JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai -400 020,India.

Affiliated to
University of Mumbai

Program**:** B.Sc. Mathematics

Course: Calculus II

Semester II

Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

F.Y. B.Sc. Mathematics Syllabus

Semester II			
Course Code	**Course Title**	**Credits**	**Lectures/ Week**
SMAT 201	CALCULUS II	02	03

Semester II – Theory

SMAT 201	Calculus–II (Credits:02 Lectures/Week:03)	
	Course Objectives: **1.** The primary aim of this course is to expose students to the beauty of the definition of limit of a function, continuity and the concept of differentiation. **2.** The first unit is based on limits and continuity in which students learn the definition of continuity and sequential continuity and the equivalence between them. Problems based on these concepts are solved rigorously. **3.** The next unit is based on differentiability. Here students understand the notion of differentiation of a real valued function and mean value theorems. The last section emphasis on applications of differentiability. **Course Outcomes:** **1.** Students get to learn the rigorous definition of limit of a function, continuity which is a cornerstone in mathematics. **2.** Students hone their analytical skills and thinking ability while learning Sandwich theorem, Intermediate value theorem which are of utmost importance in mathematics and in any science for that matter. **3.** They learn real life applications of limits and continuity and understand deeply why we need the notion of continuity, differentiability in the first place, what we mean by saying a function is continuous, differentiable etc.	
Unit I	**Limits and Continuity:** **1.** $\epsilon - \delta$ definition of limit of a (real valued) function, Right hand and Left hand limits, Uniqueness of limit when it exists, Algebra of limit of a function, Sandwich theorem. **2.** $\epsilon - \delta$ definition of continuity of a (real valued) function, examples, Sequential continuity. **3.** Algebra of continuous functions, Continuity of $\|f\|$when f is continuous. Continuity of composition of two continuous functions. **4.** Examples of discontinuous functions and continuity of constant function, identity function, trigonometric functions, polynomial functions etc. **5.** Intermediate value theorem and its applications, A continuous function on a closed and bounded interval is bounded and attains its bounds and its consequences.	**15L**
Unit II	**Differentiation:** **1.** Differentiation of a real-valued function, examples of differentiable and non-differentiable functions, differentiability implies continuity, Algebra of differentiable functions, Derivative of a inverse function. **2.** Chain-Rule, Higher ordered ivatives, Leibnitz rule, L'Hospital's rule, examples of in-determinate form. **3.** Rolle's theorem, Lagrange's and Cauchy's mean value theorem, their applications and examples.	**15L**
Unit III	**Applications of Differentiation:** **1.** Taylor's theorem and its applications. **2.** Definition of local maximum and local minimum, necessary condition, stationary points, first and second derivative test, examples, Graphing of functions using first and second derivatives. **3.** Application to economics and commerce, Concave, convex functions, points of inflections.	**15L**

References:

1. R.G. Bartle and D.R. Sherbert, Introduction to real analysis, third edition, John Wiley and Sons, 2010
2. Ajit Kumar and S. Kumaresan, Abasic course in real analysis, C R C press 2014.
3. James Stewart, Calculus: early transcend dentals, Cengage, 7th edition, 2017.

Additional References:

1. Strauss, Bradley and Smith, Calculus, Pearson 3rd edition, 2002.
2. R.R. Goldberg, Method of real analysis, Oxford and IBH, 1984.
3. T.M. Apostol, Calculus Volume I, second edition, Wiley and Sons (Asia), 1967.
4. K.G. Binmore, Mathematical Analysis, Cambridge university press, 1984.

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Program**:** B.Sc. Mathematics

Course: Algebra II

Semester II

Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

Semester II			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT 202	ALGEBRA II	02	03

SMAT 202	**Algebra II** **(Credits: 02 Lectures/Week:03)**	
	Course Objectives: **1.** The aim of this course is to introduce system of linear equations and matrices which will help them to understand vector spaces. **2.** To introduce the definition of permutation of a set, its cycle notation, order and signature of permutation. To study symmetries of equilateral triangles, squares and rectangle. **3.** To understand the definition of polynomials over a given field, divisional algorithm for polynomials over $\mathbb{R}$, roots of a polynomial and its multiplicity, roots of unity. To study remainder theorem, factor theoremand rational root theorem. **Course Outcomes:** **1.** Students will be able to solve System of line as equations and interpret it geometrically. **2.** Students will be able to define permutation and get acquainted with its properties, transpositions, order and signature of a permutation. **3.** Students will be able to find gcd of two polynomials over $\mathbb{R}$. Use Euclidean algorithm and solve problems based on that. Students will be equipped with different methods of finding roots of a polynomial.	
Unit I	**System of Line are Equations and Matrices:** **1.** System of homogeneous and non-homogeneous linear equations, the solution of system of *m* homogeneous linear equations in *n* unknowns by elimination and its geometrical interpretation. **2.** Definition of an *n*-tuple of real numbers, sum of two *n*-tuples and scalar multiplication of an *n*-tuple. **3.** Matrices with real entries; addition, scalar multiplication and multiplication of matrices; transpose of a matrix, types of matrices: zero matrix, identity matrix, diagonal matrices, triangular matrices, symmetric matrices, skew-symmetric matrices, invertible matrices, identities such as $(AB)^t = B^tA^t, (AB)^{-1} = B^{-1}A^{-1}$ **4.** System of line are equations in matrix form, elementary row operations, row echelon form, Gauss elimination method, the system of *m* homogeneous linear equations in *n* unknown s has a non-trivial solution if $m<n$.	**15L**
Unit II	**Permutations:** **1.** Definition of a permutation of a set, Set of all permutations of the set $\{1,2,\dots,n\}$ $i.e.$ S_n and its cardinality, Symmetries of an equilateral triangle, square, rectangle. **2.** Cycles, Composition of permutations, properties of permutations such as every permutation of a finite set can be written as a cycle or a product of disjoint cycles, disjoint cycles commute. **3.** Transpositions, any permutation can be expressed as a product of transpositions, order of a permutation, sign of a permutation.	**15L**
Unit III	**Polynomials:** **1.** Definition of a polynomial, polynomials over the field F where$F = \mathbb{Q}, \mathbb{R}$ or $\mathbb{C}$, Algebra of polynomials, degree of a polynomial, basic properties. **2.** Divisional algorithm for polynomials over $\mathbb{R}$, gcd of two polynomials and its basic proper-ties, Euclidean algorithm and its applications, roots of a polynomial, relation between roots and co-efficient, multiplicity of a root, remainder theorem, factor theorem.	**15L**

	3. A polynomial of degree *n* has at most *n* roots, Complex roots of a polynomial in $\mathbb{R}[X]$occur in conjugate pairs, statement of Fundamental theorem of algebra, a polynomial of degree *n*. **4.** Rational root theorem and its consequences such as $\sqrt{p}$is an irrational number when p is a prime number, roots of unity, sum of all the roots of unity	

References:

1. S. Kumaresan, Linear algebra, a geometric approach first edition, Prenticeh all of India, 2009.
2. Joseph A.Gallian, Contemporary abstract algebra, fourth edition, Narosa publications, 1999
3. John Fraleigh, A first course in abstract algebra, seventh edition, Pearson, 2013.

Additional References:

1. Norman L. Biggs, Discrete mathematics, second edition, Oxford university press, 2003
2. I.N. Herstein, Topics in algebra, second edition, Wiley India edition, 2008
3. Serge Lang, Introduction to linear algebra, second edition, Springer, 1986

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Program**:** B.Sc. Mathematics

Course: PRACTICAL-II

Semester II

Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

Semester II			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT2 PR2	PRACTICAL-II (Based on SMAT 201 /SMAT 202)	02	02

Semester II – Practical

Course Code: SMAT2 PR2
PRACTICAL-II (Based on SMAT 201, SMAT 202)

Course Objectives:

- To introduce linear equations and matrices to understand vector spaces.
- To learn the definition of continuity and sequential continuity and the equivalence between them.

Course Outcomes:

- To solve System of line as equations and interpret it geometrically.
- To solve problems based on limits and continuity

Practical for Calculus II

1) Problems on limits and continuity using definition
2) Problems on sandwich theorem and intermediate value theorem.
3) Problems on differentiability and Leibnitz rule, L'Hospital's rule
4) Problems based on mean value theorems.
5) Problems on local maxima and minima.
6) Concavity of curves with graphs.

Practical for Algebra II

1) Problems of solving homogeneous system of *m* equations and *n* unknowns by elimination, problems on row echelon form
2) Solving as y stem $Ax = b$ by Gausse limination, finding inverse of a matrix if it exists, solutions of system of linear equations.
3) Permutations of a finite set, Symmetries, cycles, compositions of permutations.
4) Permutation as a product of 2-cycles, order and sign of a permutation.
5) Problems on division algorithm and gcd of two polynomials.
6) Problems based on factor theorem, remainder theorem and rational root theorem.

Evaluation Scheme

I. Continuous Assessment (C.A.) - 40 Marks

C.A.-I: Test (MCQ) – 20 Marks of 30 minutes duration
C.A.-II: Assingnment/Project- 20 Marks

II. Semester End Examination (SEE) - 60 Marks