DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

PROGRAMME OUTCOME (PO), COURSE OUTCOME (CO) AND PROGRAMMESPECIFIC OUTCOME (PSO) FOR END SEMESTER STUDENTS UNDERGRADUATE COURSE: 2020-2021

Programme Name: B. SC. HONS (MATHEMATICS)

PROGRAMME OUTCOMES:

PO1: Disciplinary Knowledge To acquire comprehensive and sufficient knowledge of understanding in Mathematics

PO2: Critical Reasoning & Problem Analysis: To acquire the ability of deep study and then critically to think and analyse the subject of mathematics in its different areas.

PO3: Develop Interdisciplinary Knowledge: To enable students in developing an effective approach to Interdisciplinary study and enable them to build their own interdisciplinary pathway by choosing courses which makes sense to them.

PO4: Communication skill and attitudes: Excellent communication of mathematics in geometrical realization, documentation, make effective presentation to develop other branches of sciences, to think existing open programme in mathematics.

PO5: Self- Directed Learning: Ability to work independently, study the subjects in its depth and apply thoughts for solving the problems in various field .

PO6: Experimental learning and Employability options: Students are able to identify problems, use constructive reasoning to make viable arguments, and applying mathematics in real-life problems Also they will able to find job in different sectors of mathematics and mathematics related subjects.

PO7: Develop Research Related Skill: Capability of thinking the various field of Mathematics, advances in those fields and clear concept about them so that appropriatete questions are formed on related fields.

PROGRAMME SPECIFIC OUTCOME:

PSO1: Thinking every topics in a critical manner.
PSO2: When there arise situation to provide information about any problem students are able to identify it, locate, evaluate and use the information effectively.
PSO3: Realize, evaluate, formulate different quantitative models arising in social science, business and other fields.
PSO4: Apply mathematical and logical argument to develop and formulate every problem in a unique way.

PSO5: Acquire clear concept and knowledge to understand every problem and use mathematical and statistical method by the students through the course.
PSO6: Aware about the responsibility to become a citizen of the society and promise to scatter the scope of acquire knowledge.

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Course Outcomes (CO) for End Semester Students: 2020-2021

CO01: (Paper CC1 -) Calculus, Geometry &Differential Equation

- Learn about L' Hospital rule and Leibnitz rule and their application, higher order derivatives, reduction formula, In geometry they learn general equation of second degree, rotation of axes, polar equation of conics.
- Also they learn order and degree of differential equation, different kinds of mathematical models, how to solve a differential equation , bernouli equation, exact differential equation, homogeneous differential equation etc.

CO02: (Paper CC2 – Algebra)

- They learn polar representation of complex number, De Moivre's theorem and its application. In theory of equation they learn relation between roots coefficients, transformation of equation, Descarte's rule, cubic and biquadratic equation.
- Equivalence relation, congruence relation, Fundamental theory of arithmetic, system of linear equation and their application. Also they know about linear transformation, eigen values, eigen vectors, characteristic equation, and Caley Hamilton theorem.

CO03: (Paper CC3-Real Analysis)

- They learn about countable and uncountable of R, bounded above, bounded below, limit point of a set, isolated point, closed set, derived set, Bolzano weirstress theorem, Heine Borel theorem.
- Students know about sequence of real number, limit point, liminf, limsup, Cauchy sequence, monotone sequence, subsequence, infinite series and their convergence, ratio test, Cauchy nth root test, integral test, alternating series etc.

CO04: (Paper CC4-Differential equation and vector calculus)

Learning Outcomes: On completion of this area of the course, the student will be able to

● Find higher order derivatives and apply the Leibnitz rule to solve problems related to such derivatives.

● Plot the graphs of polynomials of degree 4 and 5, the derivative graph, the second derivative graph and compare them.

● Apply the concept and principles of differential calculus to find the curvature, concavity and points of inflection, envelopes, rectilinear asymptotes (Cartesian & parametric form only) of different curves.

● Trace standard curves in Cartesian coordinates and polar coordinates.

● Sketch parametric curves (Ex. Trochoid, cycloid, epicycloids, hypocycloid).

● Apply the concept and principles of differential calculus to solve different geometric and physical problems that may arise in business, economics and life sciences.

● Solve various limit problems using L' Hospital's rule·

● Derive Reduction formulae for some complex integrations and hence Integrate functions of a much higher degree which are applicable in real life situations.

● Apply the integral calculus to find arc length of a curve, arc length of parametric curves, area under a curve, surface area and volume of surface of revolution.

● Graphically obtain the surface of revolution of curves.

CO05: (Paper CC5 - Theory of Real Functions& Introduction to Metric Space)

Learning Outcomes: On successful completion of the course students will be able to develop conceptual understanding of the following:

● Definition and examples of metric spaces. Open ball. Open set. Closed set as complement of open set. Interior point and interior of a set. Limit point and closure of a set. Boundary point and boundary of a set. Properties of interior, closure and boundary. Bounded set and diameter of a set. Distance between two sets. Subspace of a metric space.

● Convergent sequence. Cauchy sequence. Every convergent sequence is Cauchy and bounded, but the converse is not true. Completeness. Cantor's intersection theorem. R is a complete metric space. Q is not complete.

● Continuous mappings, sequential criterion of continuity. Uniform continuity.

● Compactness, Sequential compactness, Heine-Borel theorem in R. Finite intersection property, continuous functions on compact sets.

● Concept of connectedness and some examples of connected metric space, connected subsets of R, C.

CO06: (Paper CC 6 - Group Theory 1)

Learning Outcomes On completion of this unit successful students will be able to:

- Demonstrate when a binary algebraic structure forms a group.
- Construct Caley tables.
- Determine possible subgroups of a group.
- Identify normal subgroups of a group.
- Examine symmetric and permutation groups.
- Explain group and subgroup orders using Lagrange's theorem.
- Identify cyclic subgroups and their generators.
- Identify factor group.

CO07: (Paper CC 7 - Numerical Methods)

Learning Outcomes:

After completion of this course, the students will be able to:

- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Solve the nonlinear equations, system of linear equations and interpolation problems using numerical methods.
- Examine the appropriate numerical differentiation and integration methods to solve problems.
- Apply the numerical methods to solve algebraic as well as differential equations.

Numerical Methods LAB

Learning Outcomes: For any of the CAS (Computer aided software), students are introduced to Data types-simple data types, floating data types, character data types, arithmetic operators and operator precedence, variables and constant declarations, expressions, input/output, relational operators, logical operators and logical expressions, control statements and loop statements, Arrays. The students become expert in solving different numerical problems (listed below) by using computer programming techniques of C/ C++/ FORTRAN 90

CO08: (Paper CC8 - Riemann Integration and Series of Functions)

Learning Outcomes: Upon successful completion of this course, students will be able to

- Define Riemann Integrable and Riemann sums .

- Prove a theorem about Riemann sums and Riemann integrals

- Knowledge of some simple techniques for testing the convergence of sequences and series of functions, and confidence in applying them.

CO09: (Paper CC9 - Multivariate Calculus)

Learning Outcomes: On completion of this unit successful students will be able :

- How to deals with vector valued functions

- To understand topics like line integral,surface integral which generalize integration to functions defined on curves & surfaces.

- To understanding the computation of work done , flux, mass, area of the surfaces.

- To understand the Greens theorem , Stokes theorem ,divergence theorem that teaches the relation between integration of functions over surfaces & its boundry,solids & its surface

CO10: (Paper CC10: Ring Theory and Linear Algebra) :

Learning Outcomes: Upon successful completion of this course, students will be able

- To write precise and accurate mathematical objects in ring theory

- For checking the irreducibility of higher degree polynomials over rings.

- To understand the concepts like ideals and quotient rings.

- To understand the concept of ring homomorphism.

CO11 (Paper CC-11: Partial Differential Equations and Application):

Learning Outcomes:

- Explain the concepts and language of partial differential equations.

- Understand the difference between ordinary & partial differential equation.

- Classify the partial differential equations.

- Solve the partial differential equation using charpits method, Jacobis method.

CO12(Paper CC-12: Group Theory II)

Learning Outcomes:

- Examine symmetric and permutation groups.
- Explain group and subgroup orders using Lagrange's theorem.
- Identify cyclic subgroups and their generators.
- Identify factor group.

CO13: (Paper CC13 - Metric Spaces and Complex Analysis)

Learning Outcomes:

Upon successful completion Complex Analysis, a student will be able to:

- Represent complex numbers algebraically and geometrically,
- Define and analyze limits and continuity for complex functions as well as consequences of continuity,
- Apply the concept and consequences of analyticity and the CauchyRiemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra,
- Analyze sequences and series of analytic functions and types of convergence,
- Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula,
- Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

CO14: (Paper CC14 – Ring Theory and Linear Algebra-II)

Learning Outcomes:

Upon successful completion of this course, students will be able

- To write precise and accurate mathematical objects in ring theory
- For checking the Irreducibility of higher degree polynomials over rings.
- To understand the concepts like ideals and quotient rings.
- To understand the concept of ring homomorphism.

- Understand the basic ideas of vector algebra: linear dependence and independence and spanning.

- Know how to find the row space, column space and null space of a matrix, and be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix, and to understand the relationship of these concepts to associated systems of linear equations.

CO15: (Paper: DSE -1 Linear Programming) :

Learning Outcomes :
Upon successful completion of this course, students will be able

- the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.

- Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.
- Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure linear programming solution of games.

CO16: (Paper : DSE-2 Probability and Statistics **)**

Upon successful completion of this course, students will be able

- Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function.

- Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution.

CO17: (Paper DSE 3A – Mechanics)

- Learn about Co-planer forces, centre of gravity for different bodies ,Stable and Unstable Equilibrium ,Equation of motion referred to a set of rotating axes, Motion of artificial satellites, Motion of a particle in three dimension.
- Concept of degrees of freedom, Moments and product of inertia, Momental Ellipsoid, Principal axes, D'Alembert's principle, Motion about a fixed axis, compound pendulum, Motion of a rigid body in two dimensions under finite and impulsive forces.

CO18: (Paper DSE4 – Mathematical Modelling)

- Learn Legendre and Bessel's equation and find their power series solution.
- Learn about Laplace transform, inverse Laplace transform and its applications to second order PDE and ODE.
- Concept of simulation used in Monte Carlo Simulation Modelling, Over viewing optimization modelling, Learn LPP model and use sensitivity analysis.

CO19: (Paper SEC 1: Logic and Sets) :

Upon successful completion of this course, students will be able

- propositions, truth table, negation, conjunction and disjunction, Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, quantifiers, binding variables and negations.

- Sets, subsets, set operations and the laws of set theory and Venn diagrams.

- Difference and Symmetric difference of two sets. Set identities, generalized union and intersections.

CO20: (Paper SEC 2: Graph Theory) :

Upon successful completion of this course, students will be able

- Basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs.

- Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles, theorems Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph.

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DEPARTMENT OF MATHEMATICS

DETAILED SYLLABUS OF ALL SEMESTER UG (HONOURS) COURSES

DEPARTMENT OF MATHEMATICS

CC -1: Calculus, Geometry & Differential Equation Credits 06

Unit 1

Hyperbolic functions, higher order derivatives, Leibnitz rule and its applications to problems of type $e^{ax+b}\sin x$, $e^{ax+b}\cos x$, $(ax+b)^n\sin x$, $(ax+b)^n\cos x$, concavity and inflection points, envelopes, asymptotes, curve tracing in cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

Unit 2

Reduction formulae, derivations and illustrations of reduction formulae of the type /sin nx dx, /cosnx dx, /tan nx dx, /sec nx dx, /(log x)^n dx, /sin^{n}x sin^{m}x dx, parametric equations, parameterizing a curve, arc length of a curve, arc length of parametric curves, area under a curve, area and volume of surface of revolution, techniques of sketching conics.

Unit 3

Reflection properties of conics, rotation of axes and second degree equations, classification of conics using the discriminant, polar equations of conics.

Spheres. Cylindrical surfaces. Central conicoids, paraboloids, plane sections of conicoids, generating lines, classification of quadrics, illustrations of graphing standard quadric surfaces like cone, ellipsoid.

Unit 4

Differential equations and mathematical models. General, particular, explicit, implicit and singular solutions of a differential equation. Exact differential equations and integrating factors, separable equations and equations reducible to this form, linear equation and Bernoulli equations, special integrating factors and transformations.

CC-2: Algebra Credits 06

Unit 1

Polar representation of complex numbers, nth roots of unity, De Moivre's theorem for rational indices and its applications.

Theory of equations: Relation between roots and coefficients, transformation ofequation, Descartes rule of signs, cubic and biquadratic equation.

Inequality: The inequality involving AM> GM> HM, Cauchy-Schwartz inequality.

Unit 2

Equivalence relations. Functions, composition of functions, Invertible functions, one to one correspondence and cardinality of a set. Well-ordering property of positive integers, division algorithm, divisibility and Euclidean algorithm. Congruence relation between integers. Principles of Mathematical induction, statement of Fundamental Theorem of Arithmetic.

Unit 3

Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation Ax=b, solution sets of linear systems, applications of linear systems, linear independence.

Unit 4

Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices. Subspaces of R^n, dimension of subspaces of R^n, rank of a matrix, Eigen values, eigen vectors and characteristic equation of a matrix. Cayley-Hamilton theorem and its use in finding the inverse of a matrix.

CC-3 : Real Analysis Credits 06

Unit 1

Review of algebraic and order properties of R, s-neighborhood of a point in R. Idea of countable sets, uncountable sets and uncountability of R. Bounded above sets, bounded below sets, bounded sets, unbounded sets. Suprema and infima. Completeness property of R and its equivalent properties. The Archimedean property, density of rational (and Irrational) numbers in R, intervals. Limit points of a set, isolated points, open set, closed set, derived set, illustrations of Bolzano-Weierstrass theorem for sets, compact sets in R, Heine-Borel Theorem.

Unit 2

Sequences, bounded sequence, convergent sequence, limit of a sequence, liminf, lim sup. Limit theorems. Monotone sequences, monotone convergence theorem. Subsequences, divergence criteria. Monotone subsequence theorem (statement only), Bolzano Weierstrass theorem for sequences. Cauchy sequence, Cauchy's convergence criterion.

Unit 3

Infinite series, convergence and divergence of infinite series, Cauchy criterion, tests for convergence: comparison test, limit comparison test, ratio test, Cauchy's nth root test, integral test. Alternating series, Leibniz test. Absolute and conditional convergence

CC-4: Differential Equations & Vector Calculus Credits 06

Unit 1

Lipschitz condition and Picard's Theorem (Statement only). General solution of homogeneous equation of second order, principle of super position for homogeneous equation, Wronskian: its properties and applications, Linear homogeneous and non- homogeneous equations of higher order with constant coefficients, Euler's equation, method of undetermined coefficients, method of variation of parameters.

Unit 2

Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients,

Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

Unit 3

Equilibrium points, Interpretation of the phase plane

Power series solution of a differential equation about an ordinary point, solutionabout a regular singular point.

Unit 4

Triple product, introduction to vector functions, operations with vector-valued functions, limits and continuity of vector functions, differentiation and integration of vector functions.

Unit 5

Graphical demonstration (Teaching aid)

1. Plotting of family of curves which are solutions of second order differential equation.
2. Plotting of family of curves which are solutions of third order differential equation.

CC-5: Theory of Real Functions& Introduction to Metric Space

Credits 06

Unit 1

Limits of functions (s - 5 approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity. Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem.

Unit 2

Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem. Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials.

Unit 3

Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1 + x)$, $1/(ax + b)$ and $(x+1)^n$. Application of Taylor's theorem to inequalities.

Unit 4

Metric spaces: Definition and examples. open and closed balls, neighbourhood,open set, interior of a set. Limit point of a set, closed set, diameter of a set, subspaces, dense sets, separable spaces.

CC-6: Group Theory 1 Credits 06

Unit 1

Symmetries of a square, dihedral groups, definition and examples of groups including permutation groups and quaternion groups (through matrices), elementary properties of groups.

Unit 2

Subgroups and examples of subgroups, centralizer, normalizer, center of a group, product of two subgroups.

Unit 3

Properties of cyclic groups, classification of subgroups of cyclic groups. Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

Unit 4

External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems

CC-7: Numerical Methods Credits 06

Unit 1

Algorithms. Convergence. Errors: relative, absolute. Round off. Truncation.

Unit 2

Transcendental and polynomial equations: Bisection method, Newton's method, secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.

Unit 3

System of linear algebraic equations: Gaussian elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis. LU decomposition

Unit 4

Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

Numerical differentiation: Methods based on interpolations, methods based on finite differences.

Unit 5

Numerical Integration: Newton Cotes formula, Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpsons 3/8th rule, Weddle's rule, Boole's Rule. midpoint rule, Composite trapezoidal rule, composite Simpson's $1/3^{rd}$ rule, Gauss quadrature formula.

The algebraic eigen value problem: Power method.

Approximation: Least square polynomial approximation.

Unit 6

Ordinary differential equations: The method of successive approximations, Euler's method, the modified Euler method, Runge-Kutta methods of orders two and four.

CC-8: Riemann Integration and Series of Functions Credits 06

Unit 1

Riemann integration: inequalities of upper and lower sums, Darbaux integration, Darbaux theorem, Riemann conditions of integrability, Riemann sum and definition of Riemann integral through Riemann sums, equivalence of two definitions. Riemann integrability of monotone and continuous functions, properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions.

Intermediate Value theorem for Integrals; Fundamental theorem of Integral Calculus.

Unit 2

Improper integrals. Convergence of Beta and Gamma functions.

Unit 3

Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions;

Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

Unit 4

Fourier series: Definition of Fourier coefficients and series, Reimann Lebesgue lemma, Bessel's inequality, Parseval's identity, Dirichlet's condition. Examples of Fourier expansions and summation results for series.

Unit 5

Power series, radius of convergence, Cauchy Hadamard theorem. Differentiation and integration of power series; Abel's theorem; Weierstrass approximation theorem.

C9T: Multivariate Calculus Credits 06

Unit 1

Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes, Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems

Unit 2

Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co- ordinates.Change of variables in double integrals and triple integrals.

Unit 3

Definition of vector field, divergence and curl.

Line integrals, applications of line integrals: mass and work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

Unit 4

Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

C10T: Ring CC-10: Ring Theory and Linear Algebra I

Unit 1

Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring. Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

Unit 2

Ring homomorphisms, properties of ring homomorphisms. Isomorphism theorems I, II and III, field of quotients.

Unit 3

Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

Unit 4

Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms. Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

CC-11: Partial Differential Equations and Application Credits 06

Partial differential equations - Basic concepts and definitions. Mathematical problems. First- order equations: classification, construction and geometrical interpretation. Method of characteristics for obtaining general solution of quasi linear equations. Canonical forms of first-order linear equations. Method of separation of variables for solving first order partial differential equations.

Unit 2

Derivation of heat equation, wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order linear equations to canonical forms.

Unit 3

The Cauchy problem, Cauchy-Kowalewskaya theorem, Cauchy problem of an infinite string. Initial boundary value problems. Semi-infinite string with a fixed end, semi-infinite string with a free end. Equations with non-homogeneous boundary conditions. Non- homogeneous wave equation. Method of separation of variables, solving the vibrating string problem. Solving the heat conduction problem

Unit 4

Central force. Constrained motion, varying mass, tangent and normal components of acceleration, modelling ballistics and planetary motion, Kepler's second law

C12T: Group Theory II

Unit 1

Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

Unit 2

Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental theorem of finite abelian groups.

Unit 3

Group actions, stabilizers and kernels, permutation representation associated with a given group action. Applications of group actions. Generalized Cayley's theorem. Index theorem.

Unit 4

Groups acting on themselves by conjugation, class equation and consequences, conjugacy in Sn, p-groups, Sylow's theorems and consequences, Cauchy's theorem, Simplicity of An for n > 5, non-simplicity tests.

CC-13: Metric Spaces and Complex Analysis Credits 06

Unit 1

Metric spaces: sequences in metric spaces, Cauchy sequences. Complete metric spaces, Cantor's theorem.

Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Connectedness, connected subsets of R.

Compactness: Sequential compactness, Heine-Borel property, totally bounded spaces, finite intersection property, and continuous functions on compact sets.

Homeomorphism. Contraction mappings. Banach fixed point theorem and its application to ordinary differential equation.

Unit 3

Limits, limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings.

Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability.

Unit 4

Analytic functions, examples of analytic functions, exponential function, logarithmic function, trigonometric function, derivatives of functions, and definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy- Goursat theorem, Cauchy integral formula.

Unit 5

Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.

Unit 6

Laurent series and its examples, absolute and uniform convergence of power series.

CC-14: Ring Theory and Linear Algebra II — Credits 06

Unit 1

Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains, factorization of polynomials, reducibility tests, irreducibility tests,

Eisenstein criterion, and unique factorization in Z [x]. Divisibility in integral domains, irreducible, primes, unique factorization domains, Euclidean domains.

Unit 2

Dual spaces, dual basis, double dual, transpose of a linear transformation and its matrix in the dual basis, annihilators. Eigen spaces of a linear operator, diagonalizability, invariant subspaces and Cayley-Hamilton theorem, the minimal polynomial for a linear operator, canonical forms.

Unit 3

Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator. Least squares approximation, minimal solutions to systems of linear equations. Normal and self-adjoint operators. Orthogonal projections and Spectral theorem.

DSE -1: Linear Programming — Credits 06

Unit 1

Introduction to linear programming problem. Theory of simplex method, graphical solution, convex sets, optimality and unboundedness, the simplex algorithm, simplex method in tableau format, introduction to artificial variables, two-phase method. Big-M method and their comparison.

Unit 2

Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

Transportation problem and its mathematical formulation, northwest-corner method, least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving

transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

Unit 3
Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure,linearprogramming solutionof games.

DSE-2: Probability and Statistics Credits 06

Unit 1
Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Unit 2
Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

Unit 3
Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers. Central limit theorem for independent and identically distributed random variables with finite variance, Markov chains, Chapman-Kolmogorov equations, classification of states.

Unit 4
Random Samples, Sampling Diatributions, Estimation of parameters, Testing of hypothesis.

DSE -3: Mechanics Credits 06

Unit 1
Co-planar forces. Astatic equilibrium. Friction. Equilibrium of a particle on a rough curve. Virtual work.. Forces in three dimensions. General conditions of equilibrium. Centre of gravity for different bodies. Stable and unstable equilibrium

Unit 2 Equations of motion referred to a set of rotating axes. Motion of a projectile in a resisting medium. Stability of nearly circular orbits. Motion under the inverse square law.Slightly disturbed orbits. Motion of artificial satellites. Motion of a particle in three dimensions. Motion on a smooth sphere, cone, and on any surface of revolution.

Unit 3
Degrees of freedom. Moments and products of inertia. Momental Ellipsoid. Principal axes. D'Alembert's Principle. Motion about a fixed axis. Compound pendulum. Motion of a rigid body in two dimensions under finite and impulsive forces. Conservation of momentum and energy.

DSE-4: Mathematical Modelling Credits 06

Unit 1
Power series solution of Bessel's equation and Legendre's equation, Laplace transform and inverse transform, application to initial value problem up to second order.

Unit 2

Monte Carlo simulation modelling: simulating deterministic behavior (area under a curve, volume under a surface), generating random numbers: middle square method, linear congruence, queuing models: harbor system, morning rush hour, Overview of optimization modelling. Linear programming model: geometric solution algebraic solution, simplex method, sensitivity analysis

SEC-1: Logic and Sets Credits

Unit 1

Introduction, propositions, truth table, negation, conjunction and disjunction. Implications, biconditional propositions, converse, contra positive and inverse propositions and precedence of logical operators. Propositional equivalence: Logical equivalences. Predicates and quantifiers: Introduction, quantifiers, binding variables and negations.

Unit 2

Sets, subsets, set operations and the laws of set theory and Venn diagrams. Examples of finite and infinite sets. Finite sets and counting principle. Empty set, properties of empty set. Standard set operations. classes of sets. Power set of a set.

Unit 3

Difference and Symmetric difference of two sets. Set identities, generalized union and intersections. Relation: Product set. Composition of relations, types of relations, partitions, equivalence Relations with example of congruence modulo relation. Partial ordering relations, n- ary relations.

SEC-2:Graph Theory Credits 02

Unit 1

Definition, examples and basic properties of graphs, pseudo graphs, complete graphs, bipartite graphs isomorphism of graphs.

Unit 2

Eulerian circuits, Eulerian graph, semi-Eulerian graph, theorems, Hamiltonian cycles,theorems Representation of a graph by matrix, the adjacency matrix, incidence matrix, weighted graph,

Unit 3

Travelling salesman's problem, shortest path, Tree and their properties, spanning tree, Dijkstra's algorithm, Warshall algorithm.

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MAPPING OF CO, PO, PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO-1	✓	✓				✓	✓	✓				✓	
CO-2	✓	✓			✓		✓		✓		✓		

C0-3	✓	✓		✓			✓		✓		✓		
CO-4	✓	✓	✓					✓	✓		✓		
CO-5	✓	✓		✓			✓		✓		✓		✓
CO-6	✓	✓		✓			✓		✓		✓		
CO-7	✓	✓				✓	✓			✓		✓	✓
CO-8	✓	✓	✓			✓		✓		✓			
CO-9	✓	✓			✓			✓		✓		✓	
CO-10	✓	✓			✓			✓	✓				✓
CO-11	✓	✓			✓		✓		✓		✓		
CO-12	✓	✓		✓			✓		✓		✓		
CO-13	✓	✓	✓			✓		✓		✓			
CO-14	✓	✓		✓				✓		✓	✓		
CO-15	✓	✓			✓			✓	✓				✓
CO-16	✓	✓		✓			✓		✓		✓		
CO-17	✓	✓		✓			✓		✓		✓		
CO-18	✓	✓			✓			✓		✓		✓	
CO-19	✓	✓	✓					✓	✓		✓		
CO-20	✓	✓				✓	✓			✓		✓	

JUSTIFICATION MATRIX OF CO WITH PO & PSO (High: 3, Medium: 2, Low: 1)

	Mapping	Correlation	Justification
CO -1	PO1	HIGH	Acquire knowledge on L Hospital rule and Leibnitz rule
	PO2	HIGH	Students make questioning and reasoning to enrich in calculus & its application on reduction formula
	PO6	MODERATE	Students able to find their scope of job real life problem learning application of this course
	PO7	HIGH	Students will be able to use research methods for this specified course in differential equation.
	PSO1	HIGH	Students will able to think critical problems related to area and volume of surface of revolution.
	PSO5	HIGH	Student realize to evaluate the problem of this course by classification of quadrics.
CO-2	PO1	HIGH	Obtain clear concept De Moivre's theorem and transformation of polynomial equation.
	PO2	HIGH	Students make questioning on biquadratic equation, division algorithm, congruence relation and system of linear equation.

	PO5	MODERATE	Students apply the knowledge of congruence relation between integers .
	PO7	LOW	Student able to think in advance topics related this subject and improve research skil.
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO4	HIGH	Student will able to identify and formulate the problems of Classical Algebra in a unique way.
CO-3	PO1	HIGH	Students acquired sound and sufficient knowledge about basics of Set in $\mathbb{R}$,sequence and series.
	PO2	HIGH	To understand how to relate other subject with the study of Cauchy convergence of criteria and Leibnitz test.
	PO4	HIGH	Student learn to communicate with other using concept of different aspect of this course
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to analize real analysis formulate different fomula to solve problems
	PSO4	MODERATE	Student will able to identify and formulate the problems of convergence of series and limit point of different sequence in a unique way.
CO-4	PO1	HIGH	Students learn the concept on Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients.
	PO2	HIGH	Acquire knowledge of questioning and reasoning on ODE.
	PO3	HIGH	To understand any interdiscplinary problem from Lipschitz condition and Picard's Theorem
	PSO1	MODERATE	Students will able to think critical problems related to this course.
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO4	HIGH	Student will able to identify and formulate the problems of Equilibrium points, Interpretation of the phase plane in a unique way.
C0-5	PO1	HIGH	Obtain knowledge on Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. Rolle's theorem
	PO2	HIGH	Acqrire knowledge about critical reasoning and questioning on Cauchy's mean value theorem. Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema
	PO4	MODERATE	Student learn to communicate with other using concept of different aspect of this course
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course
	PSO4	LOW	Student will able to identify and formulate the problems of Real Analysis in a unique way
CO-6	PO1	HIGH	Students acquired sound and sufficient knowledge about External direct product of a finite number of groups, normal subgroups, factor groups, Cauchy's theorem for finite abelian groups. Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms. First, Second and Third isomorphism theorems
	PO2	HIGH	To understand how to relate other subject with the study of Symmetries of a square, dihedral groups, definition and examples of groups including permutation groups and

			quaternion groups (through matrices), elementary properties of groups.
	PO4	HIGH	Student learn to communicate with other using concept of different aspect of this course
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to solve problems in different problems in group theory.
	PSO4	MODERATE	Student will able to identify and formulate the problems of Group Theory in a unique way.
C0-7	PO1	HIGH	Acquire knowledge on Newton Cotes formula, Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpsons 3/8th rule, Weddle's rule, Boole's Rule. midpoint rule, Composite trapezoidal rule, composite Simpson's $1/3^{rd}$ rule, Gauss quadrature formula
	PO2	HIGH	Students make questioning on Transcendental and polynomial equations: Bisection method, Newton's method, secant method, Regula-falsi method, fixed point iteration, Newton-Raphson method. Rate of convergence of these methods.
	PO6	MODERATE	Students able to find their scope of job real life problem learning application of this course
	PO7	HIGH	Students will be able to use research methods for this specified couses
	PSO1	HIGH	Students will able to think critical problems related to Interpolation and numerical integration, roots of polynomials.
	PSO5	HIGH	Student realize to evaluate the problem on Euler method and Ranga Kutta method.
C0-8	PO1	HIGH	Students learn the concept on Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions. Series of functions;
	PO2	HIGH	Acquire knowledge of questioning and reasoning on Reiann integration, intermediate value theorem, improper integrals.
	PO3	HIGH	To understand any problem from Gamma and Beta function, Fourier series.
	PSO1	MODERATE	Students will able to think critical problems related to this course.
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO4	HIGH	Student will able to identify and formulate the problems of series of function, Improper integrals in a unique way
CO-9	PO1	HIGH	Students will able to obtain vast knowledge on Functions of several variables, limit and continuity of functions of two or more variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability
	PO2	HIGH	Student learn about the questioning on Double integration ,Green's theorem ,Divergence theorem.
	PO5	HIGH	Students apply the knowledge of differentiability of function of several variable and Vector integration in a different way.
	PSO1	MODERATE	Students will think the topics of vector integration etc. In a critical manner
	PSO3	LOW	Student realize how to evaluate the problem by figures and models
	PSO5	HIGH	Student will able to analyze complex problem and acquire clear concept to handle those.

CO-10	PO1	HIGH	Learn about ring theory, ring homomorphism, vector space and subspace , linear transformation and algebra of linear transformation.
	PO2	HIGH	Students make questioning and reasoning on ring theory and vector space to enrich in specific subject
	PO5	HIGH	Students apply the knowledge of Deletion theorem, Replacement theorem, basis ,dimension, linear independent and linear dependent self directed way.
	PSO1	MODERATE	Students will able to think critical problems related to this course
	PSO2	HIGH	Student learn to identify the basis and dimension of different subspace problems and analyze to find information correctly in this course.
	PSO6	HIGH	Student will able to create awareness and scope of applying this course
CO-11	PO1	HIGH	Obtain clear concept on Derivation of heat equation, wave equation and Laplace equation. Classification of second order linear equations as hyperbolic, parabolic or elliptic. Reduction of second order linear equations to canonical forms.
	PO2	HIGH	Students make questioning on The Cauchy problem ,separation of variable and central force, Keplar's Law, to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of partial differential equation, and their solutions etc in self directed way.
	PO7	LOW	Student able to think in advance topics related this subject and improve research skil
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO4	HIGH	Student will able to identify and formulate the problems of partial differential equation in a unique way.
CO-12	PO1	HIGH	Students acquired sound and sufficient knowledge about basics of Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.
	PO2	HIGH	To understand how to relate other subject with the study Group actions, stabilizers and kernels, permutation representation associated with a given group action. Applications of group actions. Generalized Cayley's theorem. Index theorem.
	PO4	HIGH	Student learn to communicate with other using concept of different aspect of this course
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to analyse complex analysis,formulate different fomulaes to solve problems
	PSO4	MODERATE	Student will able to identify and formulate the problems of Abstract algebra in a unique way.
CO-13	PO1	HIGH	Students acquired sound and sufficient knowledge about basics of metric spaces and Liouville's theorem and the fundamental theorem of algebra. Convergence of sequences and series, Taylor series and its examples.
	PO2	HIGH	To understand how to relate other subject with the study of metric space
	PO4	HIGH	Student learn to communicate with other using concept of different aspect of this course

	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to analyse complex analysis,formulate different fomulaes to solve problems Laurent series and its examples, absolute and uniform convergence of power series
	PSO4	MODERATE	Student will able to identify and formulate the problems of metruic space in a unique way.
CO-14	PO1	HIGH	Learn vividly about conjecture, Fermat's theorem, prime counting etc.
	PO2	HIGH	To understand how to make appropriate questions and reasoning in number theory
	PO4	MODERATE	Student learn to communicate with other using concept of different aspect of this course
	PSO1	HIGH	Students will able to think critical problems related to this course
	PSO3	LOW	Student realize how to evaluate the problem by figures and models of this course
	PSO4	HIGH	Student will able to identify and formulate the problems of number theory space in a unique way
CO-15	PO1	HIGH	Learn Legendre, Bessel's equation and their power series efficiently
	PO2	HIGH	Students make questioning and reasoning to enrich in specific subject
	PO5	HIGH	Students apply the knowledge of differentiability, Countour intergration ,in self directed way.
	PSO1	MODERATE	Students will able to think critical problems related to this course
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO6	HIGH	Student will able to create awareness and scope of applying this course
CO-16	PO1	HIGH	Acquire knowledge on Laplace transform & its application on ODE,PDE
	PO2	HIGH	Students make questioning and reasoning to enrich in LT & its application on ODE,PDE
	PO6	MODERATE	Students able to find their scope of job real life problem learning application of this course
	PO7	HIGH	Students will be able to use research methods for this specified couses
	PSO1	HIGH	Students will able to think critical problems related to Laplace and Inverse LT.
	PSO5	HIGH	Student realize to evaluate the problem of this course by mathematical& statistical method

	Mapping	Correlation	Justification
CO-17	PO1	HIGH	Students acquired sound and sufficient knowledge about basics of metric spaces.
	PO2	HIGH	To understand how to relate other subject with the study of metric space
	PO4	HIGH	Student learn to communicate with other using concept of different aspect of this course
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to analyse complex analysis,formulate different fomulaes to solve problems
	PSO4	MODERATE	Student will able to identify and formulate the problems of metruic space in a unique way.
CO-18	PO1	HIGH	Students will able to obtain vast knowledge on Cauchy-Riemann equation
	PO2	HIGH	Student learn about the questioning on differentiability, C-R equation

	PO5	HIGH	Students apply the knowledge of differentiability, Countour intergration ,in self directed way.
	PSO1	MODERATE	Students will think the topics of countor integral C-R equation etc. In a critical manner
	PSO3	LOW	Student realize how to evaluate the problem by figures and models
	PSO5	HIGH	Student will able to analyze complex problem and acquire clear concept to handle those.
CO-19	PO1	HIGH	Students obtain a vivid knowledge on Sets, subsets, set operations and the laws of set theory and Venn diagrams.
	PO2	HIGH	Acquire knowledge of questioning and reasoning on Ring theory
	PO3	MODERATE	Students will able to build their interdisciplinary pathway by choosing Ring Theory,..etc
	PO6	HIGH	Students will able to identify problems, solve using constructive reasoning on this course.
	PSO1	HIGH	Students will able to think critical problems related to this course.
	PSO3	MODERATE	Student realize how to evaluate the problems of this course by figures and models
CO-20	PO1	HIGH	Students learn the concept on ideal, dual space,inner product space.
	PO2	HIGH	Acquire knowledge of questioning and reasoning on ideal, dual spaces,…etc
	PO3	HIGH	To understand any interdiscplinary problem from ideal, dual space perspective.
	PSO1	MODERATE	Students will able to think critical problems related to this course.
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.
	PSO4	HIGH	Student will able to identify and formulate the problems of dual spaces, inner product space in a unique way
	PSO2	HIGH	Student learn to identify the problems and analyze to find information correctly in this course.

ARTICULATION MATRIX OF CO WITH PO & PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO -1	3	3				3	3	3				3	
CO -2	3	3			2	1			3		3		
C0-3	3	3			2	1			3		3		
C0-4	3	3	3					2	3		3		
C0-5	3	3					3		3		1		
C0-6	3	3		3			3		3				
C0=7	3	3					3	3				3	
CO-8	3	3	3						3		3		
CO-9	3	3			3					1		3	

CO-10	3	3			3				3				3
CO-11	3	3		3			3		3		2		
CO-12	3	3			3			2		1		3	
CO-13	3	3	2			3		3		2			
CO-14	3	3	3					2	3		3		
CO-15	3		3	2				3		1	3		
CO-16	3	3		2			3		3		3		
CO-17	3	3			3			2	3				3
CO-18	3	3				3	3	3				3	
Co 19	3		3	2				3		1	3		
CO-20	3	3			2	1			3		3		
Target	3	3	2.8	2.5	2.6	2	3	2.5	3	1.3	2.7	3	3

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

The following list of students from 2020-2021 Batch have taken admission into HEIs for higher studies:

Name of student enrolling into higher education	Program graduated from	Name of institution joined	Name of programme admitted to
Subhadip Sahoo	M.G.M/Mathemetics	National Institute of Technology	M.Sc. M.Sc. in Applied Mathematics
Prasenjit Mondal	M.G.M/Mathemetics	University Of Gour Banga	M.Sc. in Applied Mathematics
Goutam Jana	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Puspendu Sau	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Subinoy Patra	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Saheb Bera	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics

Subha Bhunia	M.G.M/Mathemetics	Midnapore College (Autonomous)	M.Sc. in Applied Mathematics
Buddhadev Jana	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
ARNAB MAITY	M.G.M/Mathemetics	VIDYASAGAR UNIVERSITY	M.Sc. in Applied Mathematics
Sharbani Jana	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Sreya Jana	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Priti Das Adhikari	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Poushali Tripathy	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Tapasi Karan	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Suchismita Pradhan	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Susmita Sahoo	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
Shyamal Bera	M.G.M/Mathemetics	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics

DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, BHUPATINAGAR, PURBA MEDINIPUR-721425

DEPARTMENT OF MATHEMATICS

Attainment of Course & Programme Outcomes

For the academic year 2020-21.

(http://www.vidyasagar.ac.in/Downloads/ShowPdf.aspx?file=/policies_regulations/UG_CBCS_Regulations_18082021.pdf)

In the Outcome Based Education (OBE), assessment is done through one or more than one processes, carried out by the department, that identify, collect, and prepare data to evaluate the achievement of course outcomes (CO's).

The process for finding the attainment of Course outcomes uses various tools/methods. These methods are classified into two types: **Direct methods and indirect methods.**

Direct methods display the student's knowledge and skills from their performance in the class/assignment test, internal assessment tests, assignments, semester examinations, seminars, laboratory assignments/practicals, mini projects etc. These methods provide a sampling of what students know and/or can do and provide strong evidence of student learning.

Indirect methods such as course exit survey and examiner feedback to reflect on student's learning. They are used to assess opinions or thoughts about the graduate's knowledge or skills.

Following tables show the various methods used in assessment process that periodically documents and demonstrates the degree to which the Course Outcomes are attained. They include information on:

a) Listing and description of the assessment processes used to gather the data, and
b) The frequency with which these assessment processes are carried out.

Table 1 : Direct Assessment tool used for CO attainment			
Sr. No.	**Direct Assessment Method**	**Assessment frequency**	**Description**
1.	Internal Assessment Test	Twice in a Semester	The Internal Assessment marks in a theory paper shall be based on two tests generally conducted at the end of 6th and 11th weeks of each semester. It is a metric used to continuously assess the attainment of course outcomes w.r.t course objectives. Average marks of two tests shall be the Internal Assessment Marks for the relevant

			course.
2.	Lab Assignments / experiments	Once in a week	Lab Assignment/Experiment is a qualitative performance assessment tool designed to assess students' practical knowledge and problem solving skills. Minimum ten experiments need to be conducted for every lab course.
3.	End Semester Examination	Once in a Semester	End Semester examination (theory or practical) are the metric to assess whether all the course outcomes are attained or not framed by the course incharge. End Semester Examination is more focused on attainment of all course outcomes and uses a descriptive questions.
4.	Practical Semester Examination		
5.	Home Assignments	Twice in a Semester	Assignment is a metric used to assess student's analytical and problem solving abilities. Every student is assigned with course related tasks & assessment will be done based on their performance. Grades are assigned depending on their innovation in solving/deriving the problems.
6.	Class / Assignment Test	Twice in a Semester	It is a metric used to continuously assess the student's understanding capabilities.
7.	Preliminary Examination	Once in a semester	Preliminary examination is the metric to assess whether all the course outcomes are attained or not by asking descriptive questions.
8.	Presentations	As per the requirement	Presentation is the metric used to assess student's communication and presentation skills along with depth of the subject knowledge. Seminars topics are given to the students that cover topics of current interest or provide in-depth coverage of selected topics from the core courses.
9.	Class Attendance	As Per Vidyasagar University Guideline.	Total 5 Marks allotted for every Course / SEC/ DSE/AECC or others. The marks obtained of every course from Class Attendance by the students is following manner. 1. 05 Marks if he/ she attained greater than or equal to 95%. 2. 04 Marks if he/ she attained greater than or equal to 90%. 3. 03 Marks if he/ she attained greater than or equal to 85%. 4. 02 Marks if he/ she attained greater than or equal to 80%. 5. 01 Marks if he/ she attained greater than or equal to 75%.

Table 2: Indirect Assessment tool used for CO attainment			
Sr. No.	**Indirect Assessment Method**	**Assessment frequency**	**Method Description**
1	Course Exit Survey / Students Feedback Survey	End of Semester	Collect variety of information about course outcomes from the students after learning entire course.

The weightages given for various assessment tools used for the attainment of Course Outcomes are shown in table 3.

Table 3: List of Course Assessment tools

			Tools	**Frequency**	**Weightage**
Assessment Tools	**Direct**	**Internal Tools**	Assignment Tests	Twice in a semester	**10/75, 05/50**
			Internal Assessment	Twice in a semester	
			Home Assignments	Selected Topic	
			MOCK Practicals	Once in a semester	
			MCQ		
			Seminar/Presentations		
			Mini Projects		
			Preliminary Examination		
			End Semester Practical		**20/75(Practical Paper Only)**
			End Semester Field Visit		**03/75(Field Visit Paper Only)**
			Projects		**20/100(Project Report Only)**
		External Tools	End Semester Examination	Once in a semester	**60/75(Theory paper), 40/50(Theory paper), 40/75(Practical Paper)**
		Class Attendance	Counted after completion the End	Once in a semester	Total 5 Marks allotted for every

			Semester classes.		Course / SEC/ DSE/AECC or others. The marks obtained of every course from Class Attendance by the students is following manner. 1. 05 Marks if he/ she attained greater than or equal to 95%. 2. 04 Marks if he/ she attained greater than or equal to 90%. 3. 03 Marks if he/ she attained greater than or equal to 85%. 4. 02 Marks if he/ she attained greater than or equal to 80%. 5. 01 Marks if he/ she attained greater than or equal to 75%.
	Indirect	**--**	Course Exit Survey/ Examiners feedback	Once in a Semester	**On Marks Allotted but As Per NAAC / IQAC Guideline**

DIRECT METHOD

Academic Session: 2020-2021

Semester VI

Programme Name: B. SC. HONS (MATHEMATICS)

ATTAINMENT LEVELS FOR

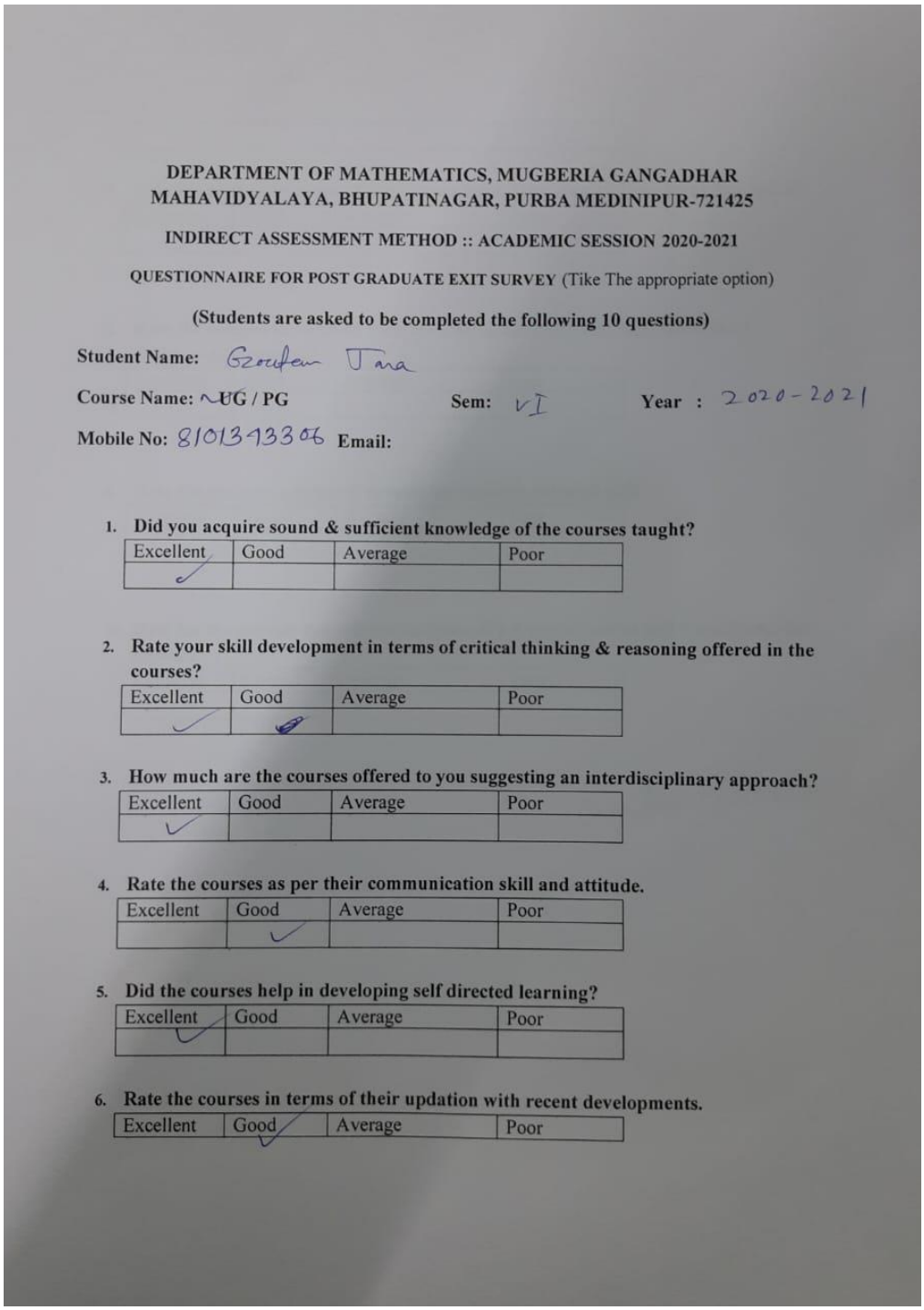
Result of UG SEM 6 of the academic year 2020-21		
Name	Class Roll	SGPA
Adip Maity	34	SQ, SGPA: 10.00
Arnab Maity	41	CGPA: 10.00
Buddhadev Jana	1	CGPA: 10.00
Goutam Jana	19	CGPA: 10.00
Kallol Jana	20	CGPA: 10.00
Mrinmay Mahapatra	3	CGPA: 10.00
Parag Mandal	33	CGPA: 10.00
Poushali Tripathy	4	CGPA: 10.00
Prasenjit Mandal	23	CGPA: 10.00
Priti Das Adhikari	24	CGPA: 10.00
Puspendu Sau	36	CGPA: 10.00
Rathin Samanta	5	CGPA: 10.00
Rathindranath Sahu	49	CGPA: 10.00
Saheb Bera	42	CGPA: 10.00
Santu Pradhan	9	CGPA: 10.00
Shrabani Jana	15	CGPA: 10.00
Shyamal Bera	16	CGPA: 10.00
Sreya Jana	48	CGPA: 10.00
Srikrishna Maity	27	CGPA: 10.00
Subha Bhunia	6	CGPA: 10.00
Subhadip Sahoo	8	CGPA: 10.00
Subinoy Patra	32	CGPA: 10.00
Suchismita kPradhan	10	CGPA: 10.00
Sumana Mandal	12	CGPA: 10.00
Susmita Sahoo	31	CGPA: 10.00
Tanmoy Bera	35	CGPA: 10.00
Tapasi Karan	17	CGPA: 10.00
Santanu Giri		CGPA: 10.00

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

PO & PSO ATTAINMENT
INDIRECT METHOD
Academic Session: 2020-2021
Semester VI
Programme Name: B. SC. HONS (MATHEMATICS)

EXIT FORM SURVEY IS CONDUCTED THROUGH QUESTIONNAIRE METHODS. OUT OF 10 QUESTIONS, FIRST 7 OF THEM RELATE DIRECTLY TO THE POs & THE LAST 3 QUESTIONS RELATE TO THE PSOs. A SAMPLE FORM IS GIVEN BELOW:



DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, BHUPATINAGAR, PURBA MEDINIPUR-721425

INDIRECT ASSESSMENT METHOD :: ACADEMIC SESSION 2020-2021

QUESTIONNAIRE FOR POST GRADUATE EXIT SURVEY (Tike The appropriate option)

(Students are asked to be completed the following 10 questions)

Student Name: Gourhari Jana

Course Name: ~~UG~~ / PG Sem: VI Year : 2020-2021

Mobile No: 8101313306 Email:

1. Did you acquire sound & sufficient knowledge of the courses taught?

Excellent	Good	Average	Poor
✓			

2. Rate your skill development in terms of critical thinking & reasoning offered in the courses?

Excellent	Good	Average	Poor
✓			

3. How much are the courses offered to you suggesting an interdisciplinary approach?

Excellent	Good	Average	Poor
✓			

4. Rate the courses as per their communication skill and attitude.

Excellent	Good	Average	Poor
	✓		

5. Did the courses help in developing self directed learning?

Excellent	Good	Average	Poor
✓			

6. Rate the courses in terms of their updation with recent developments.

Excellent	Good	Average	Poor
	✓		

7. **Rate the courses in terms of their experimental learning and employability option?**

Excellent	Good	Average	Poor
✓			

8. **Rate the courses in terms of their environmental awareness and relevance to sustainable measures?**

Excellent	Good	Average	Poor
✓			

9. **Rate the courses in terms of developing research oriented skill.**

Excellent	Good	Average	Poor
✓			

10. **How far the courses are relevant in terms of job opportunities and research/further studies?**

Excellent	Good	Average	Poor
✓			

Gezahegn Tana

DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, BHUPATINAGAR, PURBA MEDINIPUR-721425

INDIRECT ASSESSMENT METHOD :: ACADEMIC SESSION 2020-2021

QUESTIONNAIRE FOR POST GRADUATE EXIT SURVEY (Tike The appropriate option)

(Students are asked to be completed the following 10 questions)

Student Name: Suchismita Pradhan

Course Name: ✓ **UG / PG** **Sem:** 6th **Year :** 2020-2021

Mobile No: 9883485133 **Email:** Pradhan Suchismita 52 @ gmail.com

1. **Did you acquire sound & sufficient knowledge of the courses taught?**

Excellent	Good	Average	Poor
✓			

2. **Rate your skill development in terms of critical thinking & reasoning offered in the courses?**

Excellent	Good	Average	Poor
✓			

3. **How much are the courses offered to you suggesting an interdisciplinary approach?**

Excellent	Good	Average	Poor
✓			

4. **Rate the courses as per their communication skill and attitude.**

Excellent	Good	Average	Poor
✓			

5. **Did the courses help in developing self directed learning?**

Excellent	Good	Average	Poor
✓			

6. **Rate the courses in terms of their updation with recent developments.**

Excellent	Good	Average	Poor

✓			

7. **Rate the courses in terms of their experimental learning and employability option?**

Excellent	Good	Average	Poor
✓			

8. **Rate the courses in terms of their environmental awareness and relevance to sustainable measures?**

Excellent	Good	Average	Poor
✓			

9. **Rate the courses in terms of developing research oriented skill.**

Excellent	Good	Average	Poor
✓			

10. **How far the courses are relevant in terms of job opportunities and research/further studies?**

Excellent	Good	Average	Poor
✓			

Programme Name: B. SC. HONS (MATHEMATICS)

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

RATING AND RELATION OF POs AND PSOs WITH QUESTIONNARIE

Average Rating (Excellent- 4, Good-3, Average-2, Poor-1) Target level: 3

Questions	Average Rating (of 22 students)
1. Did you acquire sound & sufficient knowledge of the courses taught?	**3.8**
2. Rate your skill development in terms of critical thinking & reasoning offered in the courses?	**3.5**
3. How much are the courses offered to you suggesting an interdisciplinary approach?	**3.8**
4. Rate the courses as per their communication skill and attitude	**3.8**
5. Did the courses help in developing self directed learning?	**3.9**
6.Rate the courses in terms of their updation with recent developments.	**3.5**
7. Rate the courses in terms of their experimental learning and employability option?	**3.3**
8. Rate the courses in terms of their environmental awareness and relevance to sustainable measures?	**3.7**
9.Rate the courses in terms of developing research oriented skill	**3.8**
10. How far the courses are relevant in terms of job opportunities and research/further studies?	**3.6**

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

FINAL ATTAINMENT OF CO, PO&PSO

PROGRAMME NAME: B.Sc. HONOURS IN MATHEMATICS

BATCH
2020-2021

Direct Method: Average COs of all courses

	CO	CO	CO	CO
	17.1,17.2	18.1, 18.2	19.1, 19.2	20.1,20.2,20.3
Direct Attainment	3	3	3	3

In Direct Method, the target level is reached successfully.

Indirect Method: Average of PO & PSO with the questionnaire

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
	1	2	3	4	5	6	7	8	9	10
Indirect Attainment	3.8	3.5	3.8	3.8	3.9	3.5	3.3	3.7	3.8	3.6

In Indirect Method, the target level is reached successfully for POs & PSOs.

The report is prepared by Hironmoy Manna, Bikash Panda and Subham Maity under the guidance of Dr. Kalipada Maity, HOD, Dept of Mathematics.

Dr. Swapan Kumar Misra 2-06-2023

Principal

Mugberia Gangadhar Mahavidyalaya

Mugberia Gangadhar Mahavidyalaya ESTD.-1964 Purba Medinipur

Principal
Mugberia Gangadhar Mahavidyalaya