Fergusson College (Autonomous)

Pune

Learning Outcomes-Based Curriculum for

F.Y.B.A. Mathematics

With effect from June 2019

Programme Structure

Year	Course Code	Course Title	Credits
1	MTA-1101	Calculus-I	03
	MTA-1102	Algebra	03
	MTA-1103	Financial Mathematics-I	03
	MTA-1201	Calculus-II	03
	MTA-1202	Geometry	03
	MTA-1203	Financial Mathematics-II	03

Course Code and Title of the Course/ Paper: MTA 1101 Calculus-I
Credits: 3

Learning Outcomes	Suggested Pedagogical Processes
To learn basic concepts related to Real Numbers and their properties	Blackboard
To understand inequalities	Use of open source softwares
To learn the definition of convergence as applied to sequences	Use of projector
To learn various results and definitions related to Real Sequences and their convergence.	Seminar/Discussion/presentation by students
Apply these results to understand series of real numbers.	Special lectures by students

Unit No.	Title of Unit and Contents
I	**Real Numbers:** Algebraic and Order properties of Real numbers, Solution set of inequalities, Geometric Mean-Arithmetic Mean inequality, Bernoulli's inequality, Absolute Value of real numbers, Triangle inequality and its applications, Bounded set, Supremum (l.u.b.), Infimum (g.l.b.), Completeness property of real numbers, Archimedean property of R, Density of rational numbers in R, Intervals of real line, nested interval property (statement only).
II	**Sequences of Real Numbers:** Definition of a sequence, Limit of a sequence, Uniqueness of limit, Bounded sequence, Tail of a sequence, Algebra of limits of sequences, Squeeze theorem for sequences, Ratio test for sequences, Monotone sequence, Monotone convergence theorem (Statement only), Subsequences, Divergence Criteria, Monotone subsequence theorem (statement only), Bolzano-Weierstrass theorem (statement only), Cauchy sequence (definition and examples only).
III	**Series of Real Numbers:** Definition, Sequence of partial sums, Convergent series and Divergent series, n-th tem test, Ratio test and root tests for convergence of series (statements and examples only).

Learning Resources

Textbooks:

1. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis: John Wiley & Sons, Fourth Edition, 2011.
2. Tom M. Apostol Calculus Volume-I, Wiley International Edition, 2007.
3. M. Spivak, Calculus, Cambridge, 2006.
4. J. Stewart, Calculus, Cengage Learning, 2012.
5. G.B. Thomas, R. Finney, Calculus and Analytic Geometry, Addison-Wesley, 1995.

Suggested Reading:

1. **Who Gave You the Epsilon? Cauchy and the Origins of Rigorous Calculus Judith V. Grabiner**The American Mathematical Monthly, March 1983, Volume 90, Number 3, pp. 185–194.

Course Code and Title of the Course/ Paper: MTA 1102 Algebra
Credits:3

Learning Outcomes	Suggested Pedagogical Processes
To formulate induction problems	Blackboard
Solution of induction problems	Use of open source softwares
Understand the results of Set theory which are used to study relations, functions and natural numbers. Equivalence of sets introduce the concept of finite/infinite sets.	Use of projector
Understand the results in complex numbers which are introduced as the algebraic set of order pairs.	Seminar/Discussion/presentation by students
To solve polynomial equations	Special lectures by students
To understand similarity between polynomials and integers	

Unit No.	Title of Unit and Contents
I	Principle of Mathematical Induction: Well ordering principle for N, Principle of Mathematical induction, Strong form ofPrinciple of Mathematical induction.
II	Sets, Relation and Functions: • Power set, Operation on sets, Cartesian product of sets • Definition of function, Domain, co-domain and the range of function, injective, surjective and bijective functions, composite function, invertible function • Definition of relation, equivalence relation, equivalence classes, Definition of partition, every partition gives an equivalence relation and vice-versa.
III	Complex Numbers: • Addition and multiplication of complex numbers, Modulus and amplitude of a complex number, Real and imaginary parts and conjugate of a complex number. • Geometric representation sum, differences, product and quotient of two complex numbers as well as modulus, amplitude and the conjugate of a complex number. • De-Moivre'sTheorem,roots of unity, Euler's Formula.
IV	Polynomials: • The set Q[x] of polynomials in one variable with rational coefficients. • Division Algorithm (without proof). G.C.D of two polynomials(without proof). • Remainder Theorem, Factor Theorem (with proof). • Relation between the roots and the coefficients of a polynomial.

Learning Resources

1.**Barbeau**, Edward J, Polynomials, Springer, 1989
2. Brown and Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2010.

Course Code and Title of the Course: Financial Mathematics-I (MTA1103)
Credits: 3

Learning Outcomes	Suggested Pedagogical Processes
To equip students with basic Mathematical tools.	
To develop the skill of using mathematics in other subject.	
To increase the problem solving ability	
To develop the mathematics base needed for other subjects	

Unit No.	Title of Unit and Contents
I	**Quantitative Concepts:**What is interest? Simple and Compound interest, Nominal and Effective rate of interest, Concept and Calculations of Equated Monthly Instalments EMI, Time, Present and Future Value of Money, Applications of Time Value of Money, Impact of time and discount rate on present and future values, Relationship between net present value and financial investment, Applications of time value of money.
II	**The Matrix Algebra:**The role of linear algebra, Definitions, addition and subtraction of matrices, scalar multiplication, vector multiplication, multiplication of matrices, commutative, associative and distributive laws in matrix algebra, Identity and Null matrices, matrix expression of a system of linear equations, row operations, augmented matrix, Gaussian method of solving linear equations.
III	**Basic Concepts in Calculus:**Exponents, Polynomials, Factoring, Completing the square, Functions , Graphs, Slopes and Intercepts, Graphs of Non-linear Functions, Exponential and logarithmic functions, properties of exponents and logarithms , natural exponential and logarithmic functions, solving natural exponential and logarithmic functions

Learning Resources:

1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series
2. Frank Ayres, Mathematics of Finance, Schaum's Outline Seri

Course Code and Title of the Course/ Paper: MTA1201 Calculus-II
Credits:3

Learning Outcomes	Suggested Pedagogical Processes
Limit using sequences	Blackboard
sequential continuity	Use of open source softwares
Hard theorems and their importance	Use of projector
Differentiable functions	Seminar/Discussion/presentation by students
Applications of mean value theorems	Special lectures by students

Unit No.	Title of Unit and Contents
I	**Limits of functions**: Cluster point, Definition of limit, Limits of some standard functions, Sequential criteria for limits, Uniqueness of limit, Divergence criteria, Algebra of limits, Squeeze theorem for limit.
II	**Continuous functions:** Definition, Sequential criteria and examples, Composition of continuous functions, Continuous functions on intervals, Boundedness theorem (statement only), Maximum-Minimum theorem (statement only), Location of roots theorem (statement only), Intermediate value theorem, Fixed point theorem, Preservation of intervals theorem.
III	**Derivative:** Definition, Differentiability imply continuity, Non differentiable functions, Algebra of differentiable functions, Caratheodory's theorem, Chain rule for derivative of composite function, Derivative of inverse function.
IV	**Mean value theorems:** Vanishing of the derivative at interior extremum, Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Applications of mean value theorems to geometric properties of functions, First derivative test for extrema, Second derivative test for extrema, Derivative test for convexity, Intermediate value property for derivative, Darboux's theorem.
V	**Successive differentiation:** n-th derivative of some standard functions, Leibnitz's theorem for n^{th} derivative, Applications of Leibnitz's theorem. Indeterminate forms, L'Hospital's Rule, Taylor's theorem, Maclaurin's theorem, Applications of Taylor's Theorem.

Learning Resources

Textbooks:

1. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis: John Wiley & Sons, Fourth Edition, 2011.
2. Tom M. Apostol Calculus Volume-I, Wiley International Edition, 2007.
3. M. Spivak, Calculus, Cambridge, 2006.
4. J. Stewart, Calculus, Cengage Learning, 2012.
5. G.B. Thomas, R. Finney, Calculus and Analytic Geometry, Addison-Wesley, 1995.

Course Code and Title of the Course/ Paper: MTA1202 Geometry
Credits:3

Learning Outcomes	Suggested Pedagogical Processes
Locus of points	Blackboard
Similarity and differences between equation of line in 2D and 3D Geometry	Use of open source softwares
Similarity and differences between circle and sphere	Use of projector
Invariants	Seminar/Discussion/presentation by students
Relation between Geometry and Algebra	Special lectures by students

Unit No.	Title of Unit and Contents
I	Analytical geometry of two dimensions: • Locus of points • Change of Axes: Translation of Axis and Rotation of axes. • Removal of *xy* term and linear terms • General Equation of second degree in *x* and *y*. • Centre of Conic • Reduction to Standard form: length of Axes, equation of axes, Co-ordinates of foci, Eccentricity, vertex • Equation of directrix and latus rectum
II	Planes in Three Dimension • Rectangular Cartesian co-ordinates of a point in Plane • Orientation of Axes • Co-ordinates of a point. • Direction Angles, Direction Ratios, Direction Cosines. • Direction ratios of a line joining two points • Relation between direction ratios and direction cosines. • Angle between two lines. • General Equation of first degree. • Normal form of the equation of a plane. • Transform to the normal form. • Angle between two planes • Determination of a plane under given conditions. • Plane passing through a given points. • Plane passing through three points. • System of planes • Two sides of planes. • Length of the perpendicular from a point to a plane. • Bisectors of angles between two planes • Joint equation of two planes
III	Lines in Three Dimensions • Equation of line. • Symmetrical form of the equation of a line. • Equation of a line passing through two points • Transformation of the equation of a line from the asymmetric form to the symmetric form. • Angle between a line and plane. • Coplanar lines: Condition for a line to lie in a plane, condition for two lines to be coplanar.

	• Sets of condition which determines a line: Number of arbitrary constants in the equations of a straight line, Sets of conditions which determine line. • Skew lines and shortest distance: To find the length and the equation of the line of shortest distance between two lines. • Length of the perpendicular from a point to a line.
IV	Sphere • Equation of a sphere, sphere with a given diameter, Intercept form, • Equation of the sphere through four points. • Plane section of a sphere. • Intersection of two spheres. • Sphere through a given circle. • Sphere passing through the circle intersection of the given sphere and plane. • Sphere passing through a circle which is the intersection of two spheres • Intersection of a sphere and a line. • Equation of Tangent plane: Standard equation of sphere. Equation of tangent plane, The condition of tangency.

Learning Resources

Include Reference Books/ e-resources/ journals/any other learning material

1. Shantinarayan: Analytical Solid Geometry, S. Chand and Company Ltd, New Delhi, 1998.
2. P .K.Jain and Khalil Ahmad, A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.
3. Askwyth, E. H: The Analytical Geometry of the Conic Sections.

Course Code and Title of the Course: Financial Mathematics-II (MTA1203)
Credits: 3

Learning Outcomes	Suggested Pedagogical Processes
To develop the skill of using mathematics in other subject.	
To increase the problem solving ability	
To develop the mathematics base needed for other subjects	

Unit No.	Title of Unit and Contents
I	**The Derivatives and the Rule of Differentiations**Limit, Continuity, The slope of curve linear functions, Derivative, Differentiability and Continuity, Rules of Differentiation, Higher order derivatives, Implicit Differentiation.
II	**Use of Derivatives in Mathematics and Economics**Increasing and Decreasing functions, Concavity and Convexity, Relative extrema, Inflection points, Curve Sketching, Optimization of Functions, Marginal concepts, Optimizing economic functions, Free elasticity of demand and supply, Relationship among total, Marginal and Average concepts.
III	**Integral Calculus: The Indefinite Integral**Integration, Rules of integration, Initial conditions and boundary conditions, Integration by substitution, Integration by parts, Economic applications

Learning Resources

1. Edward Dowling, Introduction to Mathematical Economics, Schaum's Outline Series
2. Frank Ayres, Mathematics of Finance, Schaum's Outline Series