

Belda College

Department of Mathematics

Belda :: Paschim Medinipur :: 721424 :: W.B.

PROGRAMME OUTCOME (PO) & COURSE OUTCOME (CO) FOR THE ACADEMIC YEAR 2020-2021

We run two courses (UG & PG) in our department under Vidyasagar University and provide degree **B.Sc in Mathematics Hons** and **M.Sc in Applied Mathematics with Oceanology and Computer Programming**. We follow the syllabus of Vidyasagar University for UG and PG courses. The duration for UG course (B.Sc in Mathematics Hons.) is 3 years and the duration for PG course (M.Sc in Applied Mathematics) is 2 years. For **B.Sc in Mathematics Hons**, we followed Choice Based Credit System (CBCS). Under this new system students have opportunities to choose any prescribed topic or course for his study to earn credit point. More over this system is semester system and there are 6 semester for **B.Sc in Mathematics Hons**.

Our Department follows the syllabus of Vidyasagar University for PG courses. The duration of PG course is 2 years. Our department introduced PG course from the academic year 2017-2018. It is a semester system under Choice Based Credit System (CBCS). Assessment of the students are followed by Grade points and final result followed by CGPA. In the second and third semester, students have freedom to choose a paper in another department. Since the modernization and industrialization throughout the world is progressing at great speed by the efforts of the various visionaries for better living of human beings, we run **Operations Research (OR)** as special paper in PG course.

PROGRAMME OUTCOME (PO)

BACHELOR OF SCIENCE (B. Sc) : MATHEMATICS HONOURS

MASTER OF SCIENCE (M. Sc) : APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER

PROGRAMMING

PO1	Disciplinary knowledge	To acquire comprehensive and sufficient knowledge of understanding in Mathematics.
PO2	Communication skill and attitude	Excellent communication of mathematics in geometrical realization, documentation, make effective presentation to develop other branches of sciences, to think existing open programme in mathematics
PO3	Critical thinking and analytical Reasoning	To acquire the ability of deep study and then critically to think and analyse the subject of mathematics in its different areas
PO4	Problem Solving	Capability of solving problems in Computer Graphics, various models, circuits, linear system of equations, linear programming problem, Network flow problem, Mechanics, optimization and ability to provide new solutions using knowledge of mathematics
PO5	Research Related Skill	Capability of thinking the various field of Mathematics, advances in those fields and clear concept about them so that appropriate questions are formed on related fields.
PO6	Information/ digital literacy	To acquire the capability of using the software(C++ and Matlab) to solve statistical and numerical problems.
PO7	Self- directed Learning	Ability to work independently, study the subjects in its depth and apply thoughts for solving the problems in various field .
PO8	Moral and Ethical awareness/reasoning	To acquire the ability unbiased approach, trueness of action and not to use of fabrication of data to misguide.
PO9	Life long learning	To acquire the ability of self learning and life-long learning in the broadest context of scientific development.
PO10	Professional Skill	Time management, extract important information and pattern, accurately organize, analyze and interpret data.
PO11	Applicational skills	Planning, monitoring every day life using math skill, always try to optimize time, resources, money and acquire optimize return.
PO12	Experimental learning	Students are able to identify problems, use constructive reasoning to make viable arguments, and applying mathematics in real-life problems.
PO13	Employability options	Ability to find jobs in intelligence analysis, operational research, statistical research, logistics, financial analysis, market research, management consultant, IT, software engineering, computer programming, Teaching, Banking, Actuarial carriers.

PROGRAMME SPECIFIC OUTCOME (PSO) :: B. SC. (MATHEMATICS HONOURS)

& M. SC. (APPLIED MATHEMATICS)

PSO	Description
PSO1	Think every topics in a critical manner
PSO2	When there arise situation to provide information about any problem, able to identify it, locate, evaluate and use that information effectively.
PSO3	Formulate and develop every problem in unique logic and mathematical argument.
PSO4	Acquire good knowledge and understanding in advanced areas of mathematics and statistics chosen by the student from the given course.
PSO5	Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities with in the scope of bestowed rights &privileges
PSO6	Understand, formulate and use quantitative models arising in social science, business and other contexts.

COURSE OUTCOME (CO) FOR THE ACADEMIC YEAR 2020-2021

COURSE NAME :: B. SC (MATHEMATICS HONOURS)

Semester	PAPER NAME	COURSE	OUTCOMES
1 st Sem	Paper CC1 (Calculus, Geometry & Differential Equation)	CC1	--Enable to do higher order derivative by Leibnitz's rule and reduction formula for various type of integration. --Application of derivatives in other sciences --Concept of different curves and their pictorial representation --Enable to get idea of 2 & 3-dimensional shapes -- Enable to solve the various type of ordinary differential equations
	Paper CC2 (Algebra)	CC2	--Apply De Moivre's Theorem to solve various types of numerical equation -- Enable to get information of roots by observing the coefficients of algebraic equations --Enable to understand the consistent and inconsistent of system of linear equations and their solution method --Enable to get idea of relation and partition by equivalence relation and divisibility --Enable to find eigen values and eigen vectors, to find inverse of a square matrix by using Cayley-Hamilton Theorem
2 nd Sem	Paper CC3 (Real Analysis)	CC3	--Enable to understand the idea of real line and points, different type of sets of real line --To get idea of the convergency and divergency of a sequence in \mathbb{R} and to find their limit superior and limit inferior. --Applying the comparison test, ratio test, root test to recognise the idea of convergency and divergency of the series of real numbers.
	Paper CC4 (Differential Equations & Vector calculus)	CC4	--To understand the different type of ordinary differential equations and their technique of their solution of linear homogeneous and nonhomogeneous equations of higher order with constant coefficients. --To solve system of linear differential equations -- Solution by method of power series and variation of parameters. -- Scalar triple product of vectors and differentiation and integration of vector valued function.
3 rd Sem	Paper CC5 (Theory of Real Functions & Introduction to Metric Space)	CC5	-- To understand limit, continuity of single valued function in (ϵ, δ) approach. -- Concept of relative extrema, interior extremum theorem, Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem and Caratheodory's theorem and their applications. -- Idea about metric spaces and their properties like openness, closedness etc.
	Paper CC6 (Group Theory-1)	CC6	--Concept of groups and its applications linked with symmetries of geometrical objects. -- Concept of subgroups, cyclic groups, normal subgroup and their basic properties --Concept of group homomorphism and proof of First, Second and Third isomorphism theorems
	Paper C 7 Theory (Numerical Methods)	CC7	--Learn to find the roots of algebraic and transcendental equation by Bisection method, Newton's method, secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method -- To find the solution of system of linear equations by Gauss Jacobi method, Gauss Seidel method and their convergence analysis. --To find value of integration by Trapezoidal rule, Simpson's 1/3rd rule etc -- Numerical solution of differential equations by Euler's method, the modified Euler method, Runge-Kutta methods

	Paper C7P: (Numerical Methods Lab)		--Understanding programming writing in C language. -- Enable to write programs about string manipulation, numerical and statistical problems.
	SEC-1 (Logic & Sets)	SEC-1	--Concept about syntax of 1 st order logic and semantics of 1 st order languages --Idea about sets, its properties, countability, power set of a set. --Concept of relations, partitions and equivalence relations with example.
4 TH Sem	Paper CC8 (Riemann Integration and Series of Functions)	CC8	--Concept of Riemann integration & its applications. Fundamental Theorem of Integral Calculus --Understanding of convergency and uniformly convergency of sequence of function and series of functions -- Concept of improper integration and Beta, Gamma functions --Fourier series & Power series and their applications
	Paper CC9 (Multivariate Calculus)	CC9	--Concept of calculus for the function of more than one variables. Method of Lagrange multipliers to find optimum value of a function of several variables. --Concept of line integration, double integration and triple integration and to solve different types of problems by using Stoke's and Green's Theorems.
	Paper CC10 (Ring Theory and Linear Algebra I)	CC10	--Concept of rings with examples and its properties. -- Concept of subrings, integral domains, fields, ideals, quotient rings, prime and maximal ideals. --Concept of ring homomorphism and proof of First, Second and Third isomorphism theorems -- Concept of vector space and linear transformations
	SEC-2 Graph Theory	SEC-2	--Concept of graph theory with applications. --Idea of modelling and activity network. --Use of optimum time and space complexity methods.
5 th Sem	Paper CC11 (Partial Differential Equations & Applications)	CC11	--Learn about partial differential equations, its classification, construction and geometrical interpretation. -- Derivation of heat equation, wave equation and Laplace equation. --Study of central force, constrained motion, varying mass. Kepler's law of planetary motion.
	Paper CC12 (Group Theory-II)	CC12	--Learn about automorphism groups, external & internal direct product of groups, group actions and Sylow's theorems
	DSE-I (Linear Programming)	DSE-I	--Introduction of Linear Programming Problems (LPP) and various methods for its solutions. --Idea about Game Theory: formulation of two person zero sum games and its solutions
	DSE-2 (Probability and Statistics)	DSE-2	--Concept of Random Variables and corresponding Sample Space. --Learn the different distributions and measure the central tendency of them. --Learn about joint, marginal, conditional and moment generating functions distribution functions --Understand the linear regression and estimation of parameters. Find the estimated value by testing a hypothesis.
6 th Sem	Paper CC13 (Metric Spaces and Complex Analysis)	CC13	--Learn the concept of Metric space, Mapping, compactness and connectedness, Heine-Borel property, contraction, Banach fixed point Theorem related to Metric space. --Concept of various property of Complex Number, Differentiability and Analyticity of Complex Valued function, Formation of Cauchy-Reimann equation. --Idea about Contour and Contour Integral, Learn related theorem like Cauchy- Goursat theorem and Cauchy Integral formulae. --Apply Liouville's theorem in fundamental theorem of algebra.

COURSE NAME :: M. SC (APPLIED MATHEMATICS)

Semester	PAPER NAME	COURSE	OUTCOMES
1 st Sem	MTM-101 (Real Analysis)	MTM-101	--Concept of fundamental properties' of Metric Space that related to the formal development of Metric Space. --Learn about Bounded Variation and R-S integral --Understand the fundamental concept Measure theory, Lebesgue Measure, Lebesgue Integral and related theorem like Fatou's Lemma, Monotone Convergence theorem, Dominated convergence theorem etc.
	MTM-102 (Complex Analysis)	MTM -102	--The concept of Analytic functions, construction of Analytic function. Idea about contour Integration and related theorem like Cauchy-Goursat theorem, Cauchy's Integral formula, Morera's Theorem. Infinite Series: Taylor's Series, Laurent's Series. Conformal Representation: Transformation, Conformal transformation, Linear transformation, Mobius transformation. Understand the fundamental concept of Zero's, Pole's, Singularity, Residue and related theorem like Cauchy-Residue theorem.
	MTM-103 (Ordinary Differential Equations and Special Functions)	MTM -103	--Understanding of system of linear differential equations and solution of homogeneous linear system by the eigen value method, power series solution about ordinary and singular points. -- Identify and solve Legendre and Bessel equations using Legendre polynomials and Bessel function respectively.
	MTM-104 (Advanced Programming in C and MATLAB)	MTM -104	--Idea about Pinter and pointer variable. Use of pointer to access arrays, strings and functions. --To solve problems using Structure and Union. --Use of dynamic memory management functions. Use of files in C for reading and writing data in a file. --To familiarize the student in introducing and exploring MATLAB software. --To prepare the students to use MATLAB for solving numerical, statistical problems and for drawing picture/graph.
	MTM-105 (Classical Mechanics and non-linear dynamics)	MTM -105	--Understand the Lagrangeian and Hamiltonian approaches in Classical Mechanics --Familiarized with passion brackets and Hamilton Jacobi Equation. -Learn theory of small oscillation in detail along with basis of free vibration. --Kinematics and Dynamics of Rigid body in detail regarding Euler's equations of motion --Obtain concept of relativity theory and stable points, unstable point, chaos, problems related to non-linear dynamics.
	MTM-106 (Graph Theory)	MTM -106	-Understand and apply the fundamental concept of graph theory. -Define how graph serve as a models for many standard problems. -Discuss the concept of tree, Euler graph, cutsets, fundamental circuit, matrix representation --See the application of graph in science, business and industry.
	MTM-197 (Computation)	MTM -197	--Solution of numerical problems and statistical problems by using MATLAB

	al Methods: Using MATLAB (Practical))		--Programming for drawing different types pictures/graphs.
2 nd Sem	MTM-201 (Fluid Mechanics)	MTM -201	--To know about real and ideal fluids and their compressible and incompressible flow. --Enable to derive governing equations (Continuity equation, momentum equation, energy equation). --Enable to extract exact/analytical solution of Navier-Stokes equation. --Understanding of incompressible viscous flow via finite difference methods.
	MTM-202 (Numerical Analysis)	MTM -202	--To know the cubic spline interpolation, Lagrange's bivariate interpolation, Chebyshev polynomial, Economization of power series. --Numerical Integrations by Monte Carlo Method. --Know to find the roots of polynomial equation by Bairstow methods, solution of a system of non-linear equations by fixed point method and Newton Raphson's method. --To find matrix inverse and LU decomposition method. --Solution of ordinary differential equation by predictor corrector method, Milne's method. --Enable to solve partial differential equation by finite difference method, Crank-Nicolson method, iteration method.
	MTM-203 Unit-1: Abstract Algebra Unit-2: Linear Algebra	MTM -203	Unit-1: Abstract Algebra: --Concept of Morphism of groups, quotient groups and isomorphism theorems. -- Class equation and Sylow's Theorems and their applications --Understanding about rings, integral domain, quotient rings, polynomial rings, Euclidean domain --Idea about field extension, finite, algebraic and finitely generated field extensions, finite fields. Unit-2: Linear Algebra : --Idea about linear transformations and its matrix representation; application to canonical forms (Jordan Canonical form, triangular Canonical form etc). --Understanding about inner product spaces, hermitian, unitary and normal transformation.
	MTM-204-A (Statistical and Numerical Methods)	MTM -204A	--Enable to understand Mean, median, mode, Bi-variate correlation and regression, Time series analysis Hypothesis testing. --Enable to construct Lagrange's and Newton's interpolation and to find roots of algebraic and transcendental equations (Bisection, Newton-Raphson method etc.). --Numerical integration by Trapezoidal and Simpson's 1/3 method. --Enable to solve ordinary differential equation by Euler's method and R-K method.
	MTM-205 (General Theory of Continuum Mechanics)	MTM -205	--To give idea about basic concept of tensor calculus in Cartesian co-ordinates and to describe motion and deformation of body. ----- To learn the different stress measures and how and where to use them. To know basic law of continuum mechanics. --Determine stresses for hyperelastic incompressible material behaviour (for example plates, circular rods etc.). --Concept how to find the work done, energy equation of a

			perfect fluid and discuss source, sink and doublet and their images in a two dimension flow.
	MTM-206 (General Topology)	MTM -206	To give idea about Topological Space, Open set, closed set, Subspace, Neighbourhoods, limit point, closure of a Set. --Learn about Oder topology, Product topology, Quotient, topology. --Learn about Separation Axioms, Connectedness, Compact Space, Urysohn Lemma, Tietze Extension theorem.
	MTM-297 (Lab: C-Prog. with numerical methods)	MTM -297	--Enable to write programs about searching and sorting, string manipulation, evaluation of determinants, inverse of matrix, solution of system of linear equations, solution of PDE, ODE, to find eigen value of a matrix by power method. --Use of pointers, data file, structure, dynamical memory allocation for writing above programs.
3 rd Sem	MTM-301 (Partial Differential Equations and Generalized Functions)	MTM -301	--Understanding of classification of PDEs and their transformation into canonical form. --Understanding of solution of linear PDE of both 1 st and 2 nd order; formulation and solution of PDE problems in the field of industrial organisation engineering.
	MTM-302 (Transforms and Integral Equations)	MTM -302	--To know about Fourier Transform, Laplace Transform, Wavelet Transform and their applications (to solve Partial differential equations). --Understanding about Wavelet Transform --Enable to solve Integral Equation (Formulation of integral equations, Integral equations of Fredholm and Volterra type, Solution by successive substitutions and successive approximations, Resolvent Kernel Method)
	MTM-303 (Unit-1: Dynamical Oceanology and Meteorology	MTM -303	Unit-1: Dynamical Oceanology and Meteorology : --Enable to classify the forces and to derive the equation of motion (equation of continuity of volume) in a sea water. -- Enable to explain meteorological phenomena at various scales in terms of basic physical dynamic process including Poisson equation, Potential temperature, Hydrostatic equation, dry adiabatic laps rate, equation of motion of air, virtual temperature etc.
	Unit-2: Operations Research)		Unit-2: Operations Research : --To comprehend the dynamics of inventory management's principles, concept and technique as they relate to the entire supply chain (customer demand, distribution and product transformation processes). --To understand the method used by organisations to obtain the right quantities of stock or inventory. --Understanding of Queuing Theory: Basic structure of queuing models and its application to real life.
	MTM-304 (Discrete Mathematics)	MTM -304	--Enable to understand Boolean algebra, Propositional Logic, Tautology. --To develop concept of sets and propositions, Cardinality, Principle of Inclusion and exclusion. --Enable to understand computability and Formal Languages, Phrase Structure Grammars. --Understanding of Finite State Machines, Partial Order Relations and Lattices: Chains and Antichains. --Concept of Graph Theory and their applications --Analysis of Algorithms, Time Complexity, Complexity of Problems.

	MTM-305B (Special Paper-OR: Advanced Optimization and Operations Research)	MTM -305B	--Idea about how to provide better quantitative informations for making decision --Solution of problems by Revised simplex method, Fibonacci and Golden section method. --Idea about integer programming and goal programming and related problems.
	MTM-306B (Special Paper-OR: Operational Research Modelling-I)	MTM -306B	-Learn different approaches of solving DPP and its applications in project scheduling and routing problem. -Use different models of inventory to control optimal supply or production sector. -Learn the networking system and use PERT and CPM to find the optimum project. -Understand Simulation and its advantages , disadvantages . Learn Monte-Carlo simulation to generate random numbers.
4 th Sem	MTM-401 (Functional Analysis)	MTM -401	--Idea about Normed Space, fundamental properties of Normed Space, bounded linear transformation $B(X,Y)$, Banach Space, Hahn- Banach Extension Theorem. ---Idea about Conjugate Space, Reflexive Spaces, Uniform Roundedness Principle, Closed Graph theory, Open Mapping Theorem. Fundamental concept of Inner Product Space, orthonormal Basis, Varies properties of Inner Product Space and related theorem like Parallelogram law, Cauchy-Schwarz inequality, Projection Theorem. --- Learn about weak and strong convergence.
	MTM-402 Unit-1:-- Fuzzy Mathematics With Applications	MTM -402	Unit-1:-- Fuzzy Mathematics With Applications: Define fuzzy sets, α -cuts, fuzzy complements. --Discuss of operations on fuzzy sets, fuzzy numbers --Illustrate fuzzy relations, binary fuzzy sets, fuzzy number, fuzzy equivalence relations. --State some application on fuzzy set.
	Unit-2: Soft Computing		Unit-2: Soft Computing: Define Soft computing, fuzzy logic, genetic algorithm, neural networks. ---To know about application of fuzzy logic concepts in scientific problems. ---Discuss the solution of optimization problems using Genetic Algorithm.
	MTM-403 Unit-1: Magneto Hydro-Dynamics	MTM -403	Magneto Hydro-Dynamics :--Learn about Maxwell's electro magnetic field equations when medium in motion. Lorentz's force. --To know about the equations of motion of a conducting fluid. Basic equations. Simplification of the electro magnetic field equation. Magnetic Reynolds number. Alfven theorem. --Magnetic body force. Ferraro's law of isorotation. Laminar Flow of a viscous conducting liquid between parallel walls in transverse magnetic fields. M.H.D. Flow. --Understanding past a porous flat plate without induced magnetic field. MHD Couelte Flow under different boundary conditions, Magneto hydro dynamics waves.
	Unit-2: Stochastic Process and Regression		Stochastic Process:-- Concept of Markov chains with finite and countable state space and classification of states.

