of the subject and developing Mathematical tools for continuing further study in various fields of science and technology.
3. Enhancing students' overall development and to equip them with Mathematical abilities and problem-solving skills.
4. Enabling students to develop a positive attitude towards Mathematics as an interesting and valuable subject of study.

Eligibility:

F. Y. B. Sc. as per SPPU rules.

Structure of the course: B. Sc. Mathematics

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures/Practical to be conducted
1	I	Core	USMT-111	Algebra - I	Theory	2	36
		Core	USMT-112	Calculus - I	Theory	2	36
		Core	USMTP-113	Mathematics Practical	Practical	1.5	10
	II	Core	USMT-121	Algebra - II	Theory	2	36
		Core	USMT-122	Calculus - II	Theory	2	36
		Core	USMTP-123	Mathematics Practical	Practical	1.5	10
2	III	Core	USMT-231	Several Variable Calculus	Theory	2	36
		Elective	USMTELE-232A OR	Numerical Methods	Theory	2	36
			USMTELE -232B	Integral Transforms	Theory	2	36
		Core	USMTP-233A	Mathematics Practical	Practical	2	12
			USMTP-233B	Mathematics Practical	Practical	2	12
		Students opting USMTELE-232A have to select USMTP 233A Students opting USMTELE-232B have to select USMTP 233B					
		Core	USLG-231	Language	Theory	2	36
		Core	USEVS-231	Environmental Awareness	Theory	2	36
	IV	Core	USMT-241	Linear Algebra	Theory	2	36
		Elective	USMTELE-242A OR	Vector Calculus	Theory	2	36
			USMTELE -242B	Dynamical Systems	Theory	2	36
		Core	USMTP -243A	Mathematics Practical	Practical	2	12
			USMTP -243B	Mathematics Practical	Practical	2	12
		Students opting USMTELE-242A have to select USMTP 243A Students opting USMTELE-242B have to select USMTP 243B					
		Core	USLG-241	Language	Theory	2	36
		Core	USEVS-241	Environmental	Theory	2	36

				Awareness			

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures/Practical to be conducted
3	V	Core	USMT-351	Metric Spaces	Theory	2	36
			USMT-352	Real Analysis-I	Theory	2	36
			USMT-353	Group Theory	Theory	2	36
			USMT-354	Ordinary Differential Equations	Theory	2	36
		Elective	USMTELE-355A OR	Operations Research	Choose any one	2	36
			USMTELE-355B	Graph Theory		2	36
			USMTELE-356A OR	C- Programming	Choose any one	2	36
			USMTELE-356B	Number Theory		2	36
		Core	USMTP-357	Practical based on USMT-351 and USMT-352	Practical	2	12
			USMTP-358	Practical based on USMT-353 and USMT-354	Practical	2	12
			USMTP-359	Practical based on papers selected from USMT-355 and USMT-356	Practical	2	12
		SEC	USMTSEC-3510	Statistical Techniques using R software	SEC	2	36
			USMTSEC-3511	Computational Geometry	SEC	2	36
	VI	Core	USMT-361	Complex Analysis	Theory	2	36
			USMT-362	Real Analysis-II	Theory	2	36
			USMT-363	Ring Theory	Theory	2	36
			USMT-364	Partial Differential Equations	Theory	2	36
		Elective	USMTELE-365A OR	Optimization Techniques	Choose any one	2	36
			USMTELE-365B	Combinatorics		2	36
			USMTELE-366A OR	Python	Choose any one	2	36
			USMTELE-366B	Coding Theory		2	36
		Core	USMTP-367	Practical based on USMT-361 and USMT-362	Practical	2	12
			USMTP-368	Practical based on USMT-363 and USMT-364	Practical	2	12
			USMTP-369	Practical based on USMT-365 and USMT-366	Practical	2	12
		SEC	USMTSEC-3610	LaTeX	SEC	2	36
			USMTSEC-3611	Financial Mathematics	SEC	2	36

SEMESTER-III

Course Code and Title: USMT-231: Several Variable Calculus

Lectures: 36 (Credits-2)

Course Outcomes:

1. Students are able to find the partial derivatives and understand their geometry.
2. Students are able to understand the general concept of differentiability of functions of more than two variables and its applications.
3. Learn to find area and volume using multiple integrals.

Unit 1: Partial Derivatives I **[14 Lectures]**

1.1 Functions of Several Variables
1.2 Limits and Continuity in Higher Dimensions
1.3 Partial Derivatives
1.4 The Chain Rule

Unit 2: Partial Derivatives II **[10 Lectures]**

2.1 Directional Derivatives and Gradient Vectors
2.2 Tangent Planes and Differentials
2.3 Extreme Values and Saddle Points

Unit 3: Multiple Integrals **[12 Lectures]**

3.1 Double and Iterated Integrals over Rectangles
3.2 Area by Double Integration
3.3 Double Integrals in Polar Form
3.4 Triple Integrals in Rectangular Coordinates
3.5 Triple Integrals in Cylindrical and Spherical Coordinates
3.6 Substitutions in Multiple Integrals

Recommended Book: Thomas' Calculus, 14th Edition, G. B. Thomas.
Section: 14.1 to 14.7, 15.1, 15.3, 15.4, 15.5, 15.7, 15.8

Reference Books:

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

Course Code and Title: USMTELE-232A: Numerical Methods

Course Outcomes:

1. To understand common numerical methods to obtain approximate solutions of mathematical problems.
2. To develop skills in analysing the methods of interpolating a given data.
3. To derive numerical methods for various mathematical operations such as integration and solving differential equations.

Unit 1: Solution of Algebraic and Transcendental Equations [08 lectures]

1.1 Errors and their computations
1.2 The method of False position
1.3 Newton- Raphson method

Unit 2: Interpolation [12 Lectures]

2.1 Finite Difference Operators and their relations
2.2 Differences of a polynomial
2.3 Newton's Interpolation Formulae (Forward and Backward)
2.4 Lagrange's Interpolation Formula

Unit 3: Least Squares Curve Fitting Procedures [05 Lectures]

3.1 Fitting a Straight Line
3.2 Nonlinear curve fitting: Power function $y = ax^c$, polynomials of degree 2 and 3, Exponential function $y = cx^d$

Unit 4: **Numerical Integration [05 Lectures]**

4.1 Numerical Integration, General quadrature formula
4.2 Trapezoidal rule
4.3 Simpson's 1/3rd rule
4.4 Simpson's 3/8th rule

Unit 5: Numerical solution of first order ordinary differential equations [06 Lectures]

5.1 Taylor's Series method
5.2 Euler's method
5.3 Modified Euler's methods
5.4 Runge - Kutta Methods

Recommended Books:

S.S. Sastry, Introductory Methods of Numerical Analysis, 5th edition, Prentice Hall of India.
Unit 1: Chapter 1: section 1.3, Chapter 2: section 2.3, 2.5
Unit 2: Chapter 3: section 3.3, 3.5, 3.6, 3.9(3.9.1 only)
Unit 3: Chapter 4: section 4.2.1, 4.2.2, 4.2.3, 4.2.4 (Straight line, Power function $y = ax^c$, polynomials of degree 2 and 3, Exponential function $y = cx^d$ only)

Unit 4: Chapter 6: 6.4
Unit 5: Chapter 8: section 8.2, 8.4 (excluding 8.4.1)

Reference books:

1. K.E. Atkinson: An Introduction to Numerical Analysis, Wiley Publications.
2. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Prentice Hall 2007.
3. Steven C Chapra – Applied Numerical Methods with Matlab for Engineers and Scientiest.

Course Code and Title: USMTELE-232B: Integral Transforms

Lectures: 36 (Credits- 2)

Course Outcomes:

1. Students will be able to find Laplace Transform and learn some related properties.
2. Students will be able to find Inverse Laplace Transform and learn some related properties.
3. To understand the applications of Laplace Transform.
4. Students are able to learn Fourier Series.

Unit 1: The Laplace Transform [15 Lectures]

1.1 Definition, Laplace Transform of some elementary functions.
1.2 Some important properties of Laplace Transform.
1.3 Laplace Transform of derivatives, Laplace Transform of Integrals.
1.4 Methods of finding Laplace Transform, Evaluation of Integrals.
1.5 The Gamma function, Unit step function and Dirac delta function.

Unit 2: The Inverse Laplace Transform [10 Lectures]

2.1 Definition, Some inverse Laplace Transform.
2.2 Some important properties of Inverse Laplace Transform.
2.3 Inverse Laplace Transform of derivative, Inverse Laplace Transform of integrals.
2.4 Convolution Theorem, Evaluation of Integrals.

Unit 3: Applications of Laplace Transform [05 Lectures]

3.1 Solution of Ordinary Differential Equations with constant coefficients.

Unit 4: Fourier Series [06 Lectures]

4.1 Definition and examples of Fourier Series.

Recommended Book:

1. Schaum's Outline Series - Theory and Problems of Laplace Transform by Murray R. Spiegel
Unit I: Chapter 1, Unit II: Chapter 2, Unit III: Chapter 3, Unit IV: Chapter 6

Reference Books:

1. Joel L. Schiff: The Laplace Transforms - Theory and Applications, Springer-Verlag New York 1999.
2. Dyke: An Introduction to Laplace Transforms and Fourier Series, Springer International Edition, Indian Reprint 2005.
3. Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970).

Course Code and Title: USMTP-233A and USMTP-233B: Mathematics Practical

(Credits-2)

USMTP-233A is a practical based on USMT-231 and USMTELE-232A

USMTP-233B is a practical based on USMT-231 and USMTELE-232B

Practical 1 to 6 based on problems from USMT-231 and Practical 7 to 12 based on problems from USMTELE-232A or USMTELE-232B

Note:
1. Practical on Mathematical software can be performed on computer.

SEMESTER-IV

Course Code and Title: USMT-241: Linear Algebra

Course Outcomes:

1. To learn vector spaces.
2. To learn spaces associated to a matrix.
3. To learn geometry of Euclidean spaces.
4. To learn linear maps and their matrix representation.

Lectures: 36 (Credits- 2)

Unit 1: Vector spaces **[14 Lectures]**

1.1 Definitions and examples
1.2 Vector subspaces
1.3 Basis and dimension of a vector space

Unit 2: Linear transformations **[12 Lectures]**

2.1 Linear transformation
2.2 Representation of linear map by matrices
2.3 Kernel and image of linear transformation
2.4 Linear isomorphism

Unit 3: Inner product spaces **[10 Lectures]**

3.1 Inner product spaces
3.2 Orthogonality

Recommended Book:

Kumaresan, Linear algebra-A geometric approach, Prentice Hall of India.
Chapter 1, Chapter 4(4.1 to 4.4), Chapter 5(5.1, 5.2).

Reference Books:

1) Janich, Linear algebra, Springer Publication
2) Hoffman and Kunze, Linear Algebra, Prentice Hall of India

Course Code and Title: USMTELE-242A: Vector Calculus

Lectures: 36 (Credits- 2)

Course Outcomes:

1. To continue the study of Calculus carried out in the third semester of S. Y. B. Sc. with generalization for vector valued functions.
2. To reflect the broad nature of subject and develop mathematical tools for continuation of further studies in various fields of Science.
3. Student learns limit, continuity, differentiability and integration of vector function.
4. To learn various applications of calculus, surface and volume integral.

Unit 1: **Vector-Valued Functions** **[08 lectures]**

1.1 Curves in Space and Their Tangents
1.2 Integrals of Vector Functions
1.3 Arc Length in Space

Unit 2: **Integrals** **[12 Lectures]**

2.1 Line Integrals of Scalar Functions
2.2 Vector Fields and Line Integrals: Work, Circulation, and Flux
2.3 Path Independence, Conservative Fields, and Potential Functions
2.4 Green's Theorem in the Plane

Unit 3: **Surface Integrals** **[16 Lectures]**

3.1 Surface Integrals
3.2 Stokes' Theorem
3.3 The Gauss Divergence Theorem

Recommended Books:

Thomas' Calculus (14thEdition) by Hass, Heil, Weir, Pearson Indian Education Services Pvt. Ltd. Chapter 13: Sec- 13.1 to13.3 Chapter 16: Sec-16.1 to 16.4, 16.6 to 16.8

Reference books:

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

2. Basic Multivariable Calculus by J. E. Marsden, A. J. Tromba, A. Weinstein, Springer Verlag (Indian Edition)
3. Advanced Calculus (IInd Edition) by D.V. Widder, Prentice Hall of India, New Delhi (1944).

Course Code and Title: USMTELE-242B: Dynamical Systems

Lectures: 36 (Credits- 2)

Course Outcomes:

1. Students are able to understand simple models of real life examples.
2. Students are able to plot phase portrait of one and two dimensional differential systems.
3. Students are able to find solutions of linear differential systems and able to classify equilibrium points.

Unit 1: Introduction [14 Lectures]

1.1 Modelling
1.2 What Are Differential Equations?
1.3 One-Dimensional Dynamics
1.4 Examples:
Population Dynamics, Mechanical Systems
Oscillating Circuits, Fluid Mixing
1.5 Two-Dimensional Dynamics, Null clines, Phase Curves
1.6 The Lorenz Model
1.7 Quadratic ODEs: The Simplest Chaotic Systems

Unit 2: Linear System [22 Lectures]

2.1 Matrix ODEs, Eigen values and Eigenvector
Diagonalization
2.2 Two Dimensional Linear System
2.3 Exponential of Operators
2.4 Fundamental Solution Theorem
2.5 Complex Eigen values
2.6 Multiple Eigen values, Semi simple-Nilpotent Decomposition,
The Exponential, Alternatives Method
2.7 Linear Stability
2.8 Nonautonomous Linear System and Floquet Theory

Recommended Book:

James D. Meiss, Differential Dynamical Systems, Society for Industrial and Applied Mathematics Philadelphia Publication. Chapters: 1, 2.

Reference Books:

1) Morris W. Hirsh, Stephen Smale, Robert L. Devaney, Differential Equations, Dynamical Systems, and an Introduction to Chaos, Academic Press.
2) Lawrence Perko, Differential Equations and Dynamical Systems, Springer Publication.

Course Code and Title: USMTP-243A and USMTP-243B: Mathematics Practical

(Credits-2)

USMTP-243A is a practical based on USMT-241 and USMTELE-242A

USMTP-243B is a practical based on USMT-241 and USMTELE-242B

Practical 1 to 6 based on problems from USMT-241 and Practical 7 to 12 based on problems from USMTELE-242A or USMTELE-242B.

Note:

1. Practical on Mathematical software can be performed on computer.