Deccan Education Society's

# FERGUSSON COLLEGE, PUNE
# (AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

FIRST YEAR B.Sc. MATHEMATICS

SEMESTER I

**Academic Year 2017-2018**

Deccan Education Society's

# FERGUSSON COLLEGE, PUNE

Scheme of Course Structure

Faculty of Science

## Department of Mathematics

F.Y. B.Sc.

| Particulars | Name of the paper | Code | Title of Paper | No of Credits |
|---|---|---|---|---|
| F.Y. B.Sc. Semester I | Theory Paper - I | MTS1101 | Calculus I | 2 |
| | Theory Paper - II | MTS1102 | Algebra | 2 |
| | Practical Paper - I | MTS1103 | Mathematics Practical - I | 2 |
| | | | | |
| F.Y. B.Sc. Semester II | Theory Paper - I | MTS1201 | Calculus II | 2 |
| | Theory Paper - II | MTS1202 | Analytical Geometry | 2 |
| | Practical Paper - II | MTS1203 | Mathematics Practical - II | 2 |

F.Y. B.Sc.

# MTS1101 Calculus - I

No. of Credits: 2

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.

| No. | Title and Contents | Number of Lectures |
|---|---|---|
| 1 | **Real Numbers:**<br>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). | 10 |
| 2 | **Sequences and Series:**<br>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).<br>**Series:**<br>Definition, Sequence of partial sums, Convergent series and Divergent series, Some tests for convergence of series (statements and examples only). | 16 |
| 3 | **Limits:**<br>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. | 10 |

**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.

F.Y. B.Sc.

# MTS1102 Algebra

No. of Credits: 2

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.

| No. | Title and Contents | Number of Lectures |
|---|---|---|
| 1 | **Induction:** Well ordering principle for N, Principle of Mathematical induction, Strong form of Principle of Mathematical induction. | 6 |
| 2 | **Sets, Relation and Functions:**<br>• Power set, Operation on sets, Cartesian product of sets<br>• Definition of relation, equivalence relation, equivalence classes, Definition of partition, every partition gives an equivalence relation and vice-versa.<br>• Definition of function, Domain, co-domain and the range of function, injective, surjective and bijective functions, composite function, invertible function | 8 |
| 3 | **Integers**<br>• Divisibility, Division algorithm, Euclidean algorithm, Properties of G.C.D. and L.C.M.<br>• Primes, Euclid's lemma, Unique Factorization Theorem (Statement only)<br>• Congruences: Definition and elementary properties, addition and multiplication modulo $n$, Fermat's Little theorem, % (Statement only),<br>• Euler's phi-function. | 14 |
| 4 | **Complex Numbers**<br>• Addition and multiplication of complex numbers, Modulus and amplitude of a complex number, Real and imaginary parts and conjugate of a complex number.<br>• Geometric representation of sum, differences, product and quotient of two complex numbers as well as modulus, amplitude and the conjugate of a complex number.<br>• De-Moivre's Theorem, roots of unity, Euler's Formula. | 8 |

**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.

F.Y. B.Sc.

# MTS1103 Mathematics Practical-I

No. of Credits: 2

**Title of the Experiment**

1. Matrices, Determinant and rank of matrix.
2. System of linear equations.
3. Eigen-values and Eigen-vectors.
4. Equivalence Relation and its classes.
5. Divisibility.
6. Real Numbers.
7. Complex Numbers.
8. Sequences and series.
9. Continuous functions.
10. Numerical methods to solve equations: Bisection, Newton Raphson, Regula falsi.

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY
FIRST YEAR B.Sc. MATHEMATICS
SEMESTER II

**Academic Year 2017-2018**

F.Y. B.Sc.

# MTS1201 Calculus - II

No. of Credits: 2

The aim of this course is to study differentiable functions and show certain applications of continuous and differentiable functions that students studied in the first semester. 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.

| No. | Title and Contents | Number of Lectures |
|---|---|---|
| 1 | **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. | 8 |
| 2 | **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 |
| 3 | **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 propertiesof functions, First derivative test for extrema, Second derivative test for extrema, Derivative test for convexity, Intermediate value property for derivative, Darboux's theorem. | 8 |
| 4 | **Successive differentiation:** nth derivative of some standard functions, Leibnitz's theorem for nth derivative, Applications of Leibnitz's theorem. Indeterminate forms, L'Hospital's Rule, Taylor's theorem, Maclaurin's theorem, Applications of Taylor's Theorem. | 8 |
| 5 | **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. | 6 |

**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.

F.Y. B.Sc.

# MTS1202 Analytical Geometry

No. of Credits: 2

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.

| No. | Title and Contents | Number of Lectures |
|---|---|---|
| 1 | **Analytical geometry of two dimensions**<br>1. Locus of points<br>2. Change of Axes<br>(a) Translation of Axis.<br>(b) Rotation of axis.<br>3. Removal of xy term.<br>4. Invariants.<br>5. General Equation of second degree in x and y:<br>6. Centre of Conic.<br>7. Reduction to Standard form: +<br>(a) length of Axes<br>(b) Equation of Axes<br>(c) Co-ordinates of foci.<br>(d) Eccentricity<br>(e) vertex, Equation of directrix and latus rectum.<br>8. General Equation Representing Parabola. | 8 |
| 2 | Planes in Three Dimension<br>1. Rectangular Cartesian co-ordinates of a point in Plane.<br>(a) Orientation of Axes<br>(b) Co-ordinates of a point.<br>(c) Direction Angles, Direction Ratios, Direc tion Cosines.<br>(d) Direction ratios of a line joining two points<br>(e) Relation between direction ratios and direc-<br>tion cosines.<br>(f) Angle between two lines.<br>2. General Equation of first degree.<br>3. Normal form of the equation of a plane.<br>4. Transform to the normal form.<br>5. Angle between two planes<br>6. Determination of a plane under given conditions.<br>7. Plane passing through a given points.<br>8. Plane passing through three points.<br>9. System of planes<br>10. Two sides of planes.<br>11. Length of the perpendicular from a point to a<br>plane.<br>12. Bisectors of angles between two planes<br>13. Joint equation of two planes | 10 |
| 3 | **Lines in Three Dimensions**<br>1. Equation of line.<br>(a) Symmetrical form of the equation of a line. | 8 |

| | | |
|---|---|---|
| | (b) Equation of a line passing through two points<br>(c) Transformation of the equation of a line from the asymmetric form to the symmetric form.<br>(d) Angle between a line and plane.<br>2. Coplanar lines<br>(a) Condition for a line to lie in a plane.<br>(b) Condition for two lines to be coplanar.<br>3. Sets of condition which determines a line.<br>(a) Number of arbitrary constants in the equations of a straight line.<br>(b) Sets of conditions which determine line.<br>4. Skew lines and shortest distance<br>(a) To find the length and the equation of the line of shortest distance between two lines.<br>(b) Length of the perpendicular from a point to a line. | |
| 4 | Sphere<br>1. Equation of a sphere.<br>(a) Sphere with a given diameter.<br>(b) Intercept form.<br>(c) Equation of the sphere through four points.<br>2. Plane section of a sphere.<br>3. Intersection of two spheres.<br>4. Sphere through a given circle.<br>(a) Sphere passing through the circle intersection of the given sphere and plane.<br>(b) Sphere passing through a circle which is the intersection of two spheres<br>5. Intersection of a sphere and a line.<br>6. Equation of Tangent plane.<br>(a) Standard equation of sphere.<br>(b) Equation of tangent plane<br>(c) The condition of tangency. | 10 |

**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.

F.Y. B.Sc.

**MTS1203 Mathematics Practical – II**

No. of Credits: 2

1. Cubic and Biquadratic equations.
2. Polynomials: Relation between roots and coefficients
3. General second degree equation (Conic section).
4. Line and Plane
5. Sphere
6. Numerical methods to solve integration: Simpson's 1/3rd, 3/8th and Trapezoidal
7. L' Hospital rule
8. Integration
9. Differential Equations
10. Applications of differential equations