Shri Vile Parle Kelavani Mandal's

[ITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE & AMRUTBE

JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS (AUTONOMOUS)

NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),

Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of India,

Best College (2016-17), University of Mumbai

Affiliated to the

UNIVERSITY OF MUMBAI

Program: B.Sc.

Course: Mathematics

Semester I & II

Choice Based Credit System (CBCS) with effect from the Academic year 2021-22

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

PREAMBLE

Mathematics has today become integral part of all industry domains as well as fields of academics and research. The industry requirements and technologies have been steadily and rapidly advancing in application of Mathematics. Organizations are increasingly opting for Machine learning techniques and Artificial intelligence which requires strong Mathematical background. The students are thinking beyond career in the industry and aiming for research opportunities. The B.Sc. Mathematics course structure therefore needed a fresh outlook and complete overhaul. A real genuine attempt has been made while designing the new syllabus for this 3- year graduate course. This syllabus prepares the students for a career in industry and also motivates them towards further studies and research opportunities.

The core philosophy of overall syllabus is to

(i) Form strong foundation of Mathematical science,
(ii) Introduce emerging trends to the students in gradual way
(iii) Groom the students for the challenges of industry.

The syllabus proposes to have nine core subjects of Mathematics. All core subjects are proposed to have theory as well as its application. The basic foundation of important skills required for Mathematical development is laid.

We sincerely believe that any student taking this course will get very strong foundation and exposure to basics, advanced and emerging trends of the subject. We hope that the students' community and teachers' fraternity will appreciate the treatment given to the courses in the syllabus.

We wholeheartedly thank all experts who shared their valuable feedbacks and suggestions in order to improvise the contents, we have sincerely attempted to incorporate each of them. We further thank Chairperson and members of Board of Studies for their confidence in us. Special thanks to Department of Mathematics and colleagues from various colleges, who volunteered or have indirectly helped designing certain specialized courses and the syllabus as a whole.

The curriculum retains the current workload of Mathematics Departments.

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Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	Class Test	15 marks
Component 2 (CA-2)	Assignment	10 marks

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
1	On Module I a) b) Attempt any two out of three each of 6 marks	a) 8 b) 12	20
2	On Module II a) b) Attempt any two out of three each of 6 marks	a) 8 b)12	20
3	On Module III a) b) Attempt any two out of three each of 6 marks	a) 8 b) 12	20
4	On Module I,II,III Attempt any 3 out of 6 each of 6 marks	3x5=15	15
		Total Marks	**75**

DEPARTMENT OF MATHEMATICS

SYLLABUS

SEMESTER I

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: B.Sc . (2021-22)				**Semester: I**	
Course: Calculus I				**Course Code:USMAMT 101**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
2 HRS	1 HR	NIL	3	25	75

Learning Objectives:

(1) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of immense power of mathematical ideas.

(2) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Gain the knowledge of fundamental concepts of real numbers.
CO2: Explain the primary concepts of sequences and series of real numbers.
CO3: Define convergence of sequences and series.
CO4: Distinguish between convergence and divergence of sequences and series.
CO5: Analyze the importance of Cauchy's general principle of convergence of sequences and series .
CO6: Distinguish liner and non linear ordinary differential equations.
CO7: Solve linear differential equations with constant and variable coefficients.
CO8: Apply the concept to solve orthogonal trajectories, growth and decay.
CO9:

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Real Number System**	10
2	**Sequences in $\mathbb{R}$**	10
3	**First order First degree Differential equations** **10**	10
	Total	**30**
PRACTICALS		

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

Unit	Topic	No. of Hours/Credits
Module 1	**i) Introduction to Real number system, $\mathbb{R}$ and order properties of $\mathbb{R}$, absolute value function and its properties.** **ii) AM-GM inequality, Cauchy-Schwartz inequality, Intervals and neighbourhoods, Hausdorff property. (iii)** **iii) Bounded set, statement of LUB axiom and its consequences, supremum and infimum.** **iv) Archimedean property and its applications.**	**10 HRS**
Module 2	**(i) Introduction and Definition of a sequence and examples, Types of sequences, Convergent sequence and limit of a sequence, Uniqueness of limit. Some standard examples like: $\langle 1$ $1+na \rangle$ where a > 0, $\langle bn \rangle$where 0 < b < 1, $\langle c1/n \rangle$where c > 0, $\langle n1/n \rangle$** **(ii) Convergent sequence is bounded but not conversely. Divergent sequence. Algebra of convergent sequences** **(iii) Sandwich theorem with proof and examples.** **(iv) (iv)Monotonic sequence, monotone convergence theorem and its application as in $\langle (1 + 1\ n\ )\ n \rangle$. Definition of a Cauchy sequence, examples and results.**	**10 HRS**
Module 3	**(i) Definition of a differential equation, order, degree, ordinary differential equation, Review of solution of homogeneous and non-homogeneous differential equations of first order and first degree** **(ii) (General Solution of Exact equations of first order and first degree. Condition for exactness, Non-exact differential equations, Rules for finding integrating factors for non-exact equations.** **(iii) Linear and reducible to linear equations of first order** **(iv) Applications to orthogonal trajectories, population growth and decay**	**10 HRS**

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PRACTICAL I

Suggested Practicals

1. Properties of real numbers, Absolute Value function.
2. Hausdorff Property, Lower bound, Upper Bound, Supremum and infimum of a set and its properties.
3. Algebra of Supremum and infimum, Applications of Archimedean property, intervals, neighbourhoods.
4. Monotonic sequence, Bounds of a sequence, Unbounded sequence.
5. Limit of a sequence, Cauchy sequence.
6. Divergent sequence, Sandwich theorem for sequences.
7. Variable Separation Method, Homogeneous and non - homogeneous Differential Equations.
8. Exact differential equations and Non-exact differential equations
9. Linear differential equations reducible to linear differential equations and its

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: B.Sc **2021-22**	**Semester: I**
Course: Discrete Mathematics I	**Course Code: USMAMT 101**

Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
2	1	NIL	3	25	75

Learning Objectives:

(1) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of immense power of mathematical ideas and tools and know how to use them by modelling, solving and interpreting.

(2) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

Course Outcomes:

After completion of the course, learners would be able to:

CO10: Express the concepts and results of divisibility of inters effectively.(Understanding)
CO11: Understand the logic and methods behind the major proofs in number theory.(Understanding)
CO12: Solve challenging problems related to Eclidean Algorithms and Eclid theorem effectively(Evaluate)
CO13: Apply Fermat's theorem and Wison theorem effectively(Application)
CO14: Apply concept of Equivalence relation to congruence and partition of Z.(Application)
CO15: Calculations of G.C.D. of polynomials with real coefficients (Analysis)

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Natural Numbers, Integers and Divisibility**	10
2	**Congruence Relation, Introduction to Number Theory, Polynomials with real coefficients**	10
3	**Equivalence relations, Functions and Binary Operations**	10
	Total	**30**
PRACTICALS		

Unit	Topic	No. of Hours/Credits
Module 1	**(i) Introduction & Properties of $\mathbb{N}$, Well Ordering Principle, Theorem & Principles of Induction, Binomial Theorem. (ii)Introduction & Properties of $\mathbb{Z}$, Divisibility in integers, Division Algorithm. (iii)G.C.D & L.C.M, Properties of G.C.D, G.C.D Theorem, Euclidean Algorithm & Applications. (iv) Euclid's lemma, Primes & results, Fundamental theorem of Arithmetic.**	**10**
Module 2	**(i) Congruence relation and properties, Examples based on them. (ii) Euler's phi-function and properties, Euler's theorem (Statement only) and examples, Fermat's Little Theorem with proof and examples, Wilson's Theorem(Statement only) and examples. (iii)Polynomials with real coefficients, Division algorithm (Statement only), GCD of polynomials (iv)Roots of a polynomial, Multiplicity of a root, Fundamental Theorem of Algebra (Statement only), Remainder Theorem, Factor Theorem, Rational Root Theorem.**	**10**
Module 3	**(i) Cartesian product of two sets, definition of relation and examples, reflexive, symmetric and transitive relations. Equivalence relation, Equivalence classes and its properties, Partition of a set, Congruence is an equivalence relation, Partition of $\mathbb{Z}$. (ii)Definition of functions and examples, types of functions: injective, surjective and bijective functions. Invertible functions and the inverse of a function, Composition of functions and related properties. (iii) Binary operations, properties and examples.**	**10**

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

Suggested Practicals

1. Mathematical Induction and Binomial Theorem.
2. Divisibility in Integers
3. Euclidean algorithm and G.C.D., L.C.M. of integers
4. Congruence Relation
5. Application of Euler's, Fermat's and Wilson's Theorem
6. Roots of a polynomial and multiplicity
7. Equivalence Relation and Partition of a set
8. Functions 9. Binary Operations

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

DEPARTMENT OF MATHEMATICS

SYLLABUS

SEMESTER II

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal College of Commerce & Economics (AUTONOMOUS)

Program: B.Sc . 2021-22)				**Semester: II**	
Course: Calculus II				**Course Code: USMAMT 201**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
2	1	NIL	3	25	75

Learning Objectives:

(1) Enhancing students' overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent and enhance power of communication necessary for various kinds of employment.

(2) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Recall the concept of derivative ,rules of differentiation and understand the concepts of differential equations.(Revision)

CO2: Learn the concepts of curvature, evaluate and apply the concepts the concept to solve problems.(Understanding,Application)

CO3: Calculate the limit and limit point of sequences.(Anlysis)

CO4: Verify the value of the limit of a function at a point using the definition of the limit.(Application)

CO5: Check continuity of functions, understand the consequences of the intermediate value theorem for the continuous functions.(Application.Analysis)

CO6: Geometrical representation and problem solving on MVT and Roll's theorem.(Application)

CO7: Use of Scilab for curve tracing.(Analysis)

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Graphs, Limits and Continuity**	10
2	**Differentiation**	10
3	**Application of differentiation and Curve Tracing** **10**	10
	Total	**30**
PRACTICALS		

Unit	Topic	No. of Hours/Credits 2 credits
Module 1	**(i) Brief Review of a function, Graphs of some standard functions such as |x|, exp(x), log(x), sin(x), cos(x), tan(x), sin–1(x), cos–1(x) over suitable domain and analysis of such functions by plotting graphs.** **(ii) $\epsilon-\delta$ definition of Limit of a function and Continuity of a function at a point, Examples based on this concept, Uniqueness of Limit, Sequential continuity and its application.** **(iii) Algebra of Limit of a function/Continuity of a function at a point, Limit of composite functions, Left-hand limit, Right-hand limit, non-existence of limit, Infinite limit and Limit at infinity, Discontinuous Function, Examples of removable and essential discontinuity.** **(iv) Sandwich theorem with proof and examples, Intermediate Value Theorem and its application.**	**10**
Module 2	**(i) Definition of Differentiation of real valued function of one variable & examples of differentiable and non–differentiable functions, differentiable functions are continuous but not conversely.** **(ii) Algebra of differentiable functions, Chain rule.** **(iii) Higher order derivatives, nth order derivative formula for Standard functions and examples.** **(iv) Leibnitz rule for derivatives (with Proof) & examples.**	**10**
Module 3	**(i) Rolle's Theorem, Lagrange's and Cauchy's Mean value theorem** **(ii) Monotonic functions and examples, L'Hospital's rule and examples, Taylor's Theorem and examples** **(iii) Examples on Local maximum point, minimum point, stationary point, First and second derivative test and examples, Concave and convex functions, points of inflection** **(iv) Basics of SciLab, User defined Functions in SciLab, Curve tracing using Scilab.**	**10**

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

Suggested Practicals

1. Limit of a function and Sequential continuity
2. Infinite limit, Limit at infinity, Discontinuous Function
3. Sandwich theorem, Intermediate Value Theorem
4. Differentiable Function,
5. Higher order derivatives, Leibnitz rule,
6. Mean value theorems and its applications, Increasing/decreasing function
7. Extreme Values, L'Hospital's rule, Taylor's Theorem,
8. Introduction to SciLab. 9. Curve sketching using scilab.

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Program: B.Sc . (2021-22)				**Semester: II**	
Course: Dicrete Mathematics II				**Course Code: USMAMT 202**	
Teaching Scheme				**Evaluation Scheme**	
Lecture (Hours per week)	**Practical (Hours per week)**	**Tutorial (Hours per week)**	**Credit**	**Continuous Assessment (CA) (Marks - 25)**	**Semester End Examinations (SEE) (Marks- 75 in Question Paper)**
2	1	NIL	3	25	75

Learning Objectives:

(1) Enhancing students' overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent and enhance power of communication necessary for various kinds of employment.

(2) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.

Course Outcomes:

After completion of the course, learners would be able to:

CO1: Apply Pigeonhole Principle to general (practical) examples.(Application)

CO2: Understand counting principle, principle of inclusion and exclusion.(Understanding)

CO3: Apply Sterling numbers of second kind to solve problems.(Application)

CO4: Compute sums, product, quotients, conjugate , modules and arguments of complex numbers.(Analysis)

CO5: Solve homogeneous linear recurrence relation and examples(.Computation)

Outline of Syllabus: (per session plan)

Module	**Description**	**No of Hours**
1	**Counting Techniques**	10
2	**Permutations**	10
3	**Complex Numbers and Recurrence Relation**	10
	Total	**30**
PRACTICALS		

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

Unit	Topic	No. of Hours/Credits
Module 1	**(i) Pigeonhole Principle, applications and examples. (ii)Counting Principles, Permutations and Combinations, Binomials and Multinomial Theorem, Principle of Inclusion and Exclusion. (iii)Sterling's Number of Second kind definition and applications**	
Module 2	**(i) Introduction to permutations, Set of all permutations on a n-set, Composition of permutations, Cyclic permutation, Transposition. (ii) Order of a permutation, Inversion of permutations, Sign of a permutation, Odd/Even permutations, Decomposition of a permutation as a product of disjoint cycles. (iii) Derangement definition and examples.**	
Module 3	**(i) Introduction to $\mathbb{C}$, Cartesian and polar form, Geometrical Interpretation using Argand's diagram, Algebra of Complex Numbers. (ii) De Moivre's theorem and its applications, nth roots of unity and –1, th roots of complex numbers. (iii)Introduction to linear recurrence relation and formation of related problems, solution using back-tracking method, general method to solve homogeneous linear recurrence relation and examples.**	

PRACTICAL I

Suggested Practicals

1. Pigeonhole Principle
2. Counting Principles, Multinomials and Inclusion-Exclusion Principle
3. Stirling's Number of Second kind and applications
4. Permutations and compositions
5. Inverse, order and decomposition of a permutation
6. Sign of a permutation, Even/odd permutations, Derangements
7. Complex Numbers, nth roots of complex numbers.

8. Recurrence relation solutions using iterative approach 9. Homogeneous Linear Recurrence Relations