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BEJOY NARAYAN MAHAVIDYALAYA

(GOVT. SPONSORED)

NAAC ACCREDITED

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Ref. No. .....

Date. ....01-08-2022....

PROGRAMME TITLE: B.SC. IN MATHEMATICS (HONOURS) (CBCS)

Programme Outcomes (PO)

After successful completion of B.Sc. in Mathematics(Honours)(CBCS) course and after dealing with its hard, updated and advanced curriculum, the students will not only get the B.A./B.Sc. degree but also achieve the following abilities:

PO No.	Descriptions
PO-1	Acquire a strong knowledge on fundamental principle and concepts of mathematics and mathematical computing with their applications to Industries, Engineering Sciences, Biology and Environmental Sciences.
PO-2	Gain a commendable foundation on various branches of mathematics and its interconnections with other disciplines to face the real life problems to become self-empowered in the society and to lead others in the society.
PO-3	Develop problems solving skills, cultivating strong logical thinking, communicative skills both oral and written.
PO-4	Understand the professional, ethical, legal, social issues and responsibilities and generate the efficiency to address them.
PO-5	Communicate appropriately, effectively and scientifically using different tools and technology and by new findings.
PO-6	Acquire knowledge to pursue the related Post-Graduate course of studies and researches in related areas both academic and others.
PO-7	Applying one's knowledge of principles, which will result in a specific subject area to analyze its local and global impact.

Principal
Bejoy Narayan Mahavidyalaya
P.O.- Itachuna, Dt.- Hooghly.

Rajesh Mondal
Head
Department of Mathematics
Bejoy Narayan Mahavidyalaya
Itachuna, Hooghly

Programme Specific Outcomes (PSO)

After rigorous practice and completion of this course in B.Sc Mathematics (Hons.) under CBCS, one surely hopesfor the following attributes to inculcate oneself directly and indirectly:

PSO No.	Descriptions
PSO-1	Impart conceptual knowledge of mathematical science for formulating and analyzing and addressing the real world problems.
PSO-2	To equip the students sufficiently in both analytical and computational skills in mathematical sciences in present and helps them to establish carrier in mathematics by higher studies and researches.
PSO-3	Build teaching skills, subject knowledge of the course of their study which will help them to face different competitive examinations for various jobs in different fields.
PSO-4	To impart a strong communicative and interpersonal skills for working in a team.
PSO-5	To inculcate personality with high moral values, utmost softness and liberty which will devote oneself for the betterment of community, society and so our country.
PSO-6	This course teaches the students to be hard working, strongly committed, and fully dedicated; which are necessary to reach the real goal of the education: *"ja vidya, sa bimuktaya"*.

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B.SC. IN MATHEMATICS (HONOURS) (CBCS)

COURSE OUTCOMES (CO)

Course: CC-01 (Calculus, Geometry & Differential Equations):

On successful completion of this course students will be expected to:

CO-1: Understand the behavior of functions studying different approach of derivatives

CO-2: Learn about applications of definite integral to compute arc, length, area, volume etc.

CO-3: Know about the reflection properties of conics, translation and rotation of axes

CO-4: Learn classification of conics using discriminant and acquire knowledge about different conics, polar equation of conics

CO-5: Learn about central conicoids, generating lines, classification of quadrics

CO-6: Understand the concept of differential equations and their various types of solutions and distinguish among them

CO-7: Solve exact differential equations, non-exact differential equations using integrating factor, special integrating factor, transformation etc.

CO-8: Solve linear equations and equations reducible to linear form

Course: CC-02 (Algebra):

On successful completion of this course students will be expected to:

CO-1: Grasp the idea of complex numbers and its modulus and amplitude.

CO-2: Learn about the De-Moivre's theorem and can apply to solve various problems.

CO-3: Understand the relation between roots and coefficients.

CO-4: Learn how to find out an equation depending on the relations of roots of another equation.

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CO-5: Learn about the Descartes rule of signs and Sturm's functions and can use it to solve problems.

CO-6: Learn about the Cardan's method and Ferrari's method to solve the cubic and biquadratic equations respectively.

CO-7: Recognize the reciprocal equations and can solve its problems.

CO-8: Understand the relation between AM, GM and HM and can apply to solve various problems.

CO-9: Learn about the Cauchy-Schwartz inequality.

CO-10: Grasp the idea of relations, equivalence relations and Partition.

CO-11: Understand the concept of functions, composition of functions, invertible functions.

CO-12: Learn about the well ordering property of natural numbers, division algorithm, 2^{nd} principal of induction and can solve related problems.

CO-13: Learn about the congruence relation between integers and its properties and can apply to solve various problems.

CO-14: Learn how to solve a system of linear equations in any number of variables

CO-15: Learn to find Row-reduced Echelon form by using row operations

CO-16: Represent the equivalent conditions for invertibility of a matrix

CO-17: Learn basics of vector spaces keeping R^n as a model

CO-18: Work with eigenvalues and eigenvectors of a matrix

CO-19: Apply Cayley-Hamilton theorem to find the inverse of a matrix

Course: CC-03 (Real Analysis)

Upon completion of this course, students would be able to

CO-1: Understand the concept of finiteness, Countability, denumerability and Cardinality

CO-2: Realize the set of real numbers as a complete ordered field, by studying the algebraic, order and completeness properties

CO-3: Grasp the idea of boundedness and bounds of a real subset

CO-4: Define and identify open sets and closed sets

CO-5: Visualize the concept of limit points, closure, and compactness

CO-6: Describe the various types of intervals and their properties

CO-7: Grasp the concept of real sequence, and identify different types of sequences like monotone or bounded sequence

CO-8: Understand the concept of limit and convergence, and also the concept of diveregence

CO-9: Realize the significance of the Cauchy criterion

CO-10: Understand the concept of an infinite series, and its convergence (simple and absolute) or divergence

CO-11: Use different tests (Comparison test, ratio test etc.) for checking the convergence of an infinite series

Course: CC-04 (Differential Equations and Vector Calculus)

On successful completion of this course students will be expected to:

CO-1: Study real life problems by constructing ordinary differential equations

CO-2: Recognize and solve various ODEs of different orders and degrees by various methods

CO-3: Know different types of linear systems

CO-4: Learn Power-series solution of a differential equation

CO-5: Learn Vector triple product, and study limit, continuity and differentiation of vector functions

Course: CC-05 (Theory of real functions and introduction to metric spaces):

On successful completion of this course students will be expected to:

CO-1: Recall the analytic approach on limit in Differential Calculus which is ϵ-δ definition on sequence and its application to real valued functions.

CO-2: Know the algebra of limit of functions, infinite limits and limits at infinity.

CO-3: Learn the continuity of real valued function and the algebra of continuous functions.

CO-4: Aware about the characteristic properties of continuous functions, e.g. boundedness property, intermediate-value property, interval preservation property etc.

CO-5: Learn the uniform and non-uniform continuity of a real valued function, its various properties and its difference from the continuous functions.

CO-6: Gain knowledge on differentiability of a real valued function and its algebra of differentiable functions

CO-7: Know the Properties of differentiable functions: extrema of a function and its applications, intermediate value properties of derived function, Rolle'stheorem, Lagrange's Mean Value theorem and its applications, Cauchy's Mean Value theorem.

CO-8: Habituated with Taylor's theorem and Maclaurin's theorem with different form of remainders, its application for expansion of different functions like: sinx, cosx, ln(1+x),1/(ax+b), $(1+x)^n$ etc.

CO-9: To learn to generalize the distance function into a metric function

CO-10: Learn various examples of metric spaces and identify the properties which are true in real line but not generally true in a metric space

CO-11: To define Open balls, Closed balls, Open Sets, Closed Sets and Limit points in a metric space

Course: CC-06 (Group Theory-I):

On successful completion of this course students will be expected to:

CO-1: Demonstrate when a binary algebraic structure forms a group.

CO-2: Grasp the concept of group and its possible subgroups.

CO-3: Identify cyclic groups and their generators for finite and infinite both cases.

CO-4: Learn about the Lagrange's theorem and can solve various problems.

CO-5: Identify the normal subgroups and simple groups.

CO-6: Understand the idea of factor groups.

CO-7: Learn the idea of external direct product and internal direct product of groups and can apply to solve simple cases.

CO-8: Recognize the Dihedral groups and Quaternion groups.

CO-9: Know about the permutation, Symmetric group and its subgroups.

CO-10: Learn about the Cauchy theorem.

CO-11: Understand the concept of group homomorphism and its properties. Also learn the idea of isomorphism between the groups and can apply it to solve various problems.

CO-12: Apply a range of mathematical techniques to solve a variety of quantitative problems.

Course: CC-07 (Numerical Methods & Numerical Methods Lab):

Upon completion of this course, students would be able to:

CO-1: Understand various types of error such as relative, absolute, round off, truncation etc.

CO-2: Solve transcendental and polynomial equation numerically

CO-3: Solve system of linear equations by various numerical methods

CO-4: Learn about interpolation & various types of interpolation formulae

CO-5: Gain knowledge about numerical differentiation and integration by numerical methods

CO-6: Solve ordinary differential equation by methods like Euler's, Runge-kutta etc.

CO-7: Learn to solve different problems of numerical methods by computer programming, and in the process gain some programming and digital knowledge

Course: CC-08 (Riemann Integration and Series of Functions)

Upon completion of this course, students would be able to

CO-1: Develop the technique of developing Darboux's integral from the concept of Cauchy integral learnt in 10+2 course.

CO-2: Learn the integration theory in analytic way which is Riemann integration, to overcome the integration theory for discontinuous functions.

CO-3: Can show the Equivalence of Darboux's integral and Riemann integral and know their various properties

CO-4: Acquire the knowledge of Riemann integrability for piecewise continuous functions and monotone functions and algebra of integrable functions.

CO-5: Find Mean Value theorem for integrals, primitive and fundamental theorem on integral calculus.

CO-6: Know the Concept of improper integrals and its convergence and different properties

CO-7: Find the application of improper integral: convergence of Beta and Gamma functions and their properties.

CO-8: Learn Pointwise and uniform convergence of a sequence and series of real valued functions.

CO-9: Gather efficiency on the consequences of uniform convergence for sequence and series of real valued functions which are bounded, continuous, differentiable and integrable.

CO-10: Develop the Fourier series, Riemann Lebesgue Lemma, Bessel's inequality, Perseval's identity, Dirichlet's conditions for expansion of a real valued function in to a Fourier

CO-11: Know the Power series and its convergence, Cauchy-Hadamard theorem and radius of convergence

CO-12: Do Differentiation and integration of power series, Abel's theorem and Weierstrass theorem.

Course: CC-09 (Multivariate Calculus)

Upon completion of this course, students would be able to

CO-1: Understand the fundamental concepts of functions with several variables & the concepts of derivatives for this type of functions

CO-2: Apply the concepts of derivatives to find the maxima and minima for functions of several variables

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CO-3: Compute double and triple integrals efficiently & also learn about change of variables in double and triple integrals

CO-4: Apply double and triple integral to find area and volume

CO-5: Gain knowledge on the concept of divergence, curl and integration of vector point functions

CO-6: Solve problems related to line, surface and volume integrals using Gauss, Stoke's and Green's theorem

Course: CC-10 (Ring Theory and Linear Algebra-I)

Upon completion of this course, students would be able to:

CO-1: Understand the concept of ring and know the various properties of several examples of rings

CO-2: Identify the properties which make a ring an integral domain or a field

CO-3: Grasp the concept the ideals and factor rings

CO-4: Visualize the properties of ring homomorphisms

CO-5: Generalize the concept of vector spaces which they had learnt in a specific way in CC-02

CO-6: Find a basis of a vector space by extension, deletion and replacement theorems

CO-7: Realize the uniqueness of linear transformations compared to usual mappings

CO-8: Learn how to represent a linear transformation by a matrix and thus connect vector spaces and matrix algebra

Course: CC-11 (Partial Differential Equations and Applications)

Upon completion of this course, students would be able to:

CO-1: Study real-life problems by constructing partial differential equations

CO-2: Recognize and Solve various PDEs of different higher order and degree

Course: CC-12 (Mechanics-I)

Upon completion of this course, students would be able to:

CO-1: Learn the concept of equilibrium and stability of a particle

CO-2: Apply this knowledge in some engineering fields

CO-3: Learn to study Dynamical System

Course: CC-13 (Metric Space and Complex Analysis)

Upon completion of this course, students would be able to:

CO-1: Recall the basic concepts of metric spaces and its basic structures.

CO-2: Learn Completeness of metric spaces by introducing sequence in it and some other properties for achieving the completeness.

CO-3: Learn Continuity and uniform continuity of a map on metric spaces along with related characterizations.

CO-4: Learn Connectedness in a metric space along with it characterizations and its behavior under continuous mapping.

CO-5: Learn Compactness in a metric space along with it characterizations and its behavior under continuous mapping.

CO-6: Learn Homeomorphism, contraction map, Banach fixed point theorem and its application to ordinary differential equations.

CO-7: Recall the basic concept of complex numbers, its properties and function of complex variables.

CO-8: Learn Differentiability of a function of complex variables and Cauchy-Riemann equation.

CO-9: Learn Analyticity of a function of complex variables with some examples

CO-10: Learn Contour integral, Cauchy-Goursat theorem and Cauchy integral formula.

CO-11: Learn Liouville's theorem and fundamental theorem of algebra.

CO-12: Learn Sequence and series of complex numbers, Laurent series, Taylor's series, power series and its convergence.

Course: CC-14 (Ring Theory and Linear Algebra II)

Upon completion of this course, students would be able to:

CO-1: Understand the properties of polynomial rings

CO-2: Generalize the concept of divisibility, primality and irreducibility of integers in a ring set-up and understand the concept of ED, PID, UFD

CO-3: Learn to work with dual spaces and double dual spaces, and realize the identification of transformations in the double dual space with the vectors

CO-4: Understand the concept of diagonalizability and invariant subspaces

CO-5: Find the Jordan form and other canonical forms of a linear transformation

CO-6: Visualize the Inner products as a sort of product of vectors

CO-7: Find an orthogonal (orthonormal) basis of a vector space by Gram-Schmidt process

CO-8: Find the best approximation of a vector by a given subspace of the vector space

CO-9: Understand the concept of Self Adjoint, Normal and Unitary operators and compare it with the corresponding notions in matrix theory

CO-10: Visualize and work with Orthogonal projections and analyze a linear transformation by Spectral theory

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