Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.A. Degree Program in Mathematics

(Faculty of Science & Technology)

F.Y.B.A. (Mathematics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

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

Preamble:

SavitribaiPhule Pune University has decided to change the syllabi of various faculties from June,2019. 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 from different colleges affiliated to SavitribaiPhule Pune University has prepared the syllabus of F. Y. B. A. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

(i) Give the students a sufficient knowledge of fundamental principles,methods and a clearperception of innumerous power of mathematical ideas and tools and know how to usethem by modeling ,solving and interpreting.
(ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science and technology.
(iii) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .
(iv) Enabling students to develop a positive attitude towards mathematics as an interestingand valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays , state important facts resulting from their studies.
(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
(iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
(iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Course Outcome:

Sr. No	Course Outcomes
1	On completion of this course, students should be able to understand basic functions and the fundamentals of calculus required in financial mathematics
2	To understand the concepts of basic and linear algebra and applications of mathematical methods to the problem of economics.
3	To graph and differentiate the simple functions
4	To be able calculate basic quantities in financial mathematics and to apply these concepts in financial markets and real-life situations

Structure of the course:

	Semester - I		Semester -II	
Paper I	**MG-1**	**Algebra**	**MG-2**	**Analytical Geometry**
Paper II	**AMG-1**	**Calculus - I**	**AMG-2**	**Calculus - II**
Paper III	**FMG-1**	**Financial Mathematics-1**	**FMG-2**	**Financial Mathematics-2**

All three above courses are compulsory.

Equivalence of Previous syllabus along with new syllabus:

	Old course	New Course
Paper I	**MG-1 : Algebra and Geometry**	**MG-1: Algebra and MG-2 : Analytical Geometry**
Paper II	**AMG-1 : Calculus and Differential Equations**	**AMG-1: Calculus - I and AMG-2 : Calculus – II**
Paper III	**FMG- 1 : IndustrialMathematics**	**FMG-1:FinancialMathematics-1 and FMG-2: Financial Mathematics-2**

Qualifications for Teacher: M.Sc. Mathematics (with NET /SET as per existing rules).

Proposed Structure of F. Y. B. A. Mathematics Courses:

	Semester - I		Semester -II	
Paper I	**MG - 1**	**Algebra**	**MG - 2**	**Analytical Geometry**
Paper II	**AMG - 1**	**Calculus - I**	**AMG - 2**	**Calculus - II**
Paper III	**FMG - 1**	**Financial Mathematics-1**	**FMG - 2**	**Financial Mathematics-2**

Proposed Structure of S. Y. B. A. Mathematics Courses:

	Semester - III		Semester -IV	
Paper I	**MG - 3**	**Laplace Transform and Fourier Series**	**MG -4**	**Linear Algebra**
Paper II	**AMG -3**	**Calculus of Several Variables**	**AMG - 4**	**Vector Calculus**
Paper III	**FMG -3**	**Financial Mathematics- 3 (Operations Research)**	**FMG -4**	**Financial Mathematics - 4 (Optimization Techniques)**
Paper IV	**MS - 1**	**Problem Course Based on MG - 3 and AMG - 3**	**MS – 3**	**Problem Course Based on MG - 4and AMG - 4**
Paper V	**MS - 2**	**Number Theory**	**MS – 4**	**Graph Theory**

Proposed Structure of T. Y. B. A. Mathematics Courses:

	Semester - V		Semester -VI	
Paper I	**MG - 5**	**Group Theory - I**	**MG - 6**	**Ring Theory – I**
Paper II	**AMG -5**	**Real Analysis - I**	**AMG - 6**	**Real Analysis - II**
Paper III	**FMG - 5**	**Financial Mathematics - 5**	**FMG -6**	**Financial Mathematics – 6**
Paper IV	**MS - 5**	**Metric Spaces**	**MS – 7**	**Complex Analysis**
Paper V	**MS - 6**	**Ordinary Differential Equations - I**	**MS – 8**	**Partial Differential Equations– I**

Details of Syllabus:

Semester – I

MG-1:Algebra

Unit 1: Sets Relations and Functions (8 Lectures)

1.1 Sets, Relations, Equivalence relations, Equivalence classes and partitions of a set

1.2 Functions, Basic terminology, Types of Functions, Inverse of a Function, Composition of Functions (Excluding theorems only examples).

Unit2: Divisibility Theory in the Integers(10 Lectures)

2.1 Mathematical Induction:Well-Ordering Principle.

2.2 The Division Algorithm, The Greatest Common Divisor, Euclid's Lemma, The Least Common Multiple, The Euclidean Algorithm.

Unit 3: Primes and the theory of Congruence (8 Lectures)

3.1 The Fundamental Number of Arithmetic: Prime Numbers, Euclid's Lemma.

3.2 The theory of Congruence: Basic Properties of congruence.

3.3 Fermat's Theorem

Unit 4: Complex Numbers (10 Lectures)

4.1 Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential form, Products and Quotients, De-Moivre's theorem.

4.2 Roots of Complex Numbers: The n^{th} roots of unity.

4.3 Regions in Complex Plane.

Text Books:

1. **A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.**
   Unit 1: Chapter 2: Sec. 2.1 to 2.5, Chapter 3: Sec. 3.1 to 3.6, Chapter 4: Sec. 4.1 to 4.4.
2. **Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.**
   Unit 2: Textbook 2: Chapter 1: Sec. 1.1, Chapter 2: Sec. 2.2 to 2.4
   Unit 3: Textbook 2: Chapter 3: Sec. 3.1, Chapter 4: Sec. 4.1, 4.2, Chapter 5: Sec. 5.2.
3. **Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, Seventh Edition.**
   Unit 4: Textbook 3: Chapter 1: Sec 1 to 10.

Reference Books:

1. Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.
2. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert,John Wiley and Sons Inc, Fourth Edition.

AMG-1: CALCULUS - I

Unit 1: Real Numbers (06 Lectures)

1.1 The Algebriac and Order Properties of R:
Algebraic properties of R, Order properties of R, Well-Ordering Property of N. Arithmetic mean-Geometric mean inequality, Bernoulli's inequality.
(Revision: essential properties should be revised with illustrative examples)

1.2 Absolute Value and the Real Line:
Absolute value function and its properties, triangle inequality and its consequences, neighborhood of a point on real line.

1.3. The Completeness Property of R:
Definitions of Upper bound, Lower bound, supremum, infimum of subsets of R, completeness property of R.

1.4 Applications of the Supremum Property:
Archimedean property and its consequences, The density theorem (without proof).

Unit 2. Sequences (10 Lectures)

2.1 Sequences and Their Limits:
Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples on limit of sequence.

2.2 Limits Theorems:
Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.

2.3 Monotone Sequences:
Definition and examples of monotone sequences, Monotone convergence theorem and examples.

2.4 Subsequences and Bolzano -Wierstrass Theorem:
Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano -Wierstrass theorem (first proof).

Unit 3. Limits (08 lectures)

3.1 Functions and their Graphs:
Functions, domain and range, graphs of functions, representing a function numerically, Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions

3.2 Limits of Functions:

Definition of cluster point and examples, definition of limit of a function, sequential criterion for limits, divergence criteria.

3.3 Limit Theorems:
Algebra of limits (proofs using sequential criterion) ,Squeeze theoerem.

3.4 Some extension of limit concepts:
one-sided limits, infinite limits (without proof) .

Unit 4: Continuity (12 lectures)

4.1 Continuous Functions:
Definition of continuous function at a point , sequential criterion for continuity, Divergence criterion, combination of continuous functions.

4.2 Continuous Functions on Intervals:
Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum -maximum theorem(without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.

Textbook Books:

1. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.

Unit 1: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2(2.2.1 to 2.2.9), 2.3, 2.4(2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).

Unit 2: Chapter 3: Sec. 3.1(3.1.1 to 3.1.7, 3.1.10, 3.1.11), Sec. 3.2(3.2.1 to 3.2.11), Sec. 3.3(3.3.1, 3.3.4), Sec. 3.4 (3.4.1 to 3.4.3, 3.4.5 to 3.4.8).

Unit 3: Chapter 4: Sec. 4.1(4.1.1, 4.1.3 to 4.1.9), Sec. 4.2(4.2.1 to 4.2.8), Sec. 4.3 (4.3.1 to 4.3.9).

Unit 4: Chapter 5: Sec. 5.1, Sec. 5.2, Sec 5.3 (5.3.1 to 5.3.5, 5.3.7 to 5.3.10).

2. Thomas Calculus, Thirteenth edition, Pearson Publication.

Unit 3: Text book-2: Chapter 1: Sec. 1.1.

Reference books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.

FMG-1:Financial Mathematics-1

Unit 1: Review (08 lectures)

1.1 Exponents
1.2 Polynomials
1.3 Equations: Linear and quadratic
1.4 Simultaneous Equations
1.5 Functions
1.6 Graphs, Slopes and Intercepts

Unit 2: The Derivative and the rules of differentiation (10 lectures)

2.1 Limits
2.2 Continuity
2.3 The Derivative
2.4 Differentiability and Continuity
2.5 Derivative Notation
2.6 Rules of Differentiation
2.7 Higher Order Derivatives
2.8 Implicit Differentiation

Unit 3: Uses of derivative in Mathematics and Economics (10 lectures)

3.1 Increasing and Decreasing functions
3.2 Concavity and Convexity
3.3 Relative Extrema
3.4 Inflection Points
3.5 Optimization of Functions
3.6 Marginal Concepts
3.7 Optimizing Economic Functions
3.8 Relationship among Total, Marginal and Average Concepts.

Unit 4: Exponential and logarithmic functions (12 lectures)

4.1 Exponential Functions
4.2 Logarithmic Functions
4.3 Properties of Exponents and Logarithms
4.4 Natural Exponential and Logarithmic Functions

Text Book:

Introduction to Mathematical Economics, 3rd edition, Edward T. Dowling,

Schaum's outline series, McGraw Hill International Edition, 2012.

Unit 1: Chapter 1: Sec 1.1 to 1.6.
Unit 2 : Chapter 3: Sec. 3.1, 3.2, 3.4 to 3.8.
Unit 3: Chapter 4 : Sec 4.1 to 4.5, Sec. 4.7 to 4.9.
Unit 4: Chapter 7 : Sec 7.1 to 7.4.

Reference Books:

1. Alpha C. Chiang, Fundamental Methods of Mathematical Economics, McGraw-Hill, Inc. 3rd edition, 1984.
2. V.N. Kapoor, Introductory Mathematics for Business and Economics, Sultan Chand & Sons, 12th edition.
3. A. Sarama, Basic Application of Mathematics in Economics, AB Publisher, Guwahati, 2nd edition, 2016.

Semester - II

MG-2 :Analytical Geometry

Unit 1: Analytical Geometry of Two Dimension (10 Lectures)

1.1. Change of axes: translation and rotation.
1.2. Conic Sections: General equation of second degree in two variables
1.3. Reductionto standard form, centre of conic, nature of conic.

Unit 2: Planes (10 Lectures)

2.1. Direction cosines and directionratios,Equation of plane, Normal form, Transform to the normal form, Plane passing through three non-collinear points, Intercept form, Angle between two planes.
2.2. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes.

Unit 3: Lines in three dimension (8 lectures)

3.1. Equations of a line in Symmetric and unsymmetricalforms,Line passing through two points, Angle between a line and a plane.
3.2. Perpendicular distance of a pointfrom a plane, Condition for two lines to be coplanar (without proof).

Unit 4: Sphere (8 Lectures)

4.1. Equation of a sphere in different forms, plane section of a sphere.
4.2. Equation of a circle, sphere through a given circle
4.3. Intersection of asphere and a line, Equation of tangent plane to sphere.

Text Books:

1. Analytic Geometry in Two and Three Dimentions : Von Steuben

Unit1: Sec, 8.4

2. **Analytical Solid Geometry: Shantinarayan; S. Chand and Company Ltd, New Delhi, 1998.**
   Unit 2: Sec. 1.6,1.7, Sec. 2.1 to 2.7
   Unit 3: Sec. 3.1 to 3.4, 3.7
   Unit 4: Sec. 6.1 to 6.6.

Reference Book:

1. P.K.Jain and Khalil Ahmad,A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.

AMG-2 : Calculus-II

Unit 1: Differentiation (10 lectures)

1.1. The Derivatives:
Definition of the derivative of a function at a point, every differentiable function is continuous, Rules of differentiation, Caratheodary'stheorem(without proof), The chain rule, Derivative of inverse function (without proof , only examples).

1.2 The Mean Value Theorems:
Interior extremum theorem, Mean Value theorems and their Consequences, Intervals of increasing and decreasing of a function,first derivative test for extrema.

Unit 2: L' Hospital Rule and Successive Differentiation(10 lectures)

2.1L'Hospital Rule:Indeterminate forms, L'Hospital Rules(without proof)

2.2Taylor's theorem:Taylor's theorem and Maclaurin'stheorem with Lagrange's form of remainder(Without proof).

2.3. Successive Differentiation: The nth derivative and Leibnitz theorem for successive differentiation.

Unit 3: Ordinary Differential Equations (08 lectures)

3.1 Linear first order equations.
3.2 Separable equations.
3.3 Existence and Uniqueness of solutions of nonlinear equations.

Unit 4: Exact Differential Equations (08 lectures)

4.1 Transformation of nonlinear equations to separable equations.
4.2 Exact differential equations.
4.3 Integrating factors.

Textbooks:

1. **Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.**
   Unit 1: Chapter 6: Sec. 6.1(6.1.1 to 6.1.8), Sec 6.2(6.2.1 to 6.2.8).
   Unit 2: Chapter 6: Sec 6.3(6.3.1 to 6.3.7), Sec 6.4(6.4.1 to 6.4.3).
2. **Differential Calculus by Shanti Narayan, Tenth Revised Edition.**
   Units 2: Chapter 5: Sec. 5.1 to 5.6.

3. Elementary Differential equations, William F. Trench, E-book (Free download)

Unit 3: Chapter 2: Sec 2.1 to 2.3.

Unit 4: Chapter 2: Sec 2.4 to 2.6.

Reference books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.
5. Ordinary and partial Differential equations,M.D. Raisingania, S. Chand andCompany,2009.

FMG-2: Financial Mathematics-2

Unit 1 : Exponential and Logarithmic functions in Economics (08 lectures)

1.1. Interest Compounding
1.2. Discounting
1.3. Converting Exponential to Natural Exponential functions
1.4. Estimating growth rates from data points.

Unit 2 :The Fundamentals of Linear Algebra (12 lectures)

2.1. The role of linear algebra
2.2. Definitions and Terms
2.3. Addition and Subtraction of Matrices
2.4. Scalar Multiplication
2.5. Multiplication of Matrices
2.6. Commutative, Associative and Distributive laws in Matrix Algebra
2.7. Identity and null matrices
2.8. Matrix Expression of a System of Linear Equations
2.9. Determinants and Nonsingularity
2.10. Minors and Cofactors
2.11. Cofactor and Adjoint Matrices
2.12. Inverse Matrix
2.13. Solving Linear EquationsWith Inverse

Unit 3 :Integral Calculus: The Indefinite Integral (08 lectures)

3.1. Integration
3.2. Rules of Integration
3.3. Initial Conditions and Boundary Conditions
3.4. Integration by Substitutions

3.5. Integration by Parts
3.6. Economic Applications.

Unit 4 : Integral Calculus: The Definite Integral (08 lectures)

4.1. Area Under a Curve
4.2. The definite Integral
4.3. Properties of Definite Integral
4.4. Area Between Curves
4.5. Consumers and Producer's Surplus.

Text Book:

Introduction to Mathematical Economics, 3rd edition, Edward T. Dowling,

Schaum's outline series, McGraw Hill International Edition, 2012.

Unit 1: Chapter 8: Sec. 8.1, 8.3, 8.4, 8.5
Unit 2: Chapter 10 : Sec. 10.1 to 10.4, Sec. 10.6 to 10.9, Chapter 11: Sec 11.1, 11.3, 11.6, 11.7,11.8.
Unit 3: Chapter 14: Sec. 14.1 to 14.6.
Unit 4: Chapter 15: Sec. 15.1, 15.2, 15.4, 15.5, 15.8

Reference Books:

1. Alpha C. Chiang, Fundamental Methods of Mathematical Economics, McGraw-Hill, Inc. 3rd edition, 1984.
2. V.N. Kapoor, Introductory Mathematics for Business and Economics, Sultan Chand & Sons, 12th edition.
3. A. Sarama, Basic Application of Mathematics in Economics, AB Publisher, Guwahati, 2nd edition, 2016.