Sree Narayana Mangalam College Maliankara

(Affiliated to Mahatma Gandhi University, Kottayam)

PROGRAMME OUTCOME

PROGRAMME SPECIFIC OUTCOME, COURSE OUTCOME

BSc Mathematics

UNDER GRADUATE PROGRAMME OUTCOMES

At the end of the Under Graduate Program at S.N.M College, Maliankara, a student will have developed:

PO1:	**Problem solving and critical thinking**: Critical thinking skills help the students understand and assess a situation based on all the facts and information available. With the help of critical thinking skills, students can sort and organise information, data and facts to define and solve a problem. This program outcome can ensure that the students receive ample opportunities to work on these skills by providing them with pragmatic modes of learning in their respective subjects.
PO2:	**Global Perspective and social interaction:** This program outcome ensure that the students attain an ability to respect the viewpoints of those from diverse cultures, races, ages, genders, religions and lifestyles to build collaborative relationships and communicate effectively. The ability to appreciate, value, and learn from other cultures and perspectives. It also suggests in recognising instance of unhealthy influences around them and the relying on inspirations of growth and stability.
PO3:	**Ethics:** This program outcome helps in adhering to basic ethical values combined with strong subject awareness that promises in creating a complete package of genuine result guaranteeing individuals. To be ethical means that you respect, care and love hard work and consider it a valuable quality. Ethics in work place means dependable, productive, collaborative, and passionate.
PO4:	**Environment and Sustainability:** This program outcome makes students aware of, sensitive to, and knowledgeable about the environment and its interconnectedness to social and economic systems, while encouraging them to develop attitudes of concern and motivation, as well as practical, complex systems and critical thinking skills to identify and solve environmental problems. An individual can be called educated when he/she recognises and shows respects to other forms of living things.
PO5:	**Effective Citizenship:** This program outcome develops the student's capacity to feel socially responsible to her community and to take corresponding action to support its assets and to deal with its concerns. It also develops ability to demonstrate empathetic social concern and equity-based national development.
	EffectiveCommunication: This program outcome create ability to

PO6:	communicate effectively and possess scientific temper and modern outlook of the world. Ability to speak, reading, writing and listening carefully are the three most important communication skills to be developed by every individual for their life journey.
PO7:	**Life-long learning:** Engage in life-long learning to acclimatize themselves in an ever-changing world. We need to continually keep our skills sharp and up to date so that we have an edge in all we do.

PROGRAMME SPECIFIC OUTCOMES

At the end of BSc Mathematics at S.N.M College, Maliankara, a student will have developed:

PSO1	**Subject Competence and Problem Solving:** Student will be able to demonstrate a deep understanding of mathematical concepts and theories, becoming subject experts in the field. Students are able to enhance the logical, analytical and problem solving skills of students.
PSO2	**Research-related skills:** Students are able to develop a strong sense of inquiry and the capability to ask relevant and appropriate questions. They are able to excel in problem-solving, synthesizing information, and articulating their findings. Students are able to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze and interpret data, and draw valid conclusions. They will possess the ability to plan, execute, and effectively report the results of mathematical experiments or investigations.
PSO3:	Encourage students for pursuing higher studies and developing Research Aptitude Acquire their analytical thinking, logical deductions and rigor in reasoning
PSO4:	**Utilizing Existing Knowledge to Explore Issues:** To take a rigorous, quantitative approach to solve economic problems and to build and test economic models, using sophisticated economics tools.
PSO5:	**Creating New Knowledge:** Think critically, independently and creatively to synthesize concepts to formulate cases, issues, identify and formulate a question or series of questions about some economic issues that will facilitate investigation of the issue.
PSO6:	**To Encourage new initiatives:** students will be equipped with independent learning, awareness of analytical and theoretical approaches in the field of economics, exposure to recent research and state-of-the-art tools in applied for work in economics

COURSE OUTCOMES

MM1CRT01: FOUNDATION OF MATHEMATICS

On successful completion of the course, a student will be able to

CO1:	Explain the Propositional Calculus in Mathematical Logic.
CO2:	Describe Set theory, Relations & Functions.
CO3:	Describe equivalence and partial order relations. Explain Ordered sets & Lattices
CO4:	Determine the number of roots of polynomial equation of order at most four.
CO5:	Compute inverses and powers of matrices using Cayley Hamilton theorem.

MM2CRT01: ANALYTIC GEOMETRY, TRIGONOMETRY AND DIFFERENTIAL CALCULUS

CO1:	Define Conic Sections and Classify Conic Sections by eccentricity. Interpret parametric equations & Polar coordinates of Conic Sections
CO2:	Understand Tangent and Normal of a Conic section. Understand Pole and Polar and Conjugate diameters of Ellipse.
CO3:	Define Circular and hyperbolic functions of a complex variable. Illustrate the Separation of these functions into real and imaginary parts. Understand the concepts of Trigonometric functions, their properties and summation of trigonometric series
CO4:	Examine the Factorisation of x -1, x^n+1, $x^{2n} - 2x^n$ Define Summation of infinite series by C + iS method. Determine successive differentiation.

MM3CRT01- CALCULUS

At the end of this course student will have following benefits:

CO1:	.Determine the Taylor and Maclaurin series expansions of given functions. Conceive the concept of asymptotes and obtain their equations
CO2:	Find curvature and related parameters of a given curve or curves. Calculate the arc length of a given curve and area enclosed by curves.
CO3:	Calculate the arc length of a given curve and area enclosed by curves. Find the area under a given curve, length of an arc of a curve when the equations are given in parametric and polar form.
CO4:	Find the area and volume by applying the techniques of double and triple integrals
CO5:	Calculate the partial derivatives, maxima and minima of functions of more than one independent variable and use the Lagrange Multiplier method for extremum problems

MM4CRT01 - VECTOR CALCULUS, THEORY OF NUMBERS AND LAPLACE TRANSFORMS

CO1:	Interpret equations of lines and planes in space Explain integration in vector fields. Verify Stoke's Theorem, Gauss Divergence Theorem and Green's Theorem
CO2:	Find the gradient of a Scalar Field, the Divergence and Curl of a Vector Point Function, and the directional derivative.
CO3:	Understand the applications of vector integration. Introduce Basic properties of congruence. Explain Fermat's theorem, Wilson's theorem, Euler's phi function. Introduce Laplace transform
CO4:	Explain First shifting theorem, Existence of Laplace transform, Transforms of derivatives ..
CO5:	Find Solution of ordinary differential equation & initial value problem, Laplace transform of the integral of a function.

CRT01- MATHEMATICAL ANALYSIS

At the end of this course, a student will have developed ability to:

CO1:	Understand completeness, algebraic and order properties of R. Verify the convergence of sequences and series
CO2:	Interpret Cauchy's general principle of convergence. Identify Cauchy's sequences..
CO3:	Define Monotonic sequences & subsequences. Determine the limits of functions
CO4:	Determine the limits of functions. Understand theorems on limits.

MM5CRT02: DIFFERENTIAL EQUATIONS

CO1:	Understand the method for solving ordinary differential equations. Understand linear differential equations and its solutions.
CO2:	Demonstrate a solid understanding of the fundamental concepts of differential equations. Compute the solutions of second order linear differential equations using power series method
CO3:	Understand partial differential equations and method of solving the same.
CO4:	Comprehend the concept of separable extensions and acquire a deep knowledge of Galois Theory, including understanding Galois groups, normal subgroups, and fundamental theorems related to Galois Theory. solve various types of ordinary differential equations (ODEs) and partial differential equations (PDEs)
CO5:	Formulate differential equations that describe physical phenomena and interpret the solutions in the context of the original problem..

MM5CRT03 - ABSTRACT ALGEBRA

At the end of this course, a student will have developed ability to:

CO1:	Gain a solid understanding of binary operations, isomorphic binary structures, and the definition of groups. Identify and provide examples of groups and explore their elementary properties, including finite groups and their group tables.
CO2:	Understand subgroups, including cyclic subgroups, and their properties. They will be able to work with cyclic groups and explore the elementary properties of these groups.
CO3:	Students will be introduced to permutations and their role in group theory. They will understand cosets and direct products, including Cayley's theorem. Additionally, they will explore orbits, cycles, and alternating groups.
CO4:	Students will be able to apply Lagrange's theorem, which relates the order of a subgroup to the order of the parent group. They will also study homomorphisms and their properties, along with factor groups.
CO5:	Introduced to rings and fields and their basic properties. They will study homomorphisms and isomorphisms in the context of rings. Additionally, they will learn about integral domains and the characteristic of a ring.

MM5CRT08- HUMAN RIGHTS AND MATHEMATICS FOR ENVIRONMENTAL STUDIES

At the end of this course student will have following benefits

CO1:	Understand the interdisciplinary approach to studying environmental issues, recognizing the scope and importance of environmental studies.
CO2:	Gain an understanding of renewable and non-renewable resources, focusing on forest resources, water resources, mineral resources, food resources, energy resources, and land resources. They will be able to identify the challenges and impacts associated with the use and over-exploitation of these resources.
CO3:	Comprehend the definition and causes of various types of pollution, including air pollution, water pollution, soil pollution, marine pollution, noise pollution, thermal pollution, and nuclear hazards.
CO4:	Explore the concept of Fibonacci numbers and their occurrence in various natural phenomena, such as the growth patterns of plants, animals, and even atoms.
CO5:	Study the golden ratio and its geometric interpretations, construction methods, and applications in different fields, including art, architecture, and biology.
CO6:	Students will examine human rights in the Indian Constitution, focusing on fundamental rights, directive principles, and human rights of various groups. They will also explore the role of human rights commissions and human rights awareness in education.

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MM5OPT02OPEN COURSE- APPLICABLE

At the end of this course, a student will have developed ability to:

CO1:	Understand the concepts of quadratic equations, logarithm, combinatorics Understand the concepts of probability and differential calculus.
CO2:	Understand the concepts of LCM, HCF, Fractions, Ratio and Proportion and Percentage
CO3:	Understand the concept of simple interest, compound interest, and time and work and elementary algebra

MM6CRT01 - REAL ANALYSIS

At the end of this course, a student will have developed ability to:

CO1:	Understand the basic theorems relating continuity, uniform continuity.
CO2:	Understand the basic theorems relating derivability and integrability of functions. Understand the concept of Riemann integration.
CO3:	Gain experience in constructing rigorous mathematical proofs related to real analysis
C O4:	learn to use logical arguments and apply epsilon-delta proofs to establish theorems and results related to limits, continuity, derivatives, integrals, and convergence.

MM6CRT02 - GRAPH THEORY AND METRIC SPACES

At the end of this course student will have following benefits:

CO1:	Understand the concepts of different types of graphs. Understand the concepts of Trees, Bridges, Spanning trees.
CO2:	Explain Euler's Tours, the Chinese postman problem. Hamiltonian graphs & the travelling salesman problem.
CO3:	Understand the concepts of Metric Space. Understand the concept of Open sets, Closed Sets, Cantor set.
CO4:	Understand concepts Convergence, Completeness, Continuous Mapping in a metric space

MM6CRT03 : COMPLEX ANALYSIS

At the end of this course, a student will have developed ability to:

CO1:	Students will gain a strong foundation in complex analysis, enabling them to understand the behavior of functions in the complex plane, compute derivatives using the Cauchy-Riemann equation, and analyze the properties of elementary functions. They will develop critical thinking skills and the ability to apply abstract mathematical concepts to solve practical and theoretical problems in complex analysis
CO2:	Students will gain a solid foundation in complex analysis, enabling them to compute derivatives of complex functions, evaluate definite integrals along contours, and analyze contour integrals using the Cauchy-Goursat theorem. They will also develop critical thinking skills and the ability to apply complex analysis theorems, such as Cauchy's integral formula and the maximum modulus principle, to solve practical and theoretical problems. .
CO3:	Students will develop a solid understanding of convergence properties for complex sequences and series. They will gain proficiency in calculating Taylor's series for a variety of functions, including the use of Taylor's theorem for error estimation. Students will also learn about Laurent's series and its application in representing functions with isolated singularities.
CO4:	Students will develop a solid understanding of isolated singular points and their behaviors, as well as the concept of residues and their role in evaluating complex integrals. They will gain proficiency in computing residues at poles and applying them in solving improper integrals and contour integrals using Cauchy's residue theorem. .

MM6CRT04 - LINEAR ALGEBRA

At the end of this course, a student will have developed ability to:

CO1:	Understand the concepts of vector space, subspace, linear independence.
CO2:	Illustrate the concept basis and dimension of vector spaces. Understand the concepts of linear transformation
CO3:	Determine matrix representations of linear transformations. Understand the concepts of Eigen value and Eigen vector.
CO4:	Find solution of Characteristic equations. Understand the concept of diagonalisation

MM6CBT01 - OPERATIONS RESEARCH

At the end of this course, a student will have developed ability to:

CO1:	Translate the real-world problems in to corresponding LPP.
CO2:	Understand the concepts of duality in LPP.
CO3:	Identify the Transportation Problem and formulate it as an LPP and hence solve the problem
CO4:	Determine that an Assignment problem and hence solve. Understand the concept of game theory.

MM1CMT01 - PARTIAL DIFFERENTIATION, MATRICES, TRIGONOMETRY AND NUMERICALMETHODS

CO1:	Calculate partial derivatives of functions of several variables. Find the solution of a system of linear equations. Illustrate the Separation of these functions into real and imaginary parts.
CO2:	Understand the concepts of Characteristic roots and vectors. Determine the solution of a characteristic equation of a matrix. Define Summation of infinite series by C +iS method
CO3:	Express the inverse of a non-singular matrix. Execute various numerical analysis methods to obtain roots of an equation. Define Circular and hyperbolic functions of a complex variable
CO4:	Understand the concepts of Trigonometric functions, their properties and summation of trigonometric series. Examine the Factorisation of $x^n -1$, x^n+1, $x^{2n} - 2x^n a^n \cos n + a^{2n}$

MM2CMT01 - INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS

CO1:	Identify different types of differential equations. Solving 1st order differential equations
CO2:	Compute Volume using Cross-Sections and Cylindrical shells. Compute Arc lengths, Areas of surfaces of Revolution. Determine successive differentiation
CO3:	Find area using double integration and solve triple integration. Describe the origin of partial differential equation. Define Summation of infinite series by C + iS method
CO4:	Solve the differential equation dx /P = dy/ Q= dz /R. Solve linear equation of first order.

MM3CMT01 - VECTOR CALCULUS, ANALYTIC GEOMETRY AND ABSTRACT ALGEBRA

CO1:	Find the gradient of a Scalar Field, the Divergence and Curl of a Vector Point Function, and the directional derivative
CO2:	Understand the applications of vector integration. Remember the standard equations of parabola, hyperbola, and ellipse.
CO3:	Remember the standard equations of parabola, hyperbola, and ellipse. Understand the parametric forms of parabola, hyperbola, and ellipse.
CO4:	Classify the second order curves based on their equations. Understand the concepts of Groups, Subgroups, Cyclic groups,
CO5:	Find the equations of line segments and loci related to conic sections. Understand the concepts Permutations, Homomorphism.

At the end of this course, a student will have developed ability to:

CO1:	Students will have a strong foundation in Fourier series and its applications in representing periodic functions. They will gain proficiency in computing Fourier series, applying half-range expansions, and understanding the behavior of even and odd functions. Moreover, students will be able to apply power series to solve ordinary differential equations using the power series method.
CO2:	Students will have a strong foundation in Laplace transforms, enabling them to analyze and solve ordinary differential equations effectively. They will gain proficiency in computing Laplace transforms, applying linearity and shifting properties, and understanding the behavior of transforms of derivatives and integrals. Moreover, students will be able to solve initial value problems using inverse Laplace transforms and apply differentiation and integration of Laplace transforms to find solutions to differential equations. ..
CO3:	Students will be able to Understand the fundamentals of complex numbers, Visualize complex numbers in the complex plane and polar form, Explore derivatives and analytic functions in the complex plane, Apply Laplace's equation and its applications, Analyze complex exponential, trigonometric, and hyperbolic functions, Explore the logarithmic function and general power functions, Solve advanced problems involving complex numbers and functions, Develop critical thinking and problem-solving skills, Communicate mathematical ideas effectively, Appreciate the beauty and relevance of complex analysis
CO4:	Students will be able to Understand the concept of line integrals in the complex plane, Apply Cauchy's Integral Theorem, Utilize Cauchy's Integral Formula, Explore derivatives of analytic functions, Analyze complex integrals and contour integration technique