**Academic Council Meeting No. and Date: 8 / September 04, 2023**

**Agenda Number : 2 Resolution Number : 34, 35 / 2.3, 2.24**

**Vidya Prasarak Mandal's**

# B. N. Bandodkar College of Science (Autonomous), Thane

## Syllabus for

# Programme : Bachelor of Science

# Specific Programme : Mathematics

## [Major/Minor]

# [ F.Y.B.Sc. Mathematics]

## Level 4.5

**CHOICE BASED GRADING SYSTEM**

## Revised under NEP

**From academic year 2023 - 2024**

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**Eligibility:**

Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board with Mathematics as one of the subject.

**Duration :** 3 years ( level 4.5) (includes SEM I and SEM II)

**Mode of Conduct:**

Laboratory practicals / Offline lectures / Online lectures

Laboratory Practicals / Offline lectures / Online lectures

Total Credits for the Program: 44 Starting year of implementation: 2023- 24

Name of the Degree Program: B.Sc

Discipline/Subject: Mathematics

**Specific Programme:**

**F.Y.B.Sc. (Mathematics) (Major/Minor) Credits: 06**

**F.Y.B.Sc (Mathematics) (Skill Development) Credits: 02**

**F.Y.B.Sc (Mathematics) (Generic) Credits: 02**

# F.Y.B.Sc Mathematics (Major/ Minor)

## Preamble

Department of mathematics of VPM'S B. N. Bandodkar College of Science Autonomous has designed the syllabus of F.Y.B.Sc. Mathematics for the academic year 2023-24 under NEP 2020.

Mathematics is the most fundamental subject and an essential tool in the field of Science and Technology. The syllabus has been developed to prepare the students in pursuing research in Mathematics as well as to enhance their analytical skills and knowledge of mathematical tools and techniques required in industry for employment.

In recent decades, the extent of application of Mathematics to real world problems has increased by leaps and bounds. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects like Physics, Statistics and Computer Sciences, the board of studies in Mathematics has prepared the syllabus of F.Y.B.Sc. Mathematics. The present syllabi of F. Y. B. Sc. for Semester I and Semester II has been designed as per U. G. C. Model curriculum so that the students learn Mathematics needed for these branches, learn basic concepts of Mathematics and are exposed to rigorous methods gently and slowly. The syllabi would consist of two semesters and each semester would comprise of two courses for F. Y. B. Sc. Mathematics. Course I is 'Calculus I and Calculus II'. Calculus is applied and needed in every conceivable branch of science. Course II, 'Discrete Mathematics and Combinatorics' develops mathematical reasoning and logical thinking and has applications in science and technology.

**Course Outcome**

- Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling, solving and interpreting.
- Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
- Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences

**Program Specific Outcomes**

- To understand the basic concepts and fundamental theories of Mathematics
- To develop problem solving and computing skills
- To use mathematical concepts learnt for deducing proofs with logical reasoning
- To develop analytical skills and understanding of abstract theories of Mathematics
- To learn various mathematical tools and techniques and apply them in real world

## BOS Chairman: Mrs. Minal Wankhede

# VPM's B.N.Bandodkar College of Science (Autonomous), Thane

**F.Y.B.Sc. (Mathematics)**

**Structure of Programme**

| **Semester 1: Major** | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **No. of lectures In hrs** | **Credits** |
| **23BUMT1T1** | Major 1 | **30** | **2** |
| **23BUMT1T2** | Major 2 | **30** | **2** |
| **23BUMT1P1** | Mathematics Practicals | **60** | **2** |
| **23BU1 SEC7** | SEC | **45** | **2** |
| | ***Total*** | **165** | **8** |
| **Semester 1: Minor** | | | |
| **Course Code** | **Course Title** | **No. of lectures In hrs** | **Credits** |
| **23BUMT1T3** | Minor 1 | **30** | **2** |
| **23BUMT1T4** | Minor 2 | **30** | **2** |
| **23BUMT1P2** | Mathematics Practicals | **60** | **2** |
| | ***Total*** | **120** | **6** |
| **Semester 1: Generic** | | | |
| **23BUMT1T5** | Mathematics -I (Generic-1) | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Optional Electives Semester 1 -Interdisciplinary Sciences** | | | |
| **23BUID1T6** | **Soft skills and personality development-I** | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Course Title Semester 1 - (AEC)** | | | |
| **23BUEN1T8** | **Basic English Learning course** | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Semester 1 - Indian Knowledge System** | | | |
| 23BUIK1T9 | The Ancient Indian Social Structure. -I | **30** | **2** |
| | ***Total*** | **2** | |

| Semester 2: Major | | | |
|---|---|---|---|
| **Course Code** | **Course Title** | **No. of lectures In hrs** | **Credits** |
| **23BUMT2T1** | Calculus II - Major 1 | **30** | **2** |
| **23BUMT2T2** | Combinatorics- Major 2 | **30** | **2** |
| **23BUMT2P1** | Mathematics Practicals based on Paper I and Paper II | **60** | **2** |
| **23BU2SEC7** | SEC -Application of Derivative and Permutation | **45** | **2** |
| | ***Total*** | **165** | **8** |
| **Semester 2: Minor** | | | |
| **Course Code** | **Course Title** | **No. of lectures In hrs** | **Credits** |
| **23BUMT2T3** | Minor 1 | **30** | **2** |
| **23BUMT2T4** | Minor 2 | **30** | **2** |
| **23BUMT2P2** | Mathematics Practicals | **60** | **2** |
| | ***Total*** | **120** | **6** |
| **Semester 2: Generic** | | | |
| **23BUMT2T5** | Applied Mathematics -I (Generic-2) | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Optional electives Semester 2-Interdisciplinary sciences** | | | |
| **23BUID2T6** | **Soft skills and personality development-II** | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Course Title Semester 2 (AEC)** | | | |
| **23BUEN2T8** | **Scientific *English writing*** | **30** | **2** |
| | ***Total*** | **30** | **2** |
| **Semester 2- Indian Knowledge System** | | | |
| 23BUIK2T9 | The Ancient Indian Social Structure. -II | **30** | **2** |
| | ***Total*** | **30** | **2** |

**Note**: AEC , IKS, Open elective syllabus view separately.

# Semester I

| Course Code Paper I 23BUMT1T1/ 23BUMT1T3 | Course Title Semester I Calculus I | Credits 2 | No. of lectures 30 |
|---|---|---|---|

**Course Outcomes:** Upon completion of this course, students will learn about

- Mathematical aspects of Real Number system
- Sequences of real numbers

| | | |
|---|---|---|
| **Unit I :** | **Real Number System**<br>Real number system IR and order properties of IR, absolute value \| \| and its properties.<br>AM-GM inequality, Cauchy-Schwarz inequality,<br>Intervals and neighbourhoods in IR, Hausdorff property.<br>Bounded sets, statements of L.u.b. axiom and its consequences, supremum and infimum of set, maximum and minimum, Archimedean property and its applications, density theorem of rationals. | **15** |
| **Unit II:** | **Sequences In IR**<br>Definition of a sequence in IR and examples, Convergence of sequences, every convergent sequence is bounded. Limit of a convergent sequence and uniqueness of limit, divergent sequence.<br>Convergence of standard sequences.<br>Algebra of convergent sequences, sandwich theorem, monotone sequences, monotone convergence theorem and consequences.<br>Definition of subsequence, subsequence of a convergent sequence is convergent and converges to the same limit, definition of a Cauchy sequences, every convergent sequence is Cauchy sequence and converse. | **15** |

**Books and References:**

| Sr. No. | Title | Author/s | Publisher | Edition | Year |
|---|---|---|---|---|---|
| 1. | Methods of Real Analysis | R. R. Goldberg | Oxford and IBH | | 1964 |
| 2. | Mathematical Analysis | K.G. Binmore | Cambridge University Press | | 1982 |
| 3. | Introduction to Real Analysis | R. G. Bartle and D. R. Sherbert | John Wiley & Sons | | 1994 |
| 4. | A course in Calculus and Real Analysis | Sudhir Ghorpade and Balmohan Limaye | Springer International Ltd. | | 2000 |

| Course Code<br>Paper II<br>23BUMT1T2/<br>23BUMT1T4 | Course Title<br>Semester I Discrete Mathematics | Credits<br>2 | No. of lectures<br>30 |
|---|---|---|---|

**Course Outcomes:** Upon completion of this course, students will learn about

- Divisibility of integers.
- Properties of equivalence relations and partitions.

**Prerequisites:**

Set Theory: Set, subset, union and intersection of two sets, empty set, universal set, complement of a set, De Morgan's laws, Cartesian product of two sets, Relations, Permutations and combinations.

Complex numbers: Addition and multiplication of complex numbers, modulus, amplitude and conjugate of a complex number.

| | | |
|---|---|---|
| **Unit I :** | **Integers & Divisibility.**<br><br>Statements of well-ordering property of non-negative integers, Principle of finite induction (first and second) as a consequence of well-ordering property, Binomial theorem for non-negative exponents, Pascal Triangle. Divisibility in integers, division algorithm, greatest common divisor (g.c.d.) and least common multiple (l.c.m.) of two integers, basic properties of g.c.d. such as existence and uniqueness of g.c.d. of integers a and b and that the g.c.d. can be expressed as ma + nb where m, n are in Z, Euclidean algorithm, Primes, Euclid's lemma, Fundamental theorem of arithmetic, the set of primes is infinite. Congruence, definition and elementary properties, Euler's function, Statements of Euler's theorem, Fermat's theorem and Wilson theorem, Applications. | **15** |
| **Unit II :** | **Functions and Equivalence relations.**<br><br>Definition of a function, domain, codomain and range of a function, composite functions, examples, Direct image f [A] and inverse image $f^{-1}[A]$ of a function. Injective, surjective, bijective functions, Composite of injective, surjective, bijective functions, Invertible functions, Bijective functions are invertible and conversely, Examples of functions including constant, identity, projection, inclusion, Binary operation as a function, properties, examples. Equivalence relations, Equivalence classes, properties such as two equivalences classes are either identical or disjoint. Definition of partition, every partition gives an equivalence relation and vice versa,<br><br>Congruence an equivalence relation on Z, Residue classes, Partition of Z, Addition modulo n, Multiplication modulo n, examples, conjugate classes. | **15** |

**Books and References:**

| Sr. No. | Title | Author/s | Publisher | Edition | Year |
|---|---|---|---|---|---|
| 1. | Elementary Number Theory | David M. Burton | McGraw Hill Education (India) Private Ltd | 7th | |
| 2. | Discrete Mathematics | Norman L. Biggs | Clarendon Press, Oxford | Revised | 1989 |

| | | | | | |
|---|---|---|---|---|---|
| 3. | Introduction to the theory of numbers | I. Niven and S. Zuckerman | Wiley Eastern, New Delhi | 3rd | 1972 |
| 4. | A Survey of Modern Algebra | G. Birkoff and S. Maclane | Mac Millan, New York | 3rd | 1965 |
| 5. | Basic Abstract Algebra | P. B. Bhattacharya S. K. Jain and S. R. Nagpaul | New Age International | | 1994 |

| **Course Code 23BUMT1P1** | **Course Title** **Practical based on Paper 1 and paper II** | **Credits 2** | **No. of practicals** |
|---|---|---|---|
| | **Practical based on Paper I** | | |
| **Practical 1** | **Algebraic and order properties of real numbers** | | **4** |
| **Practical 2** | **Inequalities and absolute value property** | | **4** |
| **Practical 3** | **Hausdorff property and LUB axiom property** | | **4** |
| **Practical 4** | **Archemedian property** | | **4** |
| **Practical 5** | **Convergence and divergence of sequences, bounded sequences, Sandwich Theorem.** | | **4** |
| **Practical 6** | **Cauchy sequences, monotonic sequences, non-monotonic sequences.** | | **4** |
| **Practical 7** | **Miscellaneous Theoretical Questions based on full paper I** | | **4** |
| | **Practical based on paper II** | | |
| **Practical 8** | **Division Algorithm, Euclidean algorithm** | | **4** |
| **Practical 9** | **Primes and the Fundamental theorem of Arithmetic,** | | **4** |
| **Practical 10** | **Functions, Bijective and Invertible functions, Compositions of functions.** | | **4** |
| **Practical 11** | **Binary Operation, Equivalence Relations, Partition and Equivalence classes.** | | **4** |
| **Practical 12** | **Polynomial (I)** | | **4** |
| **Practical 13** | **Polynomial (II)** | | **4** |
| **Practical 14** | **Miscellaneous Theoretical Questions based on full paper** | | **4** |
| **Practical 15** | **All multiple choice questions based on paper I and paper II** | | **4** |
| | **Total** | | **60** |

# Semester II

| Course Code<br>23BUMT2T1<br>(Major)<br>/<br>23BUMT2T3<br>(Minor) | Course Title<br><br>CALCULUS II | Credits<br><br>2 | No. of lectures<br>30 |
|---|---|---|---|

**Learning Outcomes:** Students would gain enough knowledge of

- ❖ Definition of Limits of functions
- ❖ Definition of Continuity of functions and its applications

| | | |
|---|---|---|
| **Unit I :** | **Limits and Continuity**<br>Graphs of functions<br>Definitions of limit of a function, uniqueness of limit if it exists, Algebra of limits, limits of composite functions, Sandwich theorem, left hand limit, right hand limit, non-existence of limit<br>Limit at infinity, infinite limit<br>Continuous functions: Continuity of a real valued function at a point and on a set. Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.<br>Intermediate Value theorem and its applications, Bolzano-Weierstrass theorem (statement only): A continuous function on a closed and bounded interval is bounded and attains its bounds. | **15** |
| **Unit II :** | **Differentiabilty of functions**<br>Differentiation of real valued function of one variable: Definition of differentiability of a function at a point of an open interval, examples of differentiable and non-differentiable functions, differentiable functions are continuous but not conversely, algebra of differentiable functions.<br>Chain rule, Higher order derivatives, Leibniz rule, Derivative of inverse functions, Implicit differentiation(only examples) | **15** |

**Books and references:**

| Title | Author/s | Publisher | Edition | Year |
|---|---|---|---|---|
| Methods of Real Analysis | R. R. Goldberg | Oxford and IBH | | 1964 |
| Calculus | James Stewart | Brooks/Cole Publishing company | | 1994 |
| Calculus, Vol I | T.M.Apostol | WileyAndSons(Asia )Pvt.Ltd | | |
| A course in Calculus and Real Analysis | Sudhir Ghorpade and Balmohan Limaye | Springer International Ltd. | | 2000 |

| Course Code<br>23BUMT2T2/<br>23BUMT2T4 | Course Title<br>**Combinatorics** | Credits<br>2 | No. of lectures<br>30 |
|---|---|---|---|

**Learning Outcomes:** Students would gain enough knowledge about-

- ❖ Counting principles
- ❖ Permutation and combination
- ❖ derangements

| | | |
|---|---|---|
| **Unit I :** | **Preliminary Counting**<br>Finite and infinite sets, countable and uncountable sets examples such as N, Z, N × N, Q (0, 1), R.<br>Addition and multiplication Principle, counting sets of pairs, two ways counting.<br>Stirling numbers of second kind. Simple recursion formulae satisfied by S(n, k) for k =1, 2, · · · , n − 1, n.<br>Pigeonhole principle simple form(only statement). | **15** |
| **Unit II :** | **Advanced Counting**<br>Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.<br>Binomial and Multinomial Theorem, Pascal identity, examples of standard identities such as the following with emphasis on combinatorial proofs.<br>• $\sum_{k=0}^{r}\binom{m}{k}\binom{n}{r-k}=\binom{m+n}{r}$ • $\sum_{i=0}^{k}\binom{k}{i}^2=\binom{2k}{k}$<br>• $\sum_{i=r}^{n}\binom{i}{r}=\binom{n+1}{r+1}$ • $\sum_{i=0}^{n}\binom{n}{i}=2^n$<br>Non-negative integer solutions of equation $x_1 + x_2 + \cdots + x_k = n$.<br>Principal of inclusion and exclusion, its applications, derangements, explicit formula for $d_n$, deriving formula for Euler's function φ(n). | **15** |

**Books and References:**

| Sr. No. | Title | Author/s | Publisher | Edition | Year |
|---|---|---|---|---|---|
| 1. | Discrete Mathematics | Norman Biggs | Oxford University Press | | |
| 2. | Introductory Combinatorics | Richard Brualdi | John Wiley and sons | | |
| 3. | Combinatorics-Theory and Applications | V. Krishnamurthy | Affiliated East West Press. | | |
| 4. | Discrete Mathematics and its Applications | - | Tata McGraw Hills | | |
| 5. | Discrete mathematics | - | Schaum's outline series | | |

| Course Code Practical 23BUMT2P1 | Course Title Practical based on Paper I and Paper II | Credits 2 | No. of practicals |
|---|---|---|---|
| | **Practical based on BNBUSMT201** | | |
| **Practical 1** | Limit of a function and Sandwich theorem, Continuous and discontinuous function. | | **4** |
| **Practical 2** | Algebra of limits and continuous functions, Intermediate Value theorem | | **4** |
| **Practical 3** | Properties of differentiable functions, derivatives of inverse functions and implicit functions. | | **4** |
| **Practical 4** | Higher order derivatives, Leibnitz Rule. | | **4** |
| **Practical 5** | Mean value theorems and its applications, L'Hospital's Rule, Increasing and Decreasing functions. | | **4** |
| **Practical 6** | Extreme values, Taylor's Theorem and Curve Sketching. | | **4** |
| **Practical 7** | Miscellaneous Theoretical Questions based on full paper | | **4** |
| | **Practical based on BNBUSMT202** | | |
| **Practical 8** | Finite, Infinite, Countable and Uncountable sets. Counting principles, Two way counting. | | **4** |
| **Practical 9** | Stirling numbers of second kind, Pigeon hole principle. | | **4** |
| **Practical 10** | Multinomial theorem, identities, permutation and combination of multi-set. | | **4** |
| **Practical 11** | Inclusion-Exclusion principle. Euler phi function. | | **4** |
| **Practical 12** | Composition of permutations, signature of permutation, inverse of permutation | | **4** |
| **Practical 13** | Recurrence relation. | | **4** |
| **Practical 14** | Miscellaneous Theoretical Questions based on full paper | | **4** |
| **Practical 15** | Multiple choice questions on entire syllabus | | **4** |
| | **Total** | | **60** |

## Evaluation Scheme

**Internals**

| Class Test/Assignment | Active Participation& Leadership qualities | Total |
|---|---|---|
| **20 Marks Class Test** | **10** | **40** |
| **10 Marks Assignment/Project** | | |

**Internal Examination:** **Based on Unit 1 / Unit 2 of Paper I and Paper II**
**Duration: 1 Hour** **Total Marks: 20**

| | | |
|---|---|---|
| | Answer the following | **20** |
| **Q. 1** | **Based on Unit I of paper I** | **10** |
| **Q. 2** | **Based on Unit I of Paper II** | **10** |

**Theory Examination:** **Suggested Format of Question paper**
**Duration: 1.30 Hours** **Total Marks : 30**
**All questions are compulsory**

| | | | |
|---|---|---|---|
| **Q.1** | **Attempt ANY TWO of the following** | | **(10)** |
| **(A)** | Unit 1 | | |
| **(B)** | Unit 1 | | |
| **(C)** | Unit 1 | | |
| **(D)** | Unit 1 | | |
| **Q.2** | **Attempt ANY TWO of the following** | | **(10)** |
| **(A)** | Unit 2 | | |
| **(B)** | Unit 2 | | |
| **(C)** | Unit 2 | | |
| **(D)** | Unit 2 | | |
| **Q.3** | **Answers the following (Attempt ANY TWO)** | | **(10)** |
| **(A)** | **Fill in the blanks** | | |
| | i) | Unit 1 | |
| | ii) | Unit 1 | |
| | iii) | Unit 2 | |
| | iv) | Unit 2 | |
| | v) | Unit 2 | |
| **(B)** | **Multiple choice questions.** | | |
| | i) | Unit 1 | |
| | ii) | Unit 1 | |
| | iii) | Unit 1 | |
| | iv) | Unit 2 | |
| | v) | Unit 2 | |
| **(C)** | **Match the following** | | |
| | i) | Unit 1 | |
| | ii) | Unit 1 | |
| | iii) | Unit 2 | |

| | | | |
|---|---|---|---|
| | iv) | Unit 2 | |
| | v) | Unit 2 | |
| (D) | **True and False** | | |
| | i) | Unit 1 | |
| | ii) | Unit 1 | |
| | iii) | Unit 1 | |
| | iv) | Unit 2 | |
| | v) | Unit 2 | |

**Marks Distribution and Passing Criterion for Each Semester**

**Semester 1: Major**

| **Theory** | | | | |
|---|---|---|---|---|
| Course Code | Internal | Min marks for passing | Theory Examination | Min marks for passing |
| 23BUCH 1T1 | **20** | **08** | **30** | 12 |
| 23BUCH 1T2 | **20** | **08** | **30** | 12 |
| 23BUCH 1P1 | - | - | **50** | 20 |

**Semester 1: Minor**

| **Theory** | | | | |
|---|---|---|---|---|
| Course Code | Internal | Min marks for passing | Theory Examination | Min marks for passing |
| 23BUCH 1T3 | **20** | **08** | **30** | 12 |
| 23BUCH 1T4 | **20** | **08** | **30** | 12 |
| 23BUCH 1P2 | - | - | **50** | 20 |

**Semester 2: Major**

| **Theory** | | | | |
|---|---|---|---|---|
| Course Code | Internal | Min marks for passing | Theory Examination | Min marks for passing |
| 23BUCH 2T1 | **20** | **08** | **30** | 12 |
| 23BUCH 2T2 | **20** | **08** | **30** | 12 |
| 23BUCH 2P1 | - | - | **50** | 20 |

**Semester 2: Minor**

| **Theory** | | | | |
|---|---|---|---|---|
| Course Code | Internal | Min marks for passing | Theory Examination | Min marks for passing |
| 23BUCH 2T3 | **20** | **08** | **30** | 12 |
| 23BUCH 2T4 | **20** | **08** | **30** | 12 |
| 23BUCH 2P2 | - | - | **50** | 20 |

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## Semester I
## (Mathematics Skill Development)

| Course Code<br>23BU1 SEC7 | Course Title<br>**Infinite series and Polynomials** | Credits<br>2 | No. of lectures<br>15 |
|---|---|---|---|

Course outcome: After completion of the course, the students will develop the skills regarding the different tests of convergence of series. Students will also learn the in-depth knowledge of polynomials and its applications to solve various mathematical equations.

| | | |
|---|---|---|
| **Unit I:** | **Infinite Series**<br>1. Infinite series in IR. Definition of convergence and divergence. Basic examples including geometric series. Elementary results such as if $\sum_{n=1}^{\infty} a_n$ converges then $a_n \to 0$ but converse is not true. Cauchy criterion. Algebra of convergent series.<br>2. Tests for convergence. Comparison Test, Limit Comparison Test, Ratio Test, Root test, Abel Test (without proof), Dirichlet Test (without proof). Examples. The decimal expansion of real numbers. Convergence of $\sum_{n=1}^{\infty} \frac{1}{n^p}$ $(p > 1)$. Divergence of Harmonic series $\sum_{n=1}^{\infty} \frac{1}{n}$.<br>3. Alternating series, Leibnitz rule, Examples. Absolute convergence. Absolute convergence implies convergence but not conversely. Conditional convergence. | **15** |
| Unit II | **Polynomials.**<br>Definition of polynomial, polynomials over F where F = Q, R, C. Algebra of polynomials, degree of polynomial, basic properties, Division algorithm in F[X](without proof) and g.c.d. of two polynomials and its basic properties (without proof), Euclidean algorithm (without proof), applications, Roots of a polynomial, relation between roots and coefficients, multiplicity of a root, Remainder theorem, Factor theorem, A polynomial of degree n over F has at most n roots.<br>Complex roots of a polynomial in R[X] occur in conjugate pairs, Statement of Fundamental Theorem of Algebra, A polynomial of degree n in R[X] has exactly n complex roots counted with multiplicity. A non-constant polynomial in R[X] can be expressed as a product of linear and quadratic factors in C[X]. Necessary condition for a rational number to be a root of a polynomial with integer coefficients, simple consequences such as p is an irrational number where p is a prime number, nth roots of unity, sum of nth roots of unity. | **15** |

| Books and References: Semester I ( Mathematics Skill development) | | | | | |
|---|---|---|---|---|---|
| **Sr. No.** | **Title** | **Author/s** | **Publisher** | **Edition** | **Year** |
| 1. | Methods of Real Analysis | R. R. Goldberg | Oxford and IBH | | 1964 |
| 2. | Calculus and Analytic Geometry | Thomas and Finney | Addison-Wesley | | 1998 |
| 3. | Introduction to Real Analysis | R. G. Bartle and D. R. Sherbert | John Wiley & Sons | | 1994 |
| 4. | Discrete Mathematics | Norman L. Biggs | Clarendon Press, Oxford | Revised | 1989 |
| 5. | G. Birkoff and S. Maclane | A Survey of Modern Algebra | Mac Millan, New York | 3rd | 1965 |
| 6. | P. B. Bhattacharya S. K. Jain and S. R. Nagpaul | Basic Abstract Algebra | New Age International | | 1994 |

# Semester II

# (Mathematics Skill Development)

| Course Code<br>23BU2SEC7 | Course Title<br>Application of Derivative and Permutation | Credits<br>2 | No. of lectures<br>15 |
|---|---|---|---|
| **Course outcome**: After completion of the course, the students will develop the skills regarding the applications of derivative. Students will also learn the in-depth knowledge of permutations and recurrence relation and its applications. | | | |
| **Unit I:** | **Applications of Differentiability**<br>Rolle's Theorem, Lagrange's and Cauchy's Mean Value Theorems, applications and examples, Monotone increasing and decreasing functions, examples.<br>L-Hospital rule (without proof), examples of indeterminate forms, Taylor's theorem withLagrange's form of remainder with proof, Taylor polynomial and applications.<br>Definition of critical point, local maximum/minimum, necessary condition, stationary points, second derivative test, examples, concave/convex functions, point of inflection.<br>Sketching of graphs of functions using properties. | | **15** |
| **Unit II** | **Permutations and Recurrence relation.**<br>Permutation of objects, $S_n$, composition of permutations, results such as every permutation is a product of disjoint cycles, every cycle is a product of transpositions, signature of a permutation, even and odd permutations, cardinality of $S_n$, $A_n$.<br>Recurrence Relations, definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation, obtaining recurrence relations of Tower of Hanoi, Fibonacci sequence, etc. in counting problems, solving homogeneous as well as non-homogeneous recurrence relations by using iterative methods, solving a homogeneous recurrence relation of second degree using algebraic method proving the necessary result. | | **15** |

**Books and References: Semester II skill development**

| Sr. No. | Title | Author/s | Publisher | Edition | Year |
|---|---|---|---|---|---|
| **1.** | Methods of Real Analysis | R. R. Goldberg | Oxford and IBH | | 1964 |
| **2.** | Mathematical Analysis | K.G. Binmore | Cambridge University Press | | 1982 |
| **3.** | Introduction to Real Analysis | R. G. Bartle and D. R. Sherbert | John Wiley & Sons | | 1994 |
| **4.** | Elementary Number Theory | David M. Burton | McGraw Hill Education (India) Private Ltd | 7th | |
| **5.** | Discrete Mathematics | Norman L. Biggs | Clarendon Press, Oxford | Revised | 1989 |
| 6. | I. Niven and S. Zuckerman | Introduction to the theory of numbers | Wiley Eastern, New Delhi | 3rd | 1972 |

# Semester I and II

# Mathematics Generic

| Course Code<br>23BUMT1T5 | Course Title<br>Mathematics Generic (Semester I)<br>Applied Mathematics I | Credits 2 | No. of lectures<br>30 |
|---|---|---|---|
| **Course outcome:** After completion of the course, the students will develop the skills regarding the applications of basic mathematics. | | | |
| **Unit I:** | Number System, LCM and HCF, Decimal fractions, Simplifications, square roots and cube roots, Average, problems on ages, Surds and Indices | | **15** |
| **Unit II:** | Logarithm, Permutation and combinations, Probability, profit and loss, Simple and Compound interest, speed and distance, time and work, Ratio and proportion, Area | | **15** |

| Course Code<br>23BUMT2T5 | Course Title<br>Mathematics Generic (Semester II)<br>Applied Mathematics II | Credits 2 | No. of lectures<br>30 |
|---|---|---|---|
| **Course outcome:** After completion of the course, the students will develop the skills regarding the applications of basic mathematics. | | | |
| **Unit I:** | Data interpretation, Tables, Column Graphs, Bar Graphs, Line Chart, Pie Chart | | **15** |
| **Unit II:** | Set theory, Matrices, Relations and functions, Equations and Matrices | | **15** |

Books and references:


1. A modern approach to verbal and Non Verbal reasoning by R. S. Agarwal
2. Quantitative aptitude for competitive examination by R. S. Agrawal


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