R.E. Society's

R. P. Gogate College of Arts & Science and R. V. Jogalekar College of Commerce (Autonomous), Ratnagiri

Bachelor of Science (B.Sc.) Mathematics Programme

Three Year Integrated Programme

Six Semesters

Syllabus for Semester : I & II

Under Choice Based Credit System (CBCS)

To be implemented from Academic Year- 2024-2025

Name of Programme	**B.Sc. Mathematics**
Level	UG
No. of Semesters	06
Year of Implementation	**2024-25**
Programme Specific Outcomes (PSO)	1. Learner shall able to develop positive attitude towards mathematics as an interesting and valuable subject. 2. Enhancing students' overall development and to equip them with mathematical modelling, abilities, problem solving skills, creative talent. 3. Learner should be able to acquire good knowledge and understanding in advanced areas of mathematics. 4. Learner should apply Mathematical models to the problems of society.
Relevance of PSOs to the local, regional, national, and global developmental needs	Mathematics is useful at Global, Regional and local level. Better understanding of mathematics helps the student to visualise the solution of the problems in society. The application part is taken care of so that the learner should be able to create mathematical models to the problems in society. The skill set, knowledge acquired during the completion of programme shall make him employable in fields like Teaching, Banking, Research analyst, various IT industries.

Evaluation Scheme:

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed with Continuous Evaluation (CE) and Semester End Evaluation (SEE). Continuous Evaluation of each course will be of 40% and Semester End Evaluation of each course will be of 60%. The allocation of marks for the Internal Assessment and Semester End Examinations is given under every course.

Standard of Passing:

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Continuous Internal Evaluation & Semester End Examination. The learner shall obtain minimum of 40% marks in the CIE and 40% marks in SEE separately, to pass the course and minimum of Letter Grade "P" in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the CIE & SEE together.

Performance Grading:

Credit, Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result	Credits Earned
9.00-10.00	90.0 -100	O (Outstanding)	As per mentioned for every course
8.00 ≤ 9.00	80.0 ≤ 90.0	A+ (Excellent)	
7.00 ≤ 8.00	70.0 ≤ 80.0	A (Very Good)	
6.00 ≤ 7.00	60.0 ≤ 70.0	B+ (Good)	
5.50 ≤ 6.00	55.0 ≤ 60.0	B (Above Average)	
5.00 ≤ 5.50	50.0 ≤ 55.0	C (Average)	
4.00 ≤ 5.00	40.0 ≤ 50.0	P (Pass)	
Below 4.00	Below 40	F (Fail)	0
Ab (Absent)	-	Absent	

Bachelor of Science (B.Sc.) Mathematics Programme
Under Choice Based Credit System
Course Structure

F.Y.B.Sc.

(To be implemented from Academic Year- 2024-25)

Course Code	Semester I	Credits	Course Code	Semester II	Credits
Major/Minor			Major/Minor		
23_USMT101	Calculus I	2	23_USMT201	Calculus II	2
23_USMT102	Algebra I	2	23_USMT202	Discrete Mathematics I	2
23_USMT103	Mathematics Practical-1 (Based on 23_USMT101 & 23_USMT102)	2	23_USMT203	Mathematics Practical-2 Based on 23_USMT201 & 23_USMT202	2
Vocational Skill Course (VSC)			Open Elective (OE)		
23_USMT104	Problem Solving Skills in Calculus and Algebra	2	23_USMT204	Probability Theory	2
Open Elective (OE)			Skill Enhancement Course (SEC)		
23_USMT105	Introduction to Statistics	2	23_USMT205	Basic Maths for Competitive Exams	2

Note:

1. Above courses are offered by Department of Mathematics for F.Y.B.Sc and other faculty.
2. Learner should opt 22 credits for F.Y.B.Sc.
3. Remaining credits learner will opt from his/her other subject combination, IKS, AEC, CC etc.

Teaching Pattern: 2/4 lectures per week per theory/practical course of two credits.

Revised Syllabus of Courses of
Bachelor of Science (B.Sc.) Mathematics Programme at Semester I
with Effect from the Academic Year 2024-2025

Course Code	Semester I	Credits
Major/Minor		
23_USMT101	Calculus I	2
23_USMT102	Algebra I	2
23_USMT103	Mathematics Practical-1 (Based on 23_USMT101 & 23_USMT102)	2
Vocational Skill Course (VSC)		
23_USMT104	Problem Solving Skills in Calculus and Algebra	2
Open Elective (OE)		
23_USMT105	Introduction to Statistics	2

Name of the Course	Calculus I
Course Code	23_USMT101
Class	F.Y.B.Sc.
Semester	I
Number of Credits	2
Nature	Theory
Type	Major/Minor
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives introduction to basic concepts of Analysis with rigour and prepares students to study further courses in Analysis. The portion on first order, first degree differentials prepare learner to get solutions of so many kinds of problems in all subjects of Science and also prepares learner for further studies of differential equations and related fields.

Unit No.	Units	No. of Lectures
1	Real Number System	10
2	Sequences in R	10
3	Limits and Continuity	10

Nomenclature : Calculus IV

Course Outcomes :

On successful completion of this course, a learner will be able to:

CO1: outline basic concepts of real numbers with algebraic and order properties.

CO2: evaluate the limit of a sequence and decide whether a given sequence is convergent, divergent, bounded, monotone or Cauchy.

CO3: outline concepts of the limit of a function.

CO4: solve problems based on Real Number System, Sequences in R, Limits and Continuity.

Curriculum:

Unit No.	Title and Learning Points
1	Real Number System **10 Lectures**
	1.1 Real number system R and order properties of R, absolute value function in R and its properties. 1.2 AM-GM inequality, Cauchy-Schwarz inequality, Intervals and neighbourhoods, interior points, limit point, Hausdorff property. 1.3 Bounded sets, statements of I.u.b. axiom and its consequences, supremum and infimum, maximum and minimum, Archimedean property and its applications, density of rationals.
2	Sequences in R **10 Lectures**
	2.1 Definition of a sequence and examples, Convergence of sequences, every convergent sequence is bounded. Limit of a convergent sequence and uniqueness of limit, Divergent sequences. 2.2 Convergence of standard sequences 2.3 Algebra of convergent sequences, sandwich theorem, monotone sequences, monotone convergence theorem 2.4 Definition of subsequence, subsequence of a convergent sequence is convergent and converges to the same limit definition of a Cauchy sequences, every converges sequences s a Cauchy sequence and converse.
3	Limits and Continuity **10 Lectures**
	3.1 $\varepsilon - \delta$ definition of Limit of a function, uniqueness of limit if it exists, algebra of limits, limits of composite function, sandwich theorem, left-hand-limit, right-hand-limit, non-existence of limits. 3.2 Continuous functions: Continuity of a real valued function at a point and on a set using $\varepsilon - \delta$ definition, examples, Continuity of a real valued function at end points of domain using $\varepsilon - \delta$ definition, f(x) exists and equals to f(a), Sequential continuity, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.

	3.3 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.

Learning Resources recommended:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
3. R. G. Bartle- D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
4. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, Springer International Ltd, 2000.
5. T. M. Apostol, Calculus, Vol I, Wiley and Sons (Asia) Pte. Ltd.
6. James Stewart, Calculus, Third Edition, Brooks/ Cole Publishing company, 1994.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

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Name of the Course	Algebra I
Course Code	23_USMT102
Class	F.Y.B.Sc.
Semester	I
Number of Credits	2
Nature	Theory
Type	Major/Minor
Highlight revision specific to employability/ entrepreneurship/ skill development	This course deals with integers, a part of number theory so this course develops the skill of counting among students, which helps them to increase the speed and way of counting in further advanced mathematics courses and it is useful in day-to-day life.

Unit No.	Units	No. of Lectures
1	Integers and Divisibility	10
2	Functions, Relations and Binary Operations	10
3	Polynomials	10

Nomenclature : Algebra I

Course Outcomes: On successful completion of this course, a learner will be able to:

CO1: outline basic concepts of Integers & Divisibility.
CO2: find Direct image and inverse image for a function and to conclude whether function is injective or not.
CO3: outline concepts of polynomials.
CO4: solve problems based on Integers & Divisibility, Functions, Relations and Binary Operations, Polynomials.

Curriculum:

Unit No.	Title and Learning Points	
1	Integers & Divisibility	**10 Lectures**
	1.1 Statements of well-ordering property of non-negative integers, Principle of finite induction (first and second) as a consequence of the Well-Ordering Principle. 1.2 Divisibility in integers, division algorithm, greatest common divisor (g.c.d.) and least common multiple (l.c.m.) of two non-zero integers, basic properties of g.c.d. such as existence and uniqueness of g.c.d. of two non zero integers a&b and that the g.c.d. can be expressed as ma + nb for some integers m and n, Euclidean algorithm. 1.3 Primes, Euclid's lemma, Fundamental Theorem of arithmetic, 1.4 Congruences, definition and elementary properties.	
2	Functions, Relations, and Binary Operations	**10 Lectures**
	2.1 Definition of relation and function, domain, co-domain and range of a function, composite functions, examples, Direct image and inverse image for a function f, injective, surjective, bijective functions, Composite of injective, surjective, bijective functions when defied, invertible functions, bijective functions are invertible and conversely, examples of functions including constant, identity, Binary operation as a function, properties, examples. 2.2 Equivalence relation 2.3 Congruence	
3	Polynomials	**10 Lectures**
	3.1 Definition of a polynomial, polynomials over F where F = Q, R or C, Algebra of polynomials, degree of polynomial, basic properties. 3.2 Division algorithm and g.c.d of two polynomials and its basic properties, Euclidean algorithm 3.3 Roots of a polynomial, relation between roots and multiplicity of a root. 3.4 Irreducible polynomials	

Learning Resources recommended:

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd.
2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford1989.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

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Name of the Course	Mathematics Practical-1 (Problem solving skills in Calculus and Algebra) (Based on 23_USMT101 & 23_USMT102)
Course Code	23_USMT103
Class	F.Y.B.Sc.
Semester	I
Number of Credits	2
Nature	Practical
Type	Major/Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching mathematics allows students to explore the material in a more hands-on manner. This course allows students to apply problem-solving techniques and gain an understanding of the application of the courses 23_USMT101 and 23_USMT102.

Unit No.	Units	No. of Lectures
1	Real Number System	10
2	Sequences in R	10
3	Limit and Continuity	10
4	Integers & Divisibility	10
5	Functions, Relations and Binary Operations	10
6	Polynomials	10

Nomenclature: Mathematics Practical-1

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1 : solve the problems of concepts from Calculus I.
CO2 : solve the problems of concepts from Algebra I.

Curriculum:

Unit No.	Title and Learning Points	
1,2,3	Real Number System, Sequences in R, Limit and Continuity	**30 Lectures**
	1. Algebraic and Order Properties of Real Numbers and Inequalities 2. Hausdorff Property and LUB Axiom of R; Archimedean Property. 3. Convergence and divergence of sequences, bounded sequences, Sandwich Theorem. 4. Cauchy sequences, monotonic sequences, non-monotonic sequences. 5. Limit of a function and Sandwich theorem, Continuous and discontinuous function. 6. Algebra of limits and continuous functions, Intermediate Value theorem, Bolzano-Weierstrass theorem.	
4,5,6	Integers & Divisibility, Functions, Relations and Binary Operations, Polynomials	**30 Lectures**
	1. Mathematical induction, Division Algorithm, Euclidean algorithm in Z, Examples on expressing the gcd. of two non-zero integers a&b as ma + nb for some m, n in Z. 2. Primes and the Fundamental theorem of Arithmetic, Euclid's lemma, there exists infinitely many primes of the form 4n - 1 or of the form 6n -1. 3. Functions, Bijective and Invertible functions, Compositions of functions. 4. Binary Operation, Equivalence Relations, Partition and Equivalence classes. 5. Polynomial (I) 6. Polynomial (II)	

Learning Resources recommended:

1. All resources recommended for 23_USMT101 and 23_USMT102.
2. 23_USMT101 Practical Question Bank Designed by Department of Mathematics, GJC .
3. 23_USMT102 Practical Question Bank Designed by Department of Mathematics, GJC .

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	10
Viva	05
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

B. Semester End Evaluation (Paper Pattern) (30 Marks-1 hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Objective on Unit 1,2,3 of both the papers	Objective (18)
2	Descriptive on Unit 1,2,3 of One Paper	Descriptive (06)
3	Descriptive on Unit 1,2,3 of Second Paper	Descriptive (06)

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Name of the Course	Introduction to Statistics
Course Code	23_USMT105
Class	F.Y.B.Sc.
Semester	I
No of Credits	2
Nature	Theory
Type	Open Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	The field of statistics is the science of learning from data. Statistical knowledge helps student to use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions. Statistics allows students to understand a subject much more deeply.

Unit No.	Units	No. of Lectures
1	Classification and Tabulation of data	10
2	Diagrammatic and graphic presentation	10
3	Measures of central value, Measures of dispersion	10

Nomenclature: Introduction to Statistics

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1 : Organise, summarise given data.
CO2 : interpret data in tabular, graphical,pictorial formats.
CO3 : compute various measures of central tendency and dispersion.
CO4 : solve problems based on Classification and Tabulation of data,Diagrammatic and graphic presentation, Measures of central value, Measures of dispersion.

Curriculum:

Unit No.	Title and Learning Points	
1	Classification and Tabulation of data	**10 Lectures**
	1.1 Statistics: Definition and scope 1.2 Concept of statistical population and sample 1.3 Types of classification of data: quantitative and qualitative 1.4 Formation of discrete frequency distribution, Formation of continuous frequency distribution, Tabulation of data	
2	Diagrammatic and graphic presentation	**10 Lectures**
	2.1 Introduction: significance of diagrams and graphs 2.2 General rules for constructing diagrams 2.3 Types of diagrams: one dimensional diagram, two dimensional diagrams, Pie diagram. 2.4 Graphs, Graphs of frequency distribution: including histogram and ogives	
3	Measures of central value, Measures of dispersion	**10 Lectures**
	1.1 Measures of Central Tendency: Mean, Median, Mode. 1.2 Measures of dispersion: range, the quartile deviation, mean deviation, standard deviation, coefficient of variations.	

Learning Resources recommended:

1. S.C. Gupta and V.K. Kapoor, Fundamental of Mathematical Statistics, Sultan Chand and Sons, 1994.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussions	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

Revised Syllabus of Courses of
Bachelor of Science (B.Sc.) Mathematics Programme at Semester II
with Effect from the Academic Year 2024-2025

Course Code	Semester I	Credits
Major/Minor		
23_USMT201	Calculus II	2
23_USMT202	Discrete Mathematics I	2
23_USMT203	Mathematics Practical-2 Based on 23_USMT201 & 23_USMT202	2
Open Elective (OE)		
23_USMT204	Probability Theory	2
Skill Enhancement Course (SEC)		
23_USMT205	Basic Maths for Competitive Exams	2

Name of the Course	Calculus II
Course Code	23_USMT201
Class	F.Y.B.Sc.
Semester	II
Number of Credits	2
Nature	Theory
Type	Major/Minor
Highlight revision specific to employability/ entrepreneurship/ skill development	This course gives introduction to basic concepts of Analysis with rigor and prepares students to study further courses in Analysis.Formal proofs are given lot of emphasis in this course which also enhances understanding of the subject of Mathematics as a whole.

Unit No.	Units	No. of Lectures
1	Differentiability of functions	**10**
2	Applications of differentiability	**10**
3	First Order First Degree Differential Equations	**10**

Nomenclature: Calculus II

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1 : Outline concepts of differentiability of a function and will be able to interpret properties of continuous and differentiable functions..
CO2 : Apply different principles, tests and theorems for solving problems on differentiation and different aspects of real analysis.
CO3 : Solve first order,first degree differential equations
CO4 : Solve problems based on differentiability of functions, Applications of differentiability, first order first degree differential equations.

Curriculum:

Unit No.	Title and Learning Points	
1	Differentiability of functions	**10 Lectures**
	1.1 Differentiation of real valued function of one variable: Definition of differentiability of a function at a point of an open interval 1.2 examples of differentiable and non-differentiable functions 1.3 Algebra of differentiable functions 1.4 Chain rule 1.5 Higher order derivatives, Leibnitz rule. 1.6 Derivative of inverse functions 1.7 Implicit differentiation (only examples)	
2	Applications of differentiability	**10 Lectures**
	2.1 Rolle's Theorem, Lagrange's, and Cauchy's Mean Value Theorems, applications, and examples 2.2 Monotone increasing and decreasing functions, examples. 2.3 L-Hospital rule (without proof), examples of indeterminate forms 2.4 Taylor's theorem with Lagrange's form of remainder with proof, Taylor's polynomial, and applications 2.5 critical point, local maximum/minimum, Necessary condition, stationary points, second derivative test, examples, concave/convex functions, point of inflection. 2.6 Sketching of graphs of functions using properties.	

3	First Order First Degree Differential Equations	**10 Lectures**
	3.1 Review of basic concepts of differential equation 3.2 Solution of homogeneous and non-homogeneous differential equations of first order and first degree 3.3 Notion of partial derivatives 3.4 Exact Equations: General solution of Exact equations of first order and first degree. 3.5 Non exact equations: Rules for finding integrating factors (without proof) for non-exact equations 3.6 Linear and Reducible Linear equation of first order with solution and its applications to orthogonal trajectories and population growth and finding a current at a given time. 3.7 Reduction of order	

Learning Resources recommended:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. T. M. Apostol, Calculus, Vol I, Wiley And Sons (Asia) Pte. Ltd.
3. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, Springer International Ltd, 2000.
4. G. F. Simmons, Differential Equations with Applications and Historical Notes, McGrawHill, 1972.
5. E. A. Coddington , An Introduction to Ordinary Differential Equations.Prentice Hall,1961.
6. W. E. Boyce, R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, Wiely, 2013.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

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Name of the Course	Discrete Mathematics I
Course Code	23_USMT202
Class	F.Y.B.Sc.
Semester	II
Number of Credits	02
Nature	Theory
Type	Major/Minor
Highlight revision specific to employability/ entrepreneurship/ skill development	Discrete mathematics is an exciting and appropriate vehicle for working toward and achieving the goal of educating informed citizens who are better able to function in our increasingly technological society; have better reasoning power and problem-solving skills; are aware of the importance of mathematics in our society; and are prepared for future careers which will require new and more sophisticated analytical and technical tools. It is an excellent tool for improving reasoning and problem-solving abilities.

Unit No.	Units	No. of Lectures
1	Preliminary Counting	10
2	Advanced Counting	10
3	Recurrence relation	10

Nomenclature: Discrete Mathematics I

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1 : Solve the problems based on Preliminary Counting and Permutations.
CO2 : apply techniques in advanced Counting .
CO3 : Construct recurrence relation and solve problems on it.
CO4 : solve problems based on preliminary counting, advanced counting, recurrence relation.

Curriculum:

Unit No.	Title and Learning Points	
1	Preliminary Counting	**10 Lectures**
	1.1 Finite and infinite sets, countable and uncountable sets with examples 1.2 Addition and multiplication Principle, counting sets of pairs, two-way counting 1.3 Stirling numbers of second kind, simple recursion formulae satisfied by S(n,k) for k = 1,2,...,n-1,n. 1.4 Pigeonhole principle simple and strong form and examples, its applications to geometry 1.5 Permutation of objects, 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 permutation, cardinality of set of all permutations on n symbols and set of all even permutations on n symbols.	
2	Advanced Counting	**10 Lectures**
	2.1 Permutation and combination of sets and multisets circular permutations, emphasis on solving problems 2.2 Binomial and Multinomial Theorem, Pascal identity, examples of standard identities 2.3 Non-negative solutions of equation 2.4 Principal of inclusion and exclusion, its applications, derangements with explicit formula, deriving formula for Euler's function	
3	Recurrence relation	**10 Lectures**
	3.1 Recurrence Relations, definition of homogeneous , non homogeneous, linear non linear recurrence relation 3.2 Obtaining recurrence relation of Tower of Hanoi, Fibonacci sequence etc. in counting problems 3.3 Solving homogeneous as well as non-homogeneous recurrence relations by using iterative methods 3.4 solving a homogeneous recurrence relation of second degree using algebraic method proving the necessary result.	

Learning Resources recommended:

1. Norman Biggs, Discrete Mathematics, Oxford University Press.
2. Richard Brualdi, Introductory Combinatorics, John Wiley and sons.
3. V. Krishnamurthy, Combinatorics-Theory and Applications, Aliated East West Press.
4. Allen Tucker, Applied combinatorics, John Wiley and Sons
5. Chong and Ming, Principles and techniques in Combinatorics.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

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Name of the Course	Mathematics Practical-2 Based on 23_USMT201 & 23_USMT202
Course Code	23_USMT203
Class	F.Y.B.Sc.
Semester	II
Number of Credits	2
Nature	Practical
Type	Major/Minor
Highlight revision specific to employability/ entrepreneurship/ skill development	A practical approach to teaching mathematics allows students to explore the material in a more hands-on manner. This course allows students to apply problem-solving techniques and gain an understanding of the application of the courses UMAT02CR04 and UMAT02CR05.

Unit No.	Units	No. of Lectures
1	Differentiability of functions	10
2	Applications of differentiability	10
3	First Order first Degree Differential Equations	10
4	Preliminary Counting	10
5	Advanced Counting	10
6	Recurrence relation	10

Nomenclature: Mathematics Practical-2

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO1 : solve the problems of concepts from Calculus II.
CO2 : solve the problems of concepts from Discrete Mathematics I.

Curriculum:

Unit No.	Title and Learning Points	
1,2,3	Differentiability of functions, Applications of differentiability, First order first degree differential equations	**30 Lectures**
	1. Properties of differentiable functions, derivatives of inverse functions and implicit functions. 2. Higher order derivatives, Leibnitz Rule. 3. Mean value theorems and its applications, L'Hospital's Rule, Increasing and Decreasing functions 4. Extreme values, Taylor's Theorem and Curve Sketching. 5. Solving exact and non-exact, linear, reducible to linear differential equations. 6. Reduction of order of Differential Equations, Applications of Differential Equations.	
4,5,6	Preliminary Counting, Advanced Counting, Recurrence relation	**30 Lectures**
	1. Counting principles, Two-way counting. 2. Stirling numbers of second kind, Pigeon hole principle. 3. Multinomial theorem, identities, permutation, and combination of multiset. 4. Inclusion-Exclusion principle. Euler phi function. 5. Recurrence relation I 6. Recurrence relation II	

Learning Resources recommended:

1. All resources recommended for 23_USMT201, 23_USMT202
2. 23_USMT201 Practical Question Bank Designed by Department of Mathematics, GJC .
3. 23_USMT202 Practical Question Bank Designed by Department of Mathematics, GJC .

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	10
Viva	05
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

B. Semester End Evaluation (Paper Pattern) (30 Marks-1 hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Objective on Unit 1,2,3 of both the papers	Objective (18)
2	Descriptive on Unit 1,2,3 of One Paper	Descriptive (06)
3	Descriptive on Unit 1,2,3 of Second Paper	Descriptive (06)

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Name of the Course	Probability Theory
Course Code	23_USMT204
Class	F.Y.B.Sc.
Semester	II
No of Credits	2
Nature	Theory
Type	Open Elective
Highlight revision specific to employability/ entrepreneurship/ skill development	This program will help to increase the calculation ability and speed of the learner, which will be helpful in day-to-day life.

Unit No.	Units	No. of Lectures
1	Introduction	10
2	Mathematical Expectation	10
3	Theoretical Distributions	10

Nomenclature: Probability Theory

Course Outcomes:

On successful completion of this course, a learner will be able to:

CO 1: define the classical definition of probability
CO 2: find expected value of a probability distribution
CO 3: calculate the probabilities for theoretical distributions
CO 4: solve problems on Classical probability, Mathematical expectation and Theoretical distributions.

Curriculum:

Unit No.	Title and Learning Points
1	Introduction **10 Lectures**
	1.1 Classical Probability 1.2 Shortcomings of classical approach 1.3 Importance of concept of probability 1.4 Theorems of probability 1.5 Conditional Probability
2	Mathematical Expectation **10 Lectures**
	2.1 Random Variables 2.2 Probability Distribution
3	Theoretical Distributions **10 Lectures**
	3.1 Binomial Distribution 3.1.1 Obtaining coefficients of Binomial Distribution 3.1.2 Properties of Binomial Distribution 3.1.3 Constants of Binomial Distribution 3.1.4 Fitting a Binomial Distribution 3.2 Poisson Distribution 3.2.1 Constants of Poisson Distribution 3.2.2 Role of Poisson Distribution 3.2.3 Fitting a Poisson Distribution 3.3 Normal Distribution 3.3.1 Graph of Normal Distribution 3.3.2 Importance of Normal Distribution 3.3.3 Properties of Normal Distribution 3.3.4 Fitting a Normal Curve

Learning Resources recommended:

1. S. P. Gupta, Statistical Methods, Sultan Chand & Sons, 2005
2. S. C. Gupta, V. K. Kapoor, Fundamentals of Mathematical Statistics,S. Chand&Sons,2002.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Unit Test - (MCQ / Descriptive - Based on Theory and/or Problems - Online/Offline – 1 Unit test of 10 marks / 3 Unit tests of 10 marks each and best one out of three will be considered)	10
Assignments / Seminar / Group discussion	05
Attendance and active participation in classroom	05

B. Semester End Evaluation (30 Marks - 1 Hour)

Comprehensive written examination of 1-hours duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of short answer questions and descriptive type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Unit 1	Short/Long Answers (10)
2	Unit 2	Short/Long Answers (10)
3	Unit 3	Short/Long Answers (10)

Name of the Course	Basic Maths for Competitive Exams
Course Code	23_USMT205
Class	F.Y.B.Sc.
Semester	I
Number of Credits	2
Nature	Practical
Type	Skill Enhancement Course
Highlight revision specific to employability/ entrepreneurship/ skill development	This course will be helpful for those learners who are appearing for Competitive exams viz Banking, Insurance, MPSC, UPSC etc.

Unit No.	Units	No. of Lectures
1	Arithmetical Ability - I	20
2	Arithmetical Ability - II	20
3	Data Interpretation	20

Nomenclature: Basic Maths for Competitive Exams

Course Outcomes:

On successful completion of this course, a learner will be able to:
CO1 : perform basic operations on numbers
CO2 : outline concepts from maths like Ratio Proportion, Percentage etc.
CO3 : outline the concepts from data interpretation.
CO4 : Solve problems on Arithmetical Ability - I, Arithmetical Ability - II, Data Interpretation.

Curriculum:

Unit No.	Title and Learning Points	
1	Arithmetical Ability - I	**20 Lectures**
	1.1 Number System, Problems on Numbers 1.2 Simplification-BODMAS Rule, Modulus of Real Numbers 1.3 Average, Percentage, Profit and Loss	
2	Arithmetical Ability - II	**20 Lectures**
	2.1 Interest, Logarithms, Area 2.2 Ratio and Proportion 2.3 Permutation & Combination	
3	Data Interpretation	**20 Lectures**
	3.1 Tabulation, Graphs 3.2 Line graphs, Pie Charts	

Learning Resources recommended:

1. Dr. R. S. Aggarwal; Quantitative Aptitude.
2. Dinesh Khattar, Quantitative techniques for competitive exams, Pearson publication,4th edition.

Evaluation Scheme :

A. Continuous Evaluation (20 Marks)

Method	Marks
Journal	10
Viva	05
Overall Performance (Attendance, Punctuality, Sincerity, Timely Submission)	05

B. Semester End Evaluation (Paper Pattern) (30 Marks-1 hour)

Comprehensive written examination of 1-hour duration will be conducted at the end of each semester to evaluate learner's understanding of the course material. The examination will cover the entire syllabus and include a mix of multiple-choice questions and descriptive (Problems) type questions.

Question Paper Pattern :

Question No.	Unit	Marks
1	Objective on Unit 1,2,3	Objective (18)
2	Descriptive on Unit 1,2,3	Descriptive (12)

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Name and Signature: Dr. Diwakar P. Karwanje
Chairman of BoS of Mathematics