

Mathematics Programme Outcome & Course Outcome

	Objective of Programme / Course Outcome	Employability of Programme / Course	Attainment of Programme / Course Outcome
Programme Master of Science in Mathematics	<p>The outcome of the Programme offered by the Department of Mathematics, Ramananda College, Bishnupur, are</p> <ul style="list-style-type: none"> • To deal with the syllabus in a very scientific, lucid and comprehensive way, so that it is understandable to all the students. • To develop more skilled or specialized in a particular discipline. • M.Sc degrees tend to be more focused and allow students to develop the depth of their knowledge in mathematics and also students get a feel for how to use their new skilled in the real life. • Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges. 	<p>This program will enable the students to take part and qualify for the state and national level examinations such as SET, NET, GATE, NBHM etc. After completing M.Sc, some mathematics students can go to focus on mathematical research and education, teaching whereas others can use mathematics and its applications to build and improve work in finance, sciences, manufacturing, business, engineering and communications. Mathematicians can work in fields such as climate study, astronomy and space exploration, national security, medicine, animated films, robotics and many other occupations.</p>	<p>This programme uses a combination of usual classroom teaching, Numerical C-programming practicals, ICT classes, Library classes, project work to achieve the required outcome. More importance is to be found on generating in students a research interest in various topics of pure as well as applied mathematics.</p>
Courses	PG: Semester I		
Math-101C: Abstract Algebra	<p>After completion of this courses a student will learn</p> <ul style="list-style-type: none"> • A vast knowledge of group theory and ring theory which they can use for their further study. • An idea of characterization of groups and factorization domains, the fundamental axioms in mathematics and capability of developing ideas based on them, • An idea of ring, ideal, PID, ED, FD, UFD and polynomial ring. 		
Math-102C: Linear Algebra &	<p>After completion of this courses a student will be gained</p>		

Mathematics Programme Outcome & Course Outcome

<p>Module Theory</p>	<ul style="list-style-type: none"> • A clear knowledge of linear algebra regarding eigen values of various types of linear operators. • A basic idea on possible canonical forms (Jordan Canonical Form, Rational Canonical Form,) along with linear functional, • A clear concept on inner products spaces and bilinear forms and its matrix representation. • A clear idea of Ring, ideal, module theory and its properties. Grow to knowledge of the chain condition, and primary Decomposition. 		
<p>Math-103C: Real Analysis</p>	<p>The students will be introduced</p> <ul style="list-style-type: none"> • Measurable sets, measurable functions and their various properties, • Concept of Lebesgue integration as a generalization of Riemann integration, applications to volume calculations and Fourier analysis. • Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions. 		
<p>Math-104C: Ordinary differential equations and Partial differential equations</p>	<p>After completion of ODE & PDE course, the students will learn</p> <ul style="list-style-type: none"> • A clear knowledge of linear and nonlinear ODEs, existence & uniqueness of solution with the help of Picard's and Pano's theorems, • Solution techniques for both initial and boundary value problems for ODEs, • Stability of solutions along with the solution technique of Sturm-Liouville problem, Green's functions. 		

Mathematics Programme Outcome & Course Outcome

	<ul style="list-style-type: none"> • PDEs of first and second order, their classification, methods of solution of linear and nonlinear PDEs, • Cauchy problem, method of characteristic, fundamental solution. 		
<p>Math-105C(IA): Internal Assignment (Numerical Analysis and NA Practical using C-Prog.)</p>	<p>After completion of computer programming C-Language a student will be able to:</p> <ul style="list-style-type: none"> • Derive numerical methods for approximating the solution of different problems of mathematics, • Analyze the error incumbent in any such numerical approximation, • Implement a variety of numerical algorithms using appropriate technology • Write any source program to compute the numerical solutions of the mathematics problems, which arise in the research studies with applications to engineering, physical, biological or social sciences. 		
<p>106CF: Communicative Skill and personality development</p>	<p>Acquiring communicative skills and developing leadership qualities</p>	<p>Apart from the employability outcomes listed earlier, this prepares students best to perform jobs that involve regular communication, both written and oral.</p>	
PG: Semester II			
<p>Math 201C: Complex Analysis</p>	<p>After completion of this courses a student will be achieved</p> <ul style="list-style-type: none"> • A vast knowledge of various types of Complex integration, index of a curve, Winding number, • A clear idea of various types of singularities, their inter-connection and their use in Complex Analysis, • to construct Möbius 		

Mathematics Programme Outcome & Course Outcome

	transformations, mapping circles to given circles, develop functions into power series and classify singularities.		
Math 202C: Topology	<p>After completion of this courses a student will be able to know</p> <ul style="list-style-type: none"> • Topological spaces and its example. • Concept of base of a topology and making to developed open set and neighbourhood at a point. • A concept of limit point, interior point of a topology, connectedness, compactness, separation axioms. • A concept of different types topological spaces. 		
Math 203C: Calculus of several variables & Differential Geometry of curves and surfaces	<p>After completion of this courses a student will be gained:</p> <ul style="list-style-type: none"> • a clear concept of analytical properties of functions of several variables which they can use in future in research area. • An idea of applications of geometry in advanced level. 		
Math 204C: Techniques of Applied Mathematics (Generalized Functions, Special functions, Integral Equations)	<p>After completion of this courses a student will be able to understand:</p> <ul style="list-style-type: none"> • A concept of Generalized functions, their basic properties, • Special functions, ordinary point and singular point, Hermite polynomial, Legendre polynomial, Rodrigue's formula, • Legendre functions, Bessel functions, solution of Legendre, Laugurre and Bessel equation, • Classification of integral equations, existence and uniqueness of Volterra, 		

Mathematics Programme Outcome & Course Outcome

	Fredholm & Abel's integral equations.		
Math 205C(IA): Internal Assignment (Integral Transforms & Computational methods for PDEs)	<ul style="list-style-type: none"> • Students will gain a range of techniques employing the Laplace and Fourier Transforms in the solution of ordinary and partial differential equations. • Students will learn discretization techniques for the solution of ordinary differential equations and partial differential equations; stability, consistency and convergence criteria of different discretization methods; practical application of the methods to some well-known PDEs arising from mathematical modelling of real-life problems. 		
206EF: Human Rights and Value Education OR Yoga and Life Skills	Developing life skills and soft skills, inculcating values and ethics in students to generate in fellow-feeling and social awareness.		
PG: Semester III			
Math 301C: Functional Analysis	<p>After completion of this courses a student will be able to understand:</p> <ul style="list-style-type: none"> • An idea of example of Normed linear space, Banach space, Hilbert spaces and their applications. • A concept of different type spaces (realistic and abstract) and grow to developed the concept of weak, strong convergence and operators and their properties. 		
Math 302C: Classical Mechanics	Generating in students a research interest in virtual work, D'Alembert's principal, work energy relations, Lagrangian formulation of Dynamics, Poission bracket,		

Mathematics Programme Outcome & Course Outcome

	<p>theory of small oscillations and special theory of relativity. Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences.</p>		
<p>Math 303C: Continuum Mechanics</p>	<p>After completion of this courses a student will be learned:</p> <ul style="list-style-type: none"> • Lagrangian and Eulerian Coordinate systems and their relation. • Conservations laws, strain and stress tensors. • Constitutive equations for linear elastic materials. • Equations representing conservation principles. <p>Fluid equations and flow phenomena. Navier-Stokes equation for compressible and incompressible flow.</p>		
<p>Math 304ME: Advanced Algebra - I</p>	<p>After completion of this courses a student will know</p> <ul style="list-style-type: none"> • A clear idea of Ring, ideal, module theory and its properties. • Grow to knowledge the chain condition and primary Decomposition. 		
<p>Math 305ME: Dynamical Systems</p>	<p>After completion of this course a student would have</p> <ul style="list-style-type: none"> • a clear idea about linear and non-linear dynamical systems and how to linearize a nonlinear system, • a knowledge regarding bifurcations, linear and non-linear difference equations 		
<p>Math 306ME(ID): Computer Applications</p>	<p>After completion of this course, the students learn about C-language and Matlab, which arise in the research studies to</p>	<p>This course will specifically enable to students to take up jobs involving Computer</p>	

Mathematics Programme Outcome & Course Outcome

	engineering, physical, biological or social sciences.	application and computer based teaching at various levels.	
PG: Semester IV			
Math 401C Operations Research	Students will learn about Operations Research (OR), its definition, applications in different sectors, formulation and solution of LPP, primal and dual simplex methods. Generating in students a research interest in assignment problems, integer programming, project scheduling by PERT & CPM techniques, deterministic inventory problems.		
Math 402 C Graph Theory & Field Theory	The students will be able to apply principles and concept of graph theory in practical situations, concept of Mathematical logic, Trees, Bipartite graph and Matching, Chromatic number, Chromatic polynomials with figure, Colouring problems, connectivity, network & flows. They will also learn field extension along with Galois fields with their application to formulate a process of solving polynomial of any degree.		
Math 403 ME Modelling and Analysis of Biological systems	After completion of this course a student would have <ul style="list-style-type: none"> • a clear idea how to use mathematical modelling in different types of biological systems, • a knowledge of analyzing different types of mathematical models of biological systems. 		
Math 404 ME Computational Fluid Dynamics	The students will learn about the concept of how a fluid flow, conservation laws, entropy conditions, discretization methods for obtaining weak solutions,		

Mathematics Programme Outcome & Course Outcome

	<p>consistent and stable numerical schemes for computational solutions. Prepare students for pursuing research or careers in industry in mathematical sciences and allied fields.</p>		
<p>Math 405T(IA): Internal Assignment (Mathematics and its Applications)</p>	<p>After completion of this course, the students learn about:</p> <ul style="list-style-type: none"> • Basic components of academic research such a literature survey, self study to identify a problem, solve it and produce report on his/her work etc. • Prepare a scientific presentation and deliver it to a group of audience consisting of faculty members. • Prepare and successfully taking part in a viva voce. 		
<p>Programme Bachelor of Science in Mathematics (Honours)</p>	<p>The outcome of the Programme offered by the Department of Mathematics, Ramananda College, Bishnupur, are</p> <ul style="list-style-type: none"> • To deal with the syllabus in a very scientific, lucid and comprehensive way, so that it is understandable to all the students. • To develop more skilled or specialized in a particular discipline. • Equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof. 	<p>This program will enable the students to take part and qualify for School Service Commission Exam, PSC, UPSC, JAM, numerical ground of physics, chemistry. After completing B.Sc, some mathematics students can go to focus on mathematical research or higher study in Mathematics like M.Sc, whereas others can use mathematics and its applications to build and improve work in finance, sciences, manufacturing, business, engineering and communications.</p>	<p>This programme uses a combination of usual classroom teaching, Numerical C-programming practicals, ICT classes, Library classes, project work to achieve the required outcome.</p>
<p>Courses</p>	<p>UG: Semester I</p>		
<p>SH/MTH/101/C-1: Calculus, Geometry & Differential Equation</p>	<p>COI: After completion the differential equations the students should have:</p>		

Mathematics Programme Outcome & Course Outcome

	<ul style="list-style-type: none"> • Understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus. • locate the x and y intercepts, any undefined points, and any asymptotes • Understand the successive derivatives and Leibnitz rule, • An idea of 3D concept. They will know equation of sphere ,cylinder, realize different types of central, non-central conicoids, generating line of conicoids, • Understanding of the standard quadratic surfaces like cone, ellipsoid. • A clear concept about the differential equations (DE) and its application, different types of first order DE, like as homogeneous, non-homogeneous, linear and non-linear and their solutions. • This concepts will also be required in the next 2nd semester. 		
<p style="text-align: center;">SH/MTH/102/C-2: Algebra</p>	<p>CO2:.. After completion of this courses a student will be familiar with</p> <ul style="list-style-type: none"> • The relationship between abstract algebraic structures with familiar numbers systems such as the integers and real numbers, • Realizing the concept of function & Relation and also their application. • A knowledge and understanding of topics including, but not limited to 		

Mathematics Programme Outcome & Course Outcome

	<p>divisibility, prime numbers, congruence and quadratic reciprocity.</p> <ul style="list-style-type: none"> • Classical Algebra which provides a complete and contemporary perspective on classical polynomial algebra through the exploration of how it was developed and how it exists today. • A systems of linear equations and their applications, • A knowledge of linear transformation, subspace, rank, Eigen value and eigen vector, Cayley--Hamilton theorem and its use in finding the inverse of a matrix. 		
UG: Semester II			
<p>SH/MTH/201/C-3: Real Anlysis</p>	<p>CO3: After completion of this courses students will learn</p> <ul style="list-style-type: none"> • Density and Archimedean property of real numbers. • Capture about open sets and closed set • Determine if an infinite sequence is bounded, monotonic, convergent or divergent, • Determine if an infinite series is convergent or divergent by selecting the appropriate test from the following: (a) test for divergence; (b) integral test; (c) p-series test; (d) thecomparison tests; (e) alternating series test; (f) absolute convergence test; (g) ratio test; and (h) root test. 		
<p>SH/MTH/202/C-4:</p>	<p>CO4: After completion the</p>		

Mathematics Programme Outcome & Course Outcome

<p>Differential Equations and Vector Calculus</p>	<p>differential equations and Vector Calculus the students should have:</p> <ul style="list-style-type: none"> • A clear knowledge about Lipschitz's condition and existence solution of 1st order DE, i.e., Picard's theorem. • A clear concept about the 2nd and higher order differential equations (DE) and its application • A basic idea of system of differentia equations and it applications. • A clear knowledge about series solution of the differential equations. • An idea of vector triple products with their geometrical meaning, • A clear concept of limits, continuity, differentiability and integrability of vector valued functions and their applications. 		
<p>UG: Semester III</p>			
<p>SH/MTH/301/C-5: Theory of Real Functions & Introduction to Metric Space</p>	<p>CO5: After completion this course the students should have:</p> <ul style="list-style-type: none"> • Determine if subsets of a metric space are open, closed, connected, bounded, totally bounded and/or compact. • Determine if a function on a metric space is discontinuous, continuous, or uniformly continuous. • Realization of the concept of limit, continuity, differentiability with some geometrical interpretation of real functions. Application of limit at finite & infinite 		

Mathematics Programme Outcome & Course Outcome

	<p>point.</p> <ul style="list-style-type: none"> • Ideas of various real function when it is continuous or discontinuous at any point. 		
<p>SH/MTH/302/C-6: Group Theory-I</p>	<p>CO6: The students will be able to know Group theory, in modern algebra, the study of groups, which are systems consisting of a set of elements and a binary operation that can be applied to two elements of the set, which together satisfy certain axioms. They will also realize subgroup, idea of centralizer, normalizer, center of a group, concept of cyclic group and Lagrange's theorem.</p>		
<p>SH/MTH/303/C-7: Numerical Methods Numerical Methods Lab</p>	<p>CO7: Students will gain knowledge of errors occurs in numerical calculation, develop the idea and application of finite differences, understand the concept of interpolation, learn some numerical techniques of solving differential & integration equations based on interpolation. Grow to find the roots of transcendental and polynomial equation . They will able to developed their concept of iteration method and geometric representation of iteration method.</p>		
<p>SH/MTH/305/SEC-1: Pogramming using C (New)</p>	<p>CO8: After completion of computer programming C-Language a student will be able to:</p> <p>Write any source program to compute the numerical solutions of the mathematics problems, which arise in the research studies with applications to physical,</p>		

Mathematics Programme Outcome & Course Outcome

	biological or social sciences.		
UG: Semester IV			
SH/MTH/401/C-8: Riemann Integration and Series of Functions	<p>CO9: This course concerns three complementary theories of integration due to Riemann, . The student learning outcomes for the course are:</p> <ul style="list-style-type: none"> • Definitions of fundamental concepts in each integration theory, • Fundamental theorems on the existence and properties of each of these integrals • Calculate concrete integrals, rigorously justifying each step using the theory, • Apply integration theory to prove results about specific classes of functions • Construct examples that illustrate aspects of the theory • Reproduce proofs of major results in the theory • Construct proofs of known results that expand upon the theory discussed in lectures • Explain the advantages and limitations of each of the theories of integration • Series of function with examples and also realize power series and Fourier series. 		
SH/MTH/402/C-9: Multivariate Calculus	<p>CO10: After completion of Multivariate Calculus student will be gained to:</p> <ul style="list-style-type: none"> • A basic idea of vector field, divergence, curl, irrotational and solenoidal vector . • A clear knowledge about line integral and its application. • A clear concept about the Green's theorem, Stoke's and divergence theorem. 		

Mathematics Programme Outcome & Course Outcome

	<ul style="list-style-type: none"> • The concept of continuous and differentiable function of two and more variables. • Grow to knowledge of directional derivatives, tangential plane and its applications. 		
SH/MTH/403/C-10: Ring Theory and Linear Algebra-I	CO11: After completion this course the students should have: <ul style="list-style-type: none"> • An idea of Ring, sub-Ring, Field, Integral domain, Ideal, type of ideal and their properties, • Knowledge of isomorphism theorem I,II and III. • A clear concept of vector space, linear span, basis and dimension of subspaces, • Knowledge of rank, nullity, matrix representation of a linear transformation, invertibility and isomorphism. 		
SH/MTH/405/SEC-2: Graph Theory (SEC T4)	CO12: They will realize the concept of graph theory in practical situations, apply the basic concept of Mathematical logic, realize the concept of Trees, Bipartite graph and Matching Hamiltonian graph, connectivity, network & flows.		
UG: Semester V			
SH/MTH/501/C-11: Partial Differential Equations and Applications	CO13: After completion this course the students should have: <ul style="list-style-type: none"> • A clear knowledge about PDE and different types of PDE like linear and non-linear and solution method • A clear concept about the 2nd and higher order PDE and classification 2nd order PDE and its canonical form. 		

Mathematics Programme Outcome & Course Outcome

	<ul style="list-style-type: none"> • A basic idea about heat equation, wave equation and Laplace equation and their solutions. • A basic concept about Cauchy problem of an infinite string. Initial Boundary Value Problems. Semi-Infinite String with a fixed end, Semi-Infinite String with a Free end and Vibrating string problem. • A clear idea about central force, constraint motions, varying mass, tangent , normal, planetary motions and Kepler's 2nd law. 		
<p>SH/MTH/502/C-12: Group Theory - II</p>	<p>CO14: They will have an idea of Automorphism, inner automorphism, automorphism groups, external and internal direct product, concept of the Fundamental theorem of finite abelian groups, deriving Group actions, stabilizers and kernels, permutation representation associated with a given group action. Generalized Cayley's theorem., Index theorem, well describeing of Groups acting on themselves by conjugation, class equation and consequences, conjugacy in S_n, p-groups, apply of Sylow's theorems and consequences, producing Cauchy's theorem, Simplicity of A_n for $n \geq 5$ and non-simplicity tests.</p>		
<p>SH/MTH/503/DSE-1: Linear Programming (DSE T1)</p>	<p>CO15: They will be able to learn about</p> <ul style="list-style-type: none"> • Graphical method, simplex method, two-phase method and Big-M method to solve an LPP. • The conception of convex sets, primal-dual relationships, 		

Mathematics Programme Outcome & Course Outcome

	<p>economic interpretation of the dual, .</p> <ul style="list-style-type: none"> • Solving technique of Transportation and assignment problem • A complete idea of Game theory. 		
SH/MTH/504/DSE-2: Probability and Statistics (DSE T4)	<p>CO16: After completion this course the students will be able to</p> <ul style="list-style-type: none"> • Solve problems by thinking logically, making conjectures, and constructing valid mathematical arguments. • Apply mathematical reasoning to both abstract and applied problems and to both scientific and non scientific problems. 		
UG: Semester VI			
SH/MTH/601/C-13: Metric Spaces and Complex Analysis	<p>CO17: After completion this course the students will be gained:</p> <ul style="list-style-type: none"> • A clear concept of sequences in metric spaces, Cauchy sequences. Complete Metric Spaces and Cantor's theorem. • A knowledge of the differentiation and integration of functions on \mathbb{C}, with applications to problem from real analysis, • A clear concept of analytic functions, Cauchy-Riemann equation, harmonic functions, power series with their applications. 		
SH/MTH/602/C-14:	<p>CO18: Students will get an idea of Ideal, polynomial ring, division algorithm, definition of PID, ED, FD, UFD and realize their properties, concept of prime and irreducible element and</p>		

Mathematics Programme Outcome & Course Outcome

<p>Ring Theory and Linear Algebra II</p>	<p>understand their relation. The students will learn about dual spaces, annihilators. Eigen spaces, diagonalizability, invariant subspaces, minimal polynomial for a linear operator. They will gain knowledge of inner product spaces, Gram-Schmidt orthogonalisation process, the adjoint of a linear operator. least squares approximation, Orthogonal projections and Spectral theorem.</p>		
<p>SH/MTH/603/DSE-3: Number Theory (DSE T7)</p>	<p>CO19: After completion this course the students should have:</p> <ul style="list-style-type: none"> • A clear knowledge about different types of integers numbers like prime numbers, composite numbers, relatively prime numbers, Linear Diophantine equation and its solution, linear congruence, Chinese remainder theorem, Fermat's and Wilson's theorems. • A clear concept about number theoretic function, the Mobius Inversion formula, the greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues. some properties of Euler's phi-function. • A clear concept of encryption and decryption and its application. Idea of integer modulo, congruent, Legendre symbol and its properties. 		
<p>SH/MTH/604/DSE-4: Project Work</p>	<p>CO20: After completion project work the students will learn how to apply and adapt a variety of problem-solving</p>		

Mathematics Programme Outcome & Course Outcome

	<p>strategies to solve problems, to improve thinking skills, to promote effective mathematical communication, to develop mathematical knowledge through problem solving in a way that increases students interest. The Math project</p> <ul style="list-style-type: none">• Describes a classroom experiment.• Analysed the students' performance• determinates better students learning than other classic methods		
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