AQAR – QUALITATIVE METRIC

2023 - 2024

Criterion 1 - Curricular Aspects

1.1.1 Curricula developed and implemented have relevance to the local, national, regional and global developmental needs which is reflected in Programme outcomes (POs), Programme specific outcomes (PSOs) and Course Outcomes (COs), of the Programmes offered by the Institution.

Name of the Programme: B. Sc. MATHEMATICS (SF) **Programme Code: USMA**

Programme Outcomes:

PO 1	Apply acquired scientific knowledge to solve complex issues.
PO 2	Attain Analytical skills to solve complex cultural, societal and environmental issues.
PO 3	Employ latest and updated tools and technologies to analyse complex issues.
PO 4	Demonstrate Professional Ethics that foster Community, Nation and Environment Building Initiatives.

Programme Specific Outcomes:

PSO 1	Gain broad knowledge and understanding in pure Mathematics and applications of Mathematics.
PSO 2	Demonstrate a computational ability and apply logical thinking skills to solve problems that can be modelled mathematically.
PSO 3	Read, understand, analyse and formulate Mathematical theorems.
PSO 4	Acquire proficiency in the use of technology to assist in learning and investigating, Mathematical ideas and in problem solving.
PSO 5	Communicate Mathematical concepts accurately, precisely and effectively with clarity and coherence both verbal and in written form

Course Outcomes:

Course Code	Course Title	Nature Of The Course (Local/National/ Regional/ Global)	Course Description	Course Outcomes
23G1CC1	Algebra And Trigonometry	National	This course provides broad view on Algebra and Trigonometry.	CO 1: Classify and Solve reciprocal equations CO 2: Find the sum of binomial, exponential and logarithmic series. CO3:Find Eigen values, eigen vectors, verify Cayley – Hamilton theorem and diagonalize a given matrix. CO 4:Expand the powers and multiples of trigonometric functions in terms of sine and cosine. CO5: Determine relationship between circular and hyperbolic functions and the summation of trigonometric series.
23G1CC2	Differential Calculus	National	This course	CO 1: Find the nth derivative, form equations involving derivatives and

			provides broad view on differential and integral calculus.	apply Leibnitz formula CO 2: Find the partial derivative and total derivative coefficient.ibnitz formula CO 3:Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers CO 4: Find the envelope of a given family of curves CO 5:Find the evolutes and involutes and to find the radius of curvature using polar co-ordinates
23G1GE1	Mathematics For Statistics	National		**CO-1** Distinguish between proper and improper fractions. Express an algebraic fraction as the sum of its partial fractions. **CO-2** Demonstrate the knowledge to determine the sums, expansion and approximation of series including binomial, exponential, logarithmic and fourier. **CO-3** Solve problems about polynomials with real coefficients, imaginary and irrational roots.

				Explain the relationship between the derivative of a function as a function and the notion of the derivative. **CO-4** Calculate limits of a function. **CO-5** Obtain the nth derivative in successive differentiation. Apply Euler's theorem on homogenous function.
23G1GECI1/23G1GEJ1	Discrete Mathematics	National	This course strengthens and increases the understanding of some concepts in Discrete Mathematics.	CO1: Understand the basic principles of sets and operations in sets. CO2: Describe any statement formula in normal forms. CO3: Understand the basics of matrices and able to solve system of equation using matrix. CO4: Demonstrate an understanding of relations and functions and be able to determine their properties

				CO5: Understand Boolean algebra and basic properties of Boolean algebra; able to simplify simple Boolean functions by using the basic Boolean properties.
23G1FC	Foundation Course - Bridge Mathematics	National		CO 1:Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also, solve the related problems CO 2: Find the various sequences and series and solve the problems related to them. Explain the principle of counting. CO 3: Find the number of permutations and combinations in different cases. Apply the principle of counting to solve the problems on permutations and combinations CO 4:Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and submultiple angles, etc. Also, they can solve the problems

				using the transformations. CO 5:Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.
23G1SE1	Quantitative Aptitude	National	This course is designed to help the students to appear in competitive examinations.	CO 1:Solve problems on ages CO 2: Illustrate profit and loss with examples CO 3:Explain partnership and related problems CO 4: Discuss problems on time and work CO 5: Solve problems on time and distance-
23G2CC3	Analytical Geometry (Two & Three Dimensions)	National	This course provides broad view on Analytical Geometry of two & Three Dimensions.	CO 1: Find pole, polar for conics, diameters, conjugate diameters for ellipse and hyperbola CO 2: Find the polar equations of straight line and circle, equations of chord, tangent and normal and to find

				the asymptotes of hyperbola CO 3: Explain in detail the system of Planes CO 4: Explain in detail the system of Straight lines CO 5:Explain in detail the system of Spheres
23M2CC4	Integral Calculus	National	This course provides broad view on Integral Calculus.	CO1:Determine the integrals of algebraic, trigonometric and logarithmic functions and to find the reduction formulae CO2 : Evaluate double and triple integrals and problems using change of order of integration CO3: Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution CO4: Explain beta and gamma

				functions and to use them in solving problems of integration CO5: Explain Geometric and Physical applications of integral calculus.
23G2SE3	Data Interpretation	Global	This course helps the students to prepare for competitive examinations.	CO 1: Solve problems on Data Interpretation CO 2: Identify Analogy CO 3: Classify coding and Decoding CO 4: Solving Problems using ven diagram CO 5: Identify missing numbers and character
23G2SE2	Mathematics For Competitive Examinations	National	Thiscourseisdesignedtohelpthestudentstoappearincompetitiveexaminations.	CO 1:Simplify the Problems CO 2: Find the percentage CO 3: Identify Problems on Permutation and Combination CO 4: Solve Problems on blood relation and direction sense test.

				CO5: Solve Problems on blood relation and direction sense test.
19G2ACI2/19G2ACJ2	Operations Research	National	Thiscourseisdesignedtohelpthestudentstoappearincompetitiveexaminations	CO 1: Simplify the Problems CO 2: Find the percentage CO 3: Identify Problems on Permutation and Combination CO 4: Solve Problems on blood relation and direction sense test. CO 5: Solve Problems on blood relation and direction sense test.
19G3CC5	Modern Algebra	National	This course introduces the abstract concepts of modern algebra	CO1: Classify groups and explain their properties CO2: Describe cosets and Lagrange's theorem CO3: Explain the characteristics of different types of rings and their properties

				CO4: Classify various types of ideals CO5: Construct polynomial rings over UFD
19G3CC6	Advanced Statistics	National	This course provides a strong background in statistical tools which will be used in various physical and social sciences.	CO1: Classify discrete and continuous random variables and characteristics of Binomial distribution and Poisson distribution CO2: Explain and illustrate the properties of Normal distribution and solve variety of problems. CO3: Distinguish between a population and a sample and explain testing of hypothesis. CO4: Explain chi square distribution, t- distribution and describe their various applications is Statistics

				CO5: Define F- distribution and apply it to solve problems in analysis of variance
19G3SB1	Applications Of Calculus And Differential Equations	National	This course deals with applications of calculus and differential equations.	CO1: Explain Beta and Gamma functions and their properties. CO2: Solve the problems in Maxima minima of functions of two variables. CO3: Describe trajectories and orthogonal trajectories. CO4: Solve Brachistochrone problems CO5: Discuss dynamical problems with variable mass
19G4CC7	Sequences And Series	National	This course introduces the concept of sequence and series and to	CO1: Define basic concepts of sequences CO2: Explain subsequence and

			enable the students to understand the fundamental ideas in Real Analysis	Cauchy sequences CO3: Differentiate various convergence test for series and use them to solve problems CO4: Recognize alternating, convergent, conditionally and absolutely convergent series CO5: Distinguish the behaviour of series and power series
19G4CC8	Linear Algebra	National	This course will focus on matrix as linear transformations relative to a basis of a vector space	CO1: Define Vector Space and explain its various concepts CO2: Illustrate Inner Product Spaces CO3: Define basic concepts of matrices and solve linear equations CO4: Appraise Eigen Value and Eigen Vectors of matrices

				CO5: Describe bilinear forms and quadratic
22G4SB2	Trigonometry	National	This course helps the students to develop their problem solving skills.	CO 1: Recall some expansions of Trigonometric functions in sinnx, cosnx, tannx. CO 2: Recall some expansions of Trigonometric functions in $\sin^n x$, $\cos^n x$, $\sin^m x \cos^n x$ CO 3: Recall some expansions of Trigonometric functions in $\cos\theta$, $\sin\theta$ and $\tan\theta$ in a series of ascending powers of θ CO 4: Do the problems in hyperbolic functions CO 5: Explain Logarithms of Complex quantities.

9G5CC9	Real Analysis	National	This course introduces the basic concepts in analysis and to enable the students to understand fundamental ideas and theorems on metric spaces.	CO1: Describe fundamental ideas and theorems on Metric spaces CO2: Distinguish the continuity, discontinuity and uniform continuity of functions CO3: Demonstrate the connectedness and its properties CO4: Explain the concept of compactness and their roles in the real line CO5: Organize theorems in a correct mathematical way

19G5CC10	Statics	National	This course describes laws, principles, and postulates governing the statics of the system in physical reality.	CO1: Explain the concept of the forces and static equilibrium conditions CO2: Describe the perception of parallel forces and moments CO3: Classify a thorough force analysis of rigid bodies and simple structures in equilibrium CO4: Illustrate and give examples of couples and equilibrium of three forces acting on a rigid body CO5: Solve problems related to friction forces in various applications. Summarize the concept of equilibrium of strings to prepare and demonstrate the models.

19G5CC11	Linear Programming	National	The course provides appropriate methods for the efficient computation of optimal solutions to problems which are modeled by objective function and linear constraints	CO1: Formulate linear programming problems and solve by graphical method CO2: Classify simplex, two phase and Big - M method to solve linear programming problems CO3: Illustrate Duality in Linear programming CO4: Recognize and formulate transportation, assignment problems and find the optimal solution CO5: Define two person zero sum game, saddle point and solve problems.
19G5CC12	Graph Theory	National	This course is designed to introduce the	CO1: Define graphs and operations on graphs.

			students the basics of graph theory.	CO2: Summarize and understand various techniques in proving theorems on connectedness. CO3: Create examples and counter examples to illustrate Eulerian and Hamiltonian graphs with examples CO4: List out the characterization of trees and construct various matchings for a graph. CO5: Solve problems involving planarity and colourability.
23M5ME1	Numerical Methods	National	This course enables the students to solve equations using various Numerical	CO 1: Solve algebraic and transcendental equations using various methods. CO 2: Identify the various methods of solving simultaneous linear algebraic equations. CO 3: Recognize difference operators and apply the concept of interpolation.

			Methods.	CO 4: Compute the values of the derivatives at some point using numerical differentiation CO 5: Compute the values of the derivatives at some point using numerical differentiation and integration.
23M5ME2	Vector Calculus And Fourier Transforms	National	This course emphasizes the fundamental concepts of vector calculus and Fourier transforms.	CO 1: Explain the concept of differentiation of vectors CO 2: Compute divergence and curl of vectors. CO 3: Compute divergence and curl of vectors. CO 4: Compute Fourier sine and cosine transforms. CO 5: Describe the properties of Fourier transforms.
19G5ME1	Computer Programming In C	National	This course provides skills in designing and writing simple	CO1: Explain various data types and operators in C CO2: Summarize Decision Making Branching, looping statements and

			programs in C.	arrays CO3: Categorize function, pointers and structures CO4: Describe Strings and String Handling Functions. CO5: Create C program for real life problems
19G5SB3	Data Interpretation And Analytical Aptitude	Global	This course helps the students to prepare for competitive examinations.	CO 1: Solve problems on Data Interpretation CO 2: Identify Analogy CO 3: Classify coding and Decoding CO 4: Solving Problems using ven diagram CO 5: Identify missing numbers and character
19G5SB4	Cryptography	National	This course provides important tools	CO1: Explain the fundamentals of cryptography

			for ensuring the privacy, authenticity and integrity of the sensitive information involved in modern digital systems	CO2: Describe Security Services CO3: Explain Symmetric Cipher Model CO4: Discuss Block Ciphers CO5: Explain Block Cipher Design Principles
19G6CC13	Complex Analysis		This course provides various concepts in complex analysis of one variable	CO1: Explain the concept of bilinear transformations. CO2: Identify continuous, differentiable and analytic functions CO3: Solve problems on complex integration CO4: Compute analytic functions in series form and classify singularities CO5: Evaluate definite integrals using Residues

19G6CC14	Dynamics	National	This course will provide a sound knowledge of the concepts and principles in Dynamics	CO1: Describe the behaviour related to projectiles CO2: Apply the laws and principles governing dynamics of the system in physical reality. CO3: Describe the collision of elastic bodies. CO4: Explain Simple harmonic motion and its properties. CO5: Explain the motion under the action of central forces.
19G6CC15	Operations Research	National	This helps in solving problems in different environments that needs	CO1: Define sequencing problem and apply it to solve real life problems CO2: Solve problems in decision making CO3: Apply inventory control to solve

			decisions.	practical problems. CO4: Classify queuing models CO5: Explain CPM and PERT to plan schedule and control project activities.
19G5ME3	Fuzzy Mathematics	National	This course discusses the fundamentals of fuzzy set theory and fuzzy logic.	CO1: Explain the difference between crisp set and fuzzy set theory CO2: Identify the methods of fuzzy logic CO3: Recognize the operations on fuzzy sets and combination of fuzzy operations CO4: Illustrate and give examples related to fuzzy relations CO5: Build sufficient understanding of fuzzy numbers and $\alpha-$ cuts

19G6ME4	Theory Of Numbers	National	The students are introduced about the basic topics of Number Theory which includes Divisibility, Primes, Congruences, positive divisors, Fermat's and Wilson's theorem, Quadratic reciprocity.	CO1: Explain prime number and its distributions CO2: Define and interpret the concepts of divisibility, greatest common divisor, relatively prime integers and Fibonacci sequence CO3: Recognize the congruences, properties of congruences, special divisibility tests and Chinese remainder theorem. CO4: Explain the Law of Quadratic reciprocity, Quadratic Congruence with Prime and Composite Modulus CO5: Explain Fermat's theorem and its applications

19G6ME5	Lattices And Boolean Algebra	National	This course helps the students to know more about Lattices and Boolean Algebra and their usefulness in other areas of Mathematics.	CO1: Recall Posets and classify Lattices. CO2: Identify ideals and dual ideals in Lattices. CO3: Classify Modular and Distributive Lattices. CO4: Explain the concepts of Boolean Rings and Boolean Functions CO5: Apply Switching Circuits in real life situations.
19G6ME6	Discrete Mathematics	National	This course strengthens and increases the understanding of some concepts in	CO1: Describe any statement formula in normal forms CO2:Analyse the consistency of premises CO3: Classify various functions

			Discrete Mathematics	CO4: Solve Recurrence Relations CO5: Distinguish Posets and Lattices
19G6SB5	Matlab	National	This course provides knowledge of basic concepts in MATLAB.	CO1: Solve scientific problems using MATLAB CO2: Explain Operators in MATLAB CO3: Apply MATLAB in Data Analysis CO4: Construct MATLAB programs for Mathematical Calculations CO5: Describe MATLAB tools
19G6SB6	Combinatorial Mathematics	National	This course enables to study of different enumeration techniques of finite but large sets	CO1: Explain the concepts of various combinatorial numbers CO2: Identify solutions by the technique of generating functions and recurrence relation

				CO3: Solve problems on principle of inclusion and exclusion CO4: Identify Euler's function and the Ménage problem CO5: Explain Burnside's lemma and solve problems on Fibonacci numbers