Deccan Education Society's

FERGUSSON COLLEGE, PUNE

(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

FIRST YEAR B.A. MATHEMATICS

SEMESTER I and II

Academic Year 2016-2017

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
Scheme of Course Structure
(Faculty of Science)
Department of Mathematics
FYBA

FYBA Semester I	Theory Paper -I	MTA1101	Calculus - I	3
	Theory Paper - 2	MTA1102	Algebra	4
	Theory Paper - 3	MTA1103	Industrial Mathematics - I	3
FYBA Semester II	Theory Paper -I	MTA1201	Calculus - II	3
	Theory Paper - 2	MTA1202	Analytical Geometry	3
	Theory Paper - 3	MTA1203	Industrial Mathematics - II	3

FYBA AMG - I
MTA1101 Calculus - I
No. of Credits-3

The aim of this course is to understand the notion of limit and continuity of real valued functions of a real variable. The student should understand the notion of sequential continuity and apply it to solve the problems. Hence, the emphasis is more on limit and continuity of functions and less on sequences. Hence, various theorems about convergence of sequences are stated and good students can do them as an exercise or can give a seminar.

	Title and Contents	Number of Lectures
1	**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 $\mathbb{R}$, Density of rational numbers in $\mathbb{R}$, Intervals of real line, nested interval property (statement only).	6
2	**Sequences and Series:** **Sequence:** Definition of sequence, Limit of 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). **Series:** Definition, Sequence of partial sums, Convergent series and Divergent series, Some tests for convergence of series (statements and examples only).	12

	Title and Contents	Number of Lectures
3	**Limits: Limit 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.	6
4	**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.	6
5	**Differentiation: 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.	6

Students opting this course will have to do a small project. The project will be related to the topics in the syllabus. Some possible topics are:

1. The role of LUB axiom
2. Proofs of different theorems which are stated without proof

Books:

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.

FYBA MG - I
MTA1102 Algebra
No. of Credits-3

The aim of this course is to introduce the students with basic concepts in Mathematics such as relations, equivalence relations and functions. And, to introduce different techniques of proving the theorems such as induction, proof by contradiction etc. We introduce integers and complex numbers as important examples to study different algebraic structures.

	Title and Contents	Number of Lectures
1	**Induction** Well ordering principle for $\mathbb{N}$, Principle of Mathematical induction, Strong form of Principle of Mathematical induction.	6
2	**Sets, Relation and Functions** 1. Power set, Operation on sets, Cartesian product of sets 2. Definition of relation, equivalence relation, equivalence classes, Definition of partition, every partition gives an equivalence relation and vice-versa. 3. Definition of function, Domain, co-domain and the range of function, injective, surjective and bijective functions, composite function, invertible function	8
3	**Integers** 1. Divisibility, Division algorithm, Euclidean algorithm, Properties of G.C.D and L.C.M.. 2. Primes, Euclid's lemma, Unique Factorization Theorem (Statement only) 3. Congruences: Definition and elementary properties, addition and multiplication modulo n, Fermat's Little theorem, Euler's phi-function.	14

	Title and Contents	Number of Lectures
4	**Complex Numbers** 1. Addition and multiplication of complex numbers, Modulus and amplitude of a complex number, Real and imaginary parts and conjugate of a complex number. 2. Geometric representation of sum, differences, product and quotient of two complex numbers as well as modulus, amplitude and the conjugate of a complex number. 3. De-Moivre's Theorem, roots of unity, Euler's Formula.	8

Students opting this course will have to do a small project. The project will be related to the topics in the syllabus. Some possible topics are:

1. Different proofs of infinitely many primes
2. Proofs of different theorems which are stated without proof
3. Integers and polynomials

Reference books:

1. Tom M. Apostol Calculus Volume-I, Wiley International Edition, 2007.
2. Robert G. Bartle, Donald R. Sherbert, Introduction To Real Analysis: John Wiley & Sons, Fourth Edition, 2011.
3. David M. Burton, Elementary number theory, Seventh Edition, Tata McGraw Hill, 2012.
4. Churchill and Brown, Complex variables and applications, Ninth edition, 2013.

FYBA FMG - I
MTA1103 Industrial Mathematics - I

The aim of this course is to introduce various notions in Mathematics necessary to understand different notions in Economics. The notion of limit ,continuity and differentiability of real valued functions of a real variable are introduced in the first semester. In the second semester, we introduce the notion of integration. Then we introduce fundamentals of linear algebra and linear programming.

	Title and Contents	Number of Lectures
1	**Review** Exponents, Polynomials, Factoring, Equations: Linear and quadratic, completing square, simultaneous equations, Functions , Graphs, slopes and intercepts, Graphs of non-linear functions.	12
2	**The Derivatives and the rule of differentiations** Limit, continuity, The slope of curve linear functions, The derivative, Differentiability and continuity, Rules of differentiation, Higher order derivatives, Implicit differentiation.	12
3	**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.	16
4	**Exponential and logarithmic functions** Exponential functions, logarithmic functions, properties of exponents and logarithms, natural exponential and logarithmic functions, solving natural exponential and logarithmic functions.	8

TEXT BOOK:

1 . Edward T. Dowling, Introduction to Mathematical Economics, Second edition, Schaum's outline series.

SECOND SEMESTER

FYBA AMG - II
MTA1201 Calculus II
No. of Credits-3

The aim of this course is to show certain applications of continuous and differentiable functions that students studied in the first semester. Hence the first two sections are continuation of the first semester course. The next section is integration. It is expected that student should be acquainted with definite integral as area under the curve and should understand different techniques of integration. In the last section, we introduce differential equations and while solving the differential equations, student use techniques of integration to solve the differential equations.

	Title and Contents	Number of Lectures
1	**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.	10
2	**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.	8
3	**Integration** Introduction to Integration, Definition of Riemann integrable function, Fundamental Theorem of Calculus (Statements only), Integration of rational function by using partial fraction, Integration of some irrational functions, Reduction formulas.	8

	Title and Contents	Number of Lectures
4	**Differential Equations of first order and first degree:** Introduction to function of two, three variables, homogenous functions, Partial derivatives. Differential equations, General solution of Differential equations. Methods of finding solution of Differential equations of first order and first degree, Variable separable form, Homogenous Differential equations, Differential equations reducible to homogeneous form. Exact Differential equations. Differential equations reducible to exact Differential equations, Integrating factors, Linear Differential equations. Bernoulli's differential equation. Some applications of Differential Equations.	10

Students opting this course will have to do a small project. The project will be related to the topics in the syllabus. Some possible topics are:

1. What is Riemann integration?
2. Applications of mean value theorem

Books:

1. Methods of Real Analysis, by R.R. Goldberg.
2. Integral Calculus, Shantinarayan, S.K.Mittal, S. Chand and Co. Publication 2006
3. Elementary Differential Equations, Macmillan Publication, Rainville and Bedient.
4. Differential Equations And Its Applications With Historical Notes, G. F. Simmons.

FYBA MG - II
MTA1202 Analytical Geometry

The aim of this course is to explain analytical geometry of two and three dimensions. The ideas from matrix algebra will occur in a subtle way. The concepts learnt here will be useful while learning calculus of several variables.

	Title and Contents	Number of Lectures
1	Analytical geometry of two dimensions 1. Locus of points 2. Change of Axes (a) Translation of Axis. (b) Rotation of axis. 3. Removal of xy term. 4. Invariants. 5. General Equation of second degree in x and y. 6. Centre of Conic. 7. Reduction to Standard form: (a) length of Axes (b) Equation of Axes (c) Co-ordinates of foci. (d) Eccentricity (e) vertex, Equation of directrix and latus rectum. 8. General Equation Representing Parabola.	8

	Title and Contents	Number of Lectures
2	Planes in Three Dimension 1. Rectangular Cartesian co-ordinates of a point in Plane. (a) Orientation of Axes (b) Co-ordinates of a point. (c) Direction Angles, Direction Ratios, Direction Cosines. (d) Direction ratios of a line joining two points (e) Relation between direction ratios and direction cosines. (f) Angle between two lines. 2. General Equation of first degree. 3. Normal form of the equation of a plane. 4. Transform to the normal form. 5. Angle between two planes 6. Determination of a plane under given conditions. 7. Plane passing through a given points. 8. Plane passing through three points. 9. System of planes 10. Two sides of planes. 11. Length of the perpendicular from a point to a plane. 12. Bisectors of angles between two planes 13. Joint equation of two planes	10

	Title and Contents	Number of Lectures
3	Lines in Three Dimensions 1. Equation of line. (a) Symmetrical form of the equation of a line. (b) Equation of a line passing through two points (c) Transformation of the equation of a line from the asymmetric form to the symmetric form. (d) Angle between a line and plane. 2. Coplanar lines (a) Condition for a line to lie in a plane. (b) condition for two lines to be coplanar. 3. Sets of condition which determines a line. (a) Number of arbitrary constants in the equations of a straight line. (b) Sets of conditions which determine line. 4. Skew lines and shortest distance (a) To find the length and the equation of the line of shortest distance between two lines. (b) Length of the perpendicular from a point to a line.	8

	Title and Contents	Number of Lectures
4	Sphere 1. Equation of a sphere. (a) Sphere with a given diameter. (b) Intercept form. (c) Equation of the sphere through four points. 2. Plane section of a sphere. 3. Intersection of two spheres. 4. Sphere through a given circle. (a) Sphere passing through the circle intersection of the given sphere and plane. (b) Sphere passing through a circle which is the intersection of two spheres 5. Intersection of a sphere and a line. 6. Equation of Tangent plane. (a) Standard equation of sphere. (b) Equation of tangent plane (c) The condition of tangency.	10

Students opting this course will have to do a small project. The project will be related to the topics in the syllabus. Some possible topics are:

1. Classification of surfaces in three dimensions
2. Cone and Cylider

Reference books:

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

FYBA FMG - II
MTA1203 Industrial Mathematics - II

	Title and Contents	Number of Lectures
1	**Integral Calculus: The indefinite integral** Integration, Rules of integration, Initial conditions and boundary conditions, integration by substitution, integration by parts, Economic applications.	16
2	**The Fundamentals of Linear 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.	16
3	**Linear programming: A graphical approach** Graphic solution, The extreme point theorem, Slack and surplus variables, The basis theorem.	16

TEXT BOOK:

1 . Edward T. Dowling, Introduction to Mathematical Economics, Second edition, Schaum's outline series.