MUGBERIA GANGADHAR MAHAVIDYALAYA
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DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

PROGRAMME OUTCOME (PO), COURSE OUTCOME (CO) AND PROGRAMMESPECIFIC OUTCOME (PSO) FOR END SEMESTER STUDENTS UNDERGRADUATE COURSE: 2018-2019

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.

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425
DEPARTMENT OF MATHEMATICS

Course Outcomes (CO) for Students: 2018-2019

CO01: (Paper 1 Group A– Classical Algebra)

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

- 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.

CO02: (Paper 1 Group B – Abstract Algebra)

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.

CO03: (Paper 1: Group C 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.

CO04: (Paper 2 Group A-Real Analysis) :

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

- 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.

CO05: (Paper 2 Group B-Several Variables and Application)

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. .
- Solve various limit problems using L' Hospital's rule·

CO06: (Paper 2 - Group C Analytical Geometry of Two Dimensions)

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

Transformation of rectangular axis - Translations, rotation and their combination, general equation of second degree in two variables and its reduction to canonical equations, classifications of conics.

Pairs of straight lines, condition that the general equation of second degree in two variables may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax2 + 2hxy + by2 = 0$. Angle bisector, equation of two lines joining the origin to the points in which a line meets a conic.

CO07: (Paper 2 - Group D- Differential Equations –I)

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

First order differential equation of first degree and of higher degree: Separable, homogeneous and exact equations, condition of exactness, working knowledge of the rules of finding integrating factors, equation reducible to first order linear equations, Clairaut's equation, singular solution.

Application of differential equation to geometrical and physical problems, orthogonal trajectory.

CO08: (Paper 3 - Group A -Vector Analysis)

Learning Outcomes:

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

Scalar triple products and vector triple products, product of four vectors, reciprocal sets of vectors. Application in mechanics, geometry and trigonometry. Vector equations of straight lines and planes. Volume of a tetrahedron, shortest distance between two skew lines.

Ordinary derivative of vector. Space curves, parametric equations. Continuity and differentiability. Partial derivatives of vectors. Differential of vectors. Elements of differential geometry. Frenet Srenet's formula. Application of vector calculus in mechanics particularly to planetary motions.

CO09: (Paper 3 - Group B - Analytical Geometry of Three Dimensions)

Sphere, Cone, Cylinder. Surface of revolution, Ruled surface: study of their shape S and canonical equations.

Enveloping cone and enveloping cylinder. Tangents, tangent planes, normals and generating lines of quadrics.

CO10: (Paper 3 - Group C - Linear Programming and Game Theory)

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

Transportation and assignment problems: Formulation of balanced and unbalanced problems and their optimal solutions travelling salesman problems and their optimal solutions.

Game theory: Concept of game problems, rectangular game. Pure strategy and mixed strategy, saddle point, optimal strategy and value of the game, dominance, fundamental theorem of rectangular games, various methods (algebric method, graphical method, dominance principle and Simplex method) of solving rectangular games.

CO11: (Paper 4 - Group A - Analytical Dynamics of Particles)

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

Basic Concepts: Particle and rigid body; frame of reference, rest and motion, position vector, velocity and acceleration, mass, force and Newton's laws of motion.

CO12: (Paper 4 - Group B - Analytical Statics)

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

Friction: Laws of Friction, Angle of friction, Cone of friction. To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces.

CO12: (Paper 4 - Group C- Differential Equations-II)

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

Simultaneous differential equation with constant coefficients up to second order.

Power series solution of ordinary differential equation at an ordinary point.

CO13: (Paper 5 - Group A- Real Analysis – II)

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

- 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.

- 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.

CO13: (Paper 5 - Group B- Metric Space)

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

Definition and examples of metric spaces such as Rn ($n \geq 1$), $l\infty$, lp, C[a,b]. Open and closed ball, Neighborhoods of a point, open set, closed set (defined as a complement of an open set). Union and intersection of open and closed sets, limit point of a set, interior point and interior of a set, boundary points and boundary of a set, elementary properties of interior, closure and boundary of a set, bounded set, distance between a point and a set, distance between two sets.

CO13: (Paper 5 - Group C- Complex Analysis)

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

Complex functions: Limit, Continuity and differentiability of complex functions. Cauchy - Riemann Equations in Cartesian and Polar forms, Analytic functions. Sufficient conditions of Differentiability (Statement only), Harmonic function. Conjugate harmonic function, statement of Milne's Method.

CO14: (Paper 5 - Group D- Tensor Calculus)

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

Spaces of *n* dimension, Transformation of co-ordinates, Contravariant and covariant vectors. Scalar invariants, contravariant, covariant and mixed tensor. The Kroneckar delta. Symmetric and Skew-symmetric tensor.

Addition, subtraction, outer product, contraction, inner multiplication, Quotient law.

CO15: (Paper 6 - Group A- Rigid Dynamics)

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

Moment and product of inertia, Momental ellipsoid, Equimomental system, Principal axis, D'Alembert's principle. D'Alembert's equations of motion. Principles of moments, Principles of conservations of linear and angular momentum. Independence

of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy.

CO16: (Paper 6 - Group B- Hydrostatics)

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

Definition of Fluid, Perfect Fluid, Pressure. To prove that the pressure at a point in a fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids

CO17: (Paper 6 - Group C- Discrete Mathematics)

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

Sets and Propositions: Cardinality, principle of inclusion and exclusion, connectives, Tautology and contradictions, equivalence formula.

CO17: (Paper 6 - Group D- Mathematical Modeling)

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

Introduction, Basic steps of Mathematical modeling and its utility, preliminary concept of stability of differential equation.

Mathematical models with their formulation, solution, interpretation and limitations (i) Single species models (Exponential and Logistic growth), (ii) Two species population models (Two competing species and Prey-prediator).

CO18: (Paper 7 - Group A- Elements of Computer Science)

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

ANSI C: Character set in ANSI C. Key words: if, while, do, for, int, char, float, etc. Data type: character, integer, floating point, etc. Variables, Operators: =, == , !, < > , etc. (arithmetic, assignment, relational, logical, increment, etc.). Expressions: arithmetic and logical expressions. Standard input/output. Use of while, if-else, for, do - while, switch, continue, etc. Arrays, strings, user defined function. Header File.
The various problems on Mathematics are to be studied during programming in FORTRAN 77 or in C:

CO19: (Paper 7 - Group B- Mathematical Theory of Probability)

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

Concepts of mathematical probability, Random experiments, The idea of probability as a long run relative frequency. Sample space, mutually exclusive events, exhaustive events. Union of events, intersection of events, Kolmogorov's axiomatic definition of probability, classical definition as a special case of the axiomatic, theorems on the probability of the union of an events. Theorem of total probability, Boole's inequality, conditional probability, theorem of compound probability, theorem of inverse probability (Baye's theorem). Statistical independence of events, independent trials, random

CO20: (Paper 7 - Group C- Mathematical Statistics)

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

Collection of data, Tabulation and graphical representation of data, Qualitative and quantitative characteristics of discrete and continuous variables, Frequency table and its graphical representation. Measures of central tendency: mean (simple and weighted), median mode. Measures of dispersion: range, mean deviation and standard deviation, coefficient of variation, moments, skewness and kurtosis.

CO21: (Paper 8 - Group A- Numerical Analysis)

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

Solution of equations (algebraic and transcendental) : Solution of a single equation by –
i. Graphical method,
ii. Method of bisection,
iii. Regula falsi method,
iv. Fixed point iteration method,
v. Newton-Raphson method.
Geometrical interpretation of these methods. Convergence of fixed-point iteration and Newton-Raphson method.

CO22: (Paper 8 - Group B- Real Analysis – III)

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

Power series: Cauchy-Hadamard theorem, Radius of convergence, uniform convergence of power series and their related properties, uniqueness of a power series.

Fourier series. Dirichlet's condition of convergence at a point. Full range and half range series.

CO23: (Paper 8 - Group C -Linear Algebra-II)

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

Linear Transformation on Vector spaces: Definition, Null space, range space, rank and nullity, Sylvester's law, simple applications, non-singular linear transformation, inverse of linear transformation. An (m x n) real matrix as a linear transformation from R^n to R^m.

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

DETAILED SYLLABUS OF ALL SEMESTER UG (HONOURS) COURSES

DEPARTMENT OF MATHEMATICS

Paper -1

Group A

Classical algebra Marks - 30

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 of equation, Descartes rule of signs, cubic and biquadratic equation.
Inequality: The inequality involving AM> GM> HM, Cauchy-Schwartz inequality.

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.

Group B

Abstract Algebra Marks -35

Sets and Mappings: Revision of basic set theory, Cartesian product of sets, binary relation, equivalence relation and partition. Mappings: Injective, surjective, bijective, identity and inverse mappings, composition of mappings and it associativity, binary operations.

Integers: Natural numbers (Peano's axioms), statement of well ordering principle, first principle of mathematical induction, Second principle of Mathematical Induction, division algorithm, G.C.D. of two integers, existence and uniqueness of GCD.

Prime integers: Theorems of prime numbers including Euclids, unique factorizations theorem. Congruences: Properties and algebra of congruences, power of congruence, Fermat's theorem, Wilson's theorem, Euler's phi function, Fermat's theorem.

Introduction to group theory: Groupoid, semi group, quasi group, monoid, group, abelian group, examples of finite/infinite-groups taken from various branches.

Properties deducible from the definition of group including solvability of equations like $ax = b$, $ya = b$. A finite semigroup in which both the cancellation laws hold is a group.

Integral powers of an element and laws of indices in a group, order of an element of a group.

Sub-groups: Necessary and sufficient condition for a subset of a group to besubgroup. Intersection and union of two subgroups, cosets and Lagrange's theorem. Permutations, symmetric group, alternating group. Cyclic groups,subgroups of cyclic group, normal subgroups, concepts of homomorphism and Isomorphism of group.

Introduction to rings and fields: Definition and examples of ring, properties of rings directly follows from the definition, unitary and commutative rings, divisors of zero, integral domain.
Field: Definition and examples of field, every field is an integral domain, every finite integral domain is a field, characteristic of a Ring and of an integral domain, definitions of sub-ring and sub-field, statement of necessary and sufficient condition for a subset of a ring(field) to be a subring (subfield).

Group C

Linear Algebra Marks 25

Matrices (n x n) of real numbers, Algebra of matrices, symmetric and skewsymmetric matrices, orthogonal matrix, trace of a matrix.

Determinant of a square matrix of order n: Basic properties, minors and cofactors, Laplace's expansion of a determinant, Product of two determinants, adjugate and reciprocal determinants, symmetric and skew-symmetric determinants up to fourth order, Jacobi's theorem.

Adjoint of a square matrix, for a square matrix A. $(adjA) = (adjA).A = (detA).I_n$, invertible matrix, non-singularity, inverse of an orthogonal matrix. Elementary operations on matrices, echelon matrix, rank of a matrix, determination of rank of a matrix (statement and relevant results only), elementary matrices, normal form.

Congruences of matrices: Statement and application of relevant results, normal form of a matrix under Congruence.

Linear system of equations: Linear homogeneous system of equations, solution space, related results using idea of rank, necessary and sufficient condition for consistency of a linear non-homogeneous system of equations.

Inner product space: Definition and examples, norm, Euclidean vector space, orthogonality of vectors, orthonormal basis, Gram-Schmidt process of orthogonalisation.

Characteristic polynomial and equation of a matrix, Cayley-Hamilton theorem, Eigen values and Eigen vectors of a square matrix, diagonalisation of matrices, real uadratic form and reduction to canonical forms and classification.

Paper - 2

Group A

Real Analysis – I Marks-35

Intuitive ideas of natural numbers, integers, rational numbers and Irrational numbers, field axioms, order axioms, bounded set, lub of a set and the Completeness axiom (or least upper bound (lub) axiom) for the introduction of real number system, Consequences of lub axiom, Archimedian property of real numbers, rational number is Archimedian ordered field but not order complete, density property of rational and real numbers, arithmetic and geometric continuum of real numbers, extended real number system.

Open sets in terms of interior points, limit points, closed sets, ideas- of derived sets,boundary point, closure of a set, basic properties of open and closed sets (union, intersection and complement), Bolzano Weierstrass theorem, idea of open cover of a set, Heine-Borel theorem, denumerable and non-denumerable sets, denumerability of rational numbers, nondenumerability of the set of all irrational numbers and an interval.
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.

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

Real-valued functions defined on subsets' of the real line: in particular, real valued functions defined on an interval, limit at a point of a function defined on an interval, Algebra of limits, Infinite limits, Cauchy's Criteria on limit (no proof), bounded functions, monotone functions. Continuity at a point, on an interval of a function (continuity of functions *xn*, *ax*, log *x*, sin *x*, cos *x*, etc. to be assumed), properties of continuous function on a closed interval, existence of inverse functions of strictly monotone functions and its continuity. uniform continuity on an interval (only definition) and examples. Discontinuities of different kinds, discontinuities of monotone functions, denumerability of such points' of discontinuity.

Derivative, its physical and geometrical significance, sign of derivative, theorem on derivatives, condition of differentiability, rules of differentiation, chain rule and differentiation of inverse function, derivatives of higher order, Leibnitz theorem, Rolle's theorem, Lagrange's M.V.T., Cauchy's M.V.T., Darboux theorem, Taylor's theorem with different forms of remainder, Taylor's and Maclaurin's theorem infinite form with different forms remainder. Taylor's and Maclaurin's theorem infinite forms. Expansion of *ex, ax (a > 0), log(1 + x), (1 + x)m, sin x, cos x* etc. with their respective ranges of validity.

Indeterminate form, L' Hospital's rule and its consequences.

Reduction formulae for *xnex, sinnx, cosnx, sinmx, cosnx, tannx, cotnx, secnx, cosecnx, 1/(a+bcosx)n, 1/(x2 + a2)n, xm/(a + bxn), (lcosx + msinx)/(pcosx + qsinx)* etc.

Group B

Several Variables and Application Marks-20

Function of several variables, limit, continuity, double limit and repeated limit, partial differentiation, chain rule, exact differentiation of implicit functions, successive partial derivatives, Schwarz's theorem and Young's theorem, Euler's theorem of homogeneous function and its converse (up to three variables), Jacobian with simple properties.

Tangent, normal, curvature, asymptotes, envelope, singular points, curve tracing.

Group C

Analytical Geometry of Two Dimensions **Marks-20**

Transformation of rectangular axis - Translations, rotation and their combination, general equation of second degree in two variables and its reduction to canonical equations, classifications of conics.

Pairs of straight lines, condition that the general equation of second degree in two variables may represent two straight lines. Point of intersection of two intersecting straight lines. Angle between two lines given by $ax2 + 2hxy + by2 = 0$. Angle bisector, equation of two lines joining the origin to the points in which a line meets a conic.

Circle, Parabola, Ellipse and Hyperbola, Tangent and normals, Equations of pair-of tangents from an external point, chord of contact, pole and polar, conjugate points, conjugate lines, conjugate diameters.

Polar equation of straight lines and circles. Polar equation of a conic referred to a focus as pole, equation of tangent, normal, chord of contact.

Group D

Differential Equations –I Marks-15

First order differential equation of first degree and of higher degree: Separable, homogeneous and exact equations, condition of exactness, working knowledge of the rules of finding integrating factors, equation reducible to first order linear equations, Clairaut's equation, singular solution.

Application of differential equation to geometrical and physical problems, orthogonal trajectory.

Higher order linear differential equations with constant coefficient: complementary function, particular integral, method of undetermined coefficients, symbolic operator D.

Second order linear equations with variable coefficients, exact equations, Euler's homogeneous equation, reduction to an equation of constant coefficient.Transformation of equation by changing the dependent variable / the independent variable. Method of variation of parameter. Reduction of second order linear differential equation when one solution is known.

Simple Eigen-value problems.

PART II

Paper-III

(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Vector Analysis **Marks: 25**

Scalar triple products and vector triple products, product of four vectors, reciprocal sets of vectors. Application in mechanics, geometry and trigonometry. Vector equations of straight lines and planes. Volume of a tetrahedron, shortest distance between two skew lines.

Ordinary derivative of vector. Space curves, parametric equations. Continuity and differentiability. Partial derivatives of vectors. Differential of vectors. Elements of differential geometry. Frenet Srenet's formula. Application of vector calculus in mechanics particularly to planetary motions.

Gradient, divergence and rot (or curl) of a vector. The vector differential operator ∇, gradient, divergence, rot (or curl). Geometrical and physical interpretations. Formulae involving ∇. Invariance. Vector integral calculus: Ordinary integrals of vectors. Line integrals. Surface integrals. Volume integrals. Green's theorem. Statement and

verification of the divergence theorem of Gauss and Stoke's theorem. Related integral theorems, applications.

Group – B

Analytical Geometry of Three Dimensions **Marks 30**

Rectangular cartesian co-ordinates in space, Concept of a geometric vector (directed lines segment). Projection of a vector on a co-ordinate axis, inclination of a vector with an axis, co-ordinates of a vector, direction cosines of a vector, distance between two points. Division of a directed line segment in a given ratio, the equation of a surface and the equation of a curve.

Equation of plane: General, intercept and normal form. The sides of a plane, signed distance of a point from a plane. Equation of a plane passing through the intersection of two planes. Angle between two intersecting planes, bi-sectors of angle between two intersecting planes, Parallelism and perpendicularity of two planes.

Straight line in space: its equation in symmetrical (canonical) and parametric forms. Direction ratio and direction cosines, canonical equation of the line of intersection of two intersecting planes. Angle between two lines. Condition for Parallelism and perpendicularity of two straight lines, of a straight line and a plane, Equations of skew lines, Distance of a point from a straight line. Shortest distance between two skew lines.

Sphere, Cone, Cylinder. Surface of revolution, Ruled surface: study of their shape S and canonical equations.

Enveloping cone and enveloping cylinder. Tangents, tangent planes, normals and generating lines of quadrics.

Transformation of rectangular axes: translation, rotation and their combinations. General equation of second degree in three variables: reduction to canonical (normal) forms. Classification of quadrics and their equation in canonical forms.

Group – C

Linear Programming and Game Theory **Marks: 35**

Inequations, formation of problems from daily life involving inequations, slack and surplus variables, definition of L.P.P., canonical, standard and matrix form of L.P.P., solution of L.P.P by graphical method. Basic solutions, feasible solution and basic feasible solutions, degenerate and non-degenerate B.F.S., vectors, bases and dimension, convex sets, convex hull, convex cone, convex polyhedral and simplex, hyperplane, polytope, polyhedral, separating and supporting hyperplane. The collection of all feasible solution of a L.P.P. constitutes a convex set whose extreme point correspond to its B.F.S. The objective function has its optimum value at an extreme point of the convex polyhedron generated by the set of feasible solutions, a B.F.S. to a L.P.P. corresponds to an extreme point of the convex set of feasible solutions, if the objective function assumes its optimal value at more than one extreme

points, then every convex combination of these extreme points also gives the optimal value of the objective function. If the L.P.P. admits an optimal solution then at least one B.F.S. must be optimal. Reduction of a F.S. to B.F.S.

Theory of simplex method, feasibility and optimality conditions, The algorithm, Unbounded solution, alternative optimal. Two phase method, Charne's Big-M method, degeneracy in L.P.P. and its resolution. Cycling (definition only). Duality, The dual of the dual is primal, weak and strong duality theorems, solution of the dual (primal) from the simplex table of the primal (dual).

Transportation and assignment problems: Formulation of balanced and unbalanced problems and their optimal solutions travelling salesman problems and their optimal solutions.

Game theory: Concept of game problems, rectangular game. Pure strategy and mixed strategy, saddle point, optimal strategy and value of the game, dominance, fundamental theorem of rectangular games, various methods (algebric method, graphical method, dominance principle and Simplex method) of solving rectangular games.

Paper-IV

(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Analytical Dynamics of Particles — Marks: 40

Basic Concepts: Particle and rigid body; frame of reference, rest and motion, position vector, velocity and acceleration, mass, force and Newton's laws of motion.

Motion of a particle in one dimension: Rectilinear motion under constant and variable forces, impulse and impulsive forces, linear momentum, kinetic energy, work, power, conservative forces depending on position, potential energy and principle of conservation of linear momentum and energy, collision of elastic bodies, falling bodies including various problems, motion under gravity with resistance varying as integral powers of velocity. S.H.M. linearly damped oscillation, forced oscillations, damped forced oscillations, principle of superposition, strings and springs, varying mass problem, rockets and falling rain.

Motion of a particle in a plane: Expressions for velocity and acceleration in Cartesian and polar coordinates, expressions for tangential and normal acceleration, equation of motion in Cartesian (w.r.to fixed and rotation frames) and polar coordinates, momentum (linear and angular), work, energy, conservative forces, principle of conservation of linear momentum, angular momentum and energy. Central forces and central orbits, motion under inverse square law (attractive and repulsive). Escape velocity. Planetary motion and Kepler's laws, motion of an artificial satellite, geo-stationary orbits, stability of nearly circular motion, disturbed elliptic orbit, constrained motion, simple and cycloidal pendulum, motion on rough curves (circle, parabola, ellipse, cycloid etc.) under gravity. Motion in resisting medium. Projectiles in a resisting medium when resistance varies as an integral power of velocity.

Group – B

Analytical Statics Marks: 30

Friction: Laws of Friction, Angle of friction, Cone of friction. To find the positions of equilibrium of a particle lying on a (i) rough plane curve, (ii) rough surface under the action of any given forces.

Centre of Gravity: General formula for the determination of C.G. Determination of position of C.G. of any arc, area of solid of known shape by method of integration.

Astatic Equilibrium, Astatic Centre. Positions of equilibrium of a particle lying on a smooth plane curve under action of given forces. Action at a joint in a frame work.

Virtual work: Principle of virtual work for a single particle. Deduction of the conditions of equilibrium of a particle under coplanar forces from the principle of virtual work. The principle of virtual work for a rigid body. Forces which do not appear in the equation of virtual work. Forces which appear in the equation of virtual work. The principle of virtual work for any system of coplanar forces acting on a rigid body. Converse of the principle of virtual work.

Stable and Unstable equilibrium. Co-ordinates of a body and of a system of bodies. Field of forces. Conservative field. Potential energy of a system. The energy test of stability. Condition of stability of equilibrium of a perfectly rough heavy body lying on fixed body. Rocking stones.

Forces in three dimensions. Moment of a force about a line. Axis of a couple. Resultant of any two couples acting on a body. Resultant of any number of couples acting on a rigid body. Reduction of a system of forces acting on a rigid body. Resultant force in an invariant of the system but the resultant couple is not an invariant. Conditions of equilibrium of a system of forces acting on a body. Deductions of the conditions of equilibrium of a system of forces acting on a rigid body from the principle of virtual work. Poinsot's central axis. A given system of forces can have only one central axis. Wrench, Pitch, Intensity and Screw. Condition that a given system of forces may have a single resultant. Invariants of a given system of forces. Equation of the central axis of a given system of force.

Group -C

Differential Equations-II Marks: 20

Simultaneous differential equation with constant coefficients up to second order.

Power series solution of ordinary differential equation at an ordinary point.

Partial differential equation: Introduction, formulation of P.D.E. Solution of first order linear P.D.E.: Lagrange's method.

Definition of Laplace transform, Elementary properties of Laplace transform, Laplace transform of derivatives, Laplace transform of integrals, Formulae of inverse Laplace transform, Statement of Convolution theorem, solution of O.D.E. up to second order with constant coefficient using Laplace transform.

Paper - V

(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Real Analysis – II Marks: 50

Riemann theory of integration: Partition and refinement of partition of a closed and bounded interval, Upper Darboux sum and Lower Darboux sum and associated results, upper integral and lower integral, Darbbux theorem, Darboux definition of integration over a closed and bounded interval, Riemann's definition of integrability, equivalence of Darboux definition of integrability (statement only), necessary and sufficient conditions of Riemann integrability, Integrability of continuous, monotonic and piecewise continuous functions with finite number of points of discontinuities, infinite number of points of discontinuities having finite number of limit points, integrability of sum, scalar multiple, product, quotient, modulus of integrable functions. Functions defined by integrals, their continuity and differentiability, Fundamental theorem of integral calculus. First mean value theorem and second mean value theorem (Bonnet and Weierstrass's form (no proof of integral calculus. Definition of log x as an integral and deduction of simple properties.

Improper integral: Necessary and sufficient condition for convergence of improper integral(for unbounded function and unbounded range of integration), comparison and limit test for convergence, absolute and non-absolute convergence, Abel's and Dirichlet's test for convergence of the integral of a product(statement only), Beta and Gamma functions, their convergence, relation and simple properties.

Differentiation and integration w.r.to parameter under integral sign, statement of relevant theorem.
Multiple integral: Concept of upper sum, lower sum, upper integral, lower integral and Double integral (no rigorous statement is needed), statement of existence theorem for continuous function, change of order of integration, Triple integral, change of variables in double and triple integral (problem only), determination of volume and surface area by multiple integral (problem only).

Concept of implicit function: statement and simple application of implicit function theorem for two variables, differentiation of implicit function.

Mean value and Taylor's theorem for function of two variables, Transformation of variables. Maxima and minima of functions of two or more variables. Lagrange's method of undetermined multipliers (up to four variables), concept of saddle point.

Group - B

Metric Space **Marks: 15**

Definition and examples of metric spaces such as Rn ($n \geq 1$), $l\infty$, lp, C[a,b]. Open and closed ball, Neighborhoods of a point, open set, closed set (defined as a complement of an open set). Union and intersection of open and closed sets, limit point of a set, interior point and interior of a set, boundary points and boundary of a set, elementary properties of interior, closure and boundary of a set, bounded set, distance between a point and a set, distance between two sets.

Sub-space of a metric space, sequence, convergence sequence, Cauchy sequences. Complete and incomplete metric spaces completeness of *Rn* ($n \geq 1$), C[a,b]. Cantor's intersection theorem.

Group - C

Complex Analysis **Marks: 10**

Complex numbers as ordered pairs. Geometrical representation of complex numbers. Extended Complex plane. Stereographic projection.

Complex functions: Limit, Continuity and differentiability of complex functions. Cauchy - Riemann Equations in Cartesian and Polar forms, Analytic functions. Sufficient conditions of Differentiability (Statement only), Harmonic function. Conjugate harmonic function, statement of Milne's Method.

Group - D

Tensor Calculus **Marks: 15**

Spaces of *n* dimension, Transformation of co-ordinates, Contravariant and covariant vectors. Scalar invariants, contravariant, covariant and mixed tensor. The Kroneckar delta. Symmetric and Skew-symmetric tensor.

Addition, subtraction, outer product, contraction, inner multiplication, Quotient law.

The line element and the metric tensor; Riemannian space, conjugate or reciprocal tensor.

Christoffel symbols and their laws transformation, covariant differentiation of vectors and tensors, covariant differentiations of sum and products. Divergence of a vector, Laplacian of a scalar invariant.

Curvature tensors and Ricci tensor, covariant curvature tensor.

PART III

Paper - VI

(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Rigid Dynamics **Marks: 30**

Moment and product of inertia, Momental ellipsoid, Equimomental system, Principal axis, D'Alembert's principle. D'Alembert's equations of motion. Principles of moments, Principles of conservations of linear and angular momentum. Independence of the motion of centre of inertia and the motion relative to the centre of inertia. Principle of energy. Principle of conservation of energy.

Equation of motion of a rigid body about a fixed axis. Expression for kinetic energy and moment of momentum of a rigid body moving about a fixed axis. Compound pendulum. Interchangeability of the points of a suspension and centre of oscillation. Minimum time of oscillation. Reaction of axis of rotation.

Equations of motion of a rigid body moving in two dimensions. Expression for kinetic energy and angular momentum about the origin of a rigid body moving in two dimensions. Two dimensional motion of a solid of revolution down a rough inclined plane. Necessary and sufficient condition for pure rolling. Two dimensional motion of a solid of revolution moving on a rough horizontal plane.

Equations of motion under impulsive forces. Equation of motion about a fixed axis under impulsive forces. Centre of percussion. To show that (i) if there is a definite straight line such that the sum of the moments of the external impulses acting on a system of particles about it vanishes, then the total angular momentum of the system about that line remains unaltered, (ii) the change of K.E. of a system of particles moving in any manner under the application of impulsive forces is equal to the work done by the impulsive forces. Impulsive forces applied to a rigid body moving in two dimensions.

Group B

Hydrostatics **Marks: 25**

Definition of Fluid, Perfect Fluid, Pressure. To prove that the pressure at a point in a fluid in equilibrium is the same in every direction. Transmissibility of liquid pressure. Pressure of heavy fluids. To prove –

(a) In a fluid at rest under gravity the pressure is the same at all points in the same horizontal plane.
(b) In a homogeneous fluid at rest under gravity the difference between the pressures at two points is proportional to the difference of their depths.
(c) In a fluid at rest under gravity horizontal planes are surfaces of equal density.
(d) When two fluids of different densities at rest under gravity do not mix, their surface of separation is a horizontal plane. Pressure in heavy homogeneous liquid. Thrust of heavy homogeneous liquid of plane surfaces.

Definition of centre of pressure. Formula for the depth of the centre of pressure of a plane area. Position of the centre of pressure. Centre of pressure of a triangular area whose angular points are at different depths. Centre of pressure of a circular area. position of the centre of pressure referred to co-ordinate axes through the centroid of the area. Centre of pressure of an elliptical area when its major axis in vertical or along the line of greatest slope. Effect of additional depth on centre of pressure.

Equilibrium of fluids in given fields of force: Definition of field of force, line of force. Pressure derivative in terms of force. Surface of equi-pressure. To find the necessary and sufficient conditions of equilibrium of a fluid under the action of a force whose components are X, Y, Z along the co-ordinate axes. To prove (i) that surfaces of equal pressure are the surfaces intersecting orthogonally the fines of force. (ii) when the force system is conservative, the surfaces of equal pressure are equipotential surfaces and are also surfaces of equal density. To find the differential equations of the surfaces of equal pressure and density.

Rotating fluids. To determine the pressure at any point and the surfaces of equal pressure when a mass of homogeneous liquid contained in a vessel, revolves uniformly about a vertical axis.

Thurst on Curved Surface.

The stability of the equilibrium of floating bodies. Definition, stability of equilibrium of a floating body, metacentre, plane of floatation, surface of buoyancy. General propositions about small rotational displacements. To derive the condition for stability.

Group - C

Discrete Mathematics **Marks: 20**

Sets and Propositions: Cardinality, principle of inclusion and exclusion, connectives, Tautology and contradictions, equivalence formula.

Graph Theory: Graphs: undirected graphs, Directed graphs, basic properties, complete graph, complement of a Graph, bipartite Graphs, Necessary and Sufficient condition for a Bipartite Graph, Weighted Graphs, Walk, Path, Cycles, Circuit, Euler Graph, Konisberg Bridge Problem. Trees: Basic properties, spanning tree.

Partial order relations and Lattices: Definitions of poset, lattice, chain and antichain, properties of a lattice, distributive lattice with properties.

Discrete numeric functions and generating functions.

Group - D

Mathematical Modeling **Marks: 15**

Introduction, Basic steps of Mathematical modeling and its utility, preliminary concept of stability of differential equation.

Mathematical models with their formulation, solution, interpretation and limitations (i) Single species models (Exponential and Logistic growth), (ii) Two species population models (Two competing species and Prey-prediator).

Simple epidemic model (SI) with the formulation, solution, interpretation and limitations.

Paper- VII

(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Elements of Computer Science **Marks: 30**

Elementary computers programming: Concepts of machine language, assembly language, different high level languages and compilers. Application of computer programming: Different steps of solving a problem by a Computer. Computer oriented algorithm. Flowchart.

Boolean Algebra and applications:

Binary arithmetic: binary numbers, binary-to-decimal conversion, decimal-tobinary conversion, Addition, subtraction, multiplication and division of binary numbers, Algebra of sets. Definition of Boolean algebra by Huntington postulates, Two elements Boolean algebra and other examples, principle of duality, basic theorems, Boolean functions, truth table, disjunctive and conjunctive normal forms, Theorem on construction of a Boolean function from a truth table and examples. Different binary operations and operators: AND, OR, NOT, NAND, NOR. Bistable devices, Logic gates-AND, OR, NOT, NAND, NOR (including block diagram and input-output table). Logic gates representations for Boolean expressions, Binary half adder and full adder.

Programming Languages: Either FORTRAN 77 or ANSI C

FORTRAN 77: Fixed and floating point modes, constants and variables, subscripted variables, arithmetic expression, library functions, statements, and arithmetic, input, output and control statements. Arithmetic assignment statement, GO TO, Arithmetic IF, Logical IF, BLOCK IF, DO, CONTINUE, READ, WRITE, PRINT, STOP, END, DIMENSION and FORMAT (List directed, I, E, F, X and H specification only). Two dimensional arrays, arithmetic statement, functions subprogram, subroutine subprogram. strings.

ANSI C: Character set in ANSI C. Key words: if, while, do, for, int, char, float, etc. Data type: character, integer, floating point, etc. Variables, Operators: =, == , !, < > , etc. (arithmetic, assignment, relational, logical, increment, etc.). Expressions: arithmetic and logical expressions. Standard input/output. Use of while, if-else, for, do - while, switch, continue, etc. Arrays, strings, user defined function. Header File.
The various problems on Mathematics are to be studied during programming in FORTRAN 77 or in C:

Group – B

Mathematical Theory of Probability **Marks: 35**

Concepts of mathematical probability, Random experiments, The idea of probability as a long run relative frequency. Sample space, mutually exclusive events, exhaustive events. Union of events, intersection of events, Kolmogorov's axiomatic definition of probability, classical definition as a special case of the axiomatic, theorems on the probability of the union of an events. Theorem of total probability, Boole's inequality, conditional probability, theorem of compound probability, theorem of inverse probability (Baye's theorem). Statistical independence of events, independent trials, random
variables, discrete and continuous distributions, probability distribution function, expectation, variance, moments of a random variable, basic ideas of moment generating function (m.g.f.) and characteristic function, dependent and independent trials. Bernoulli's trials, Binomial law, Joint distribution of two random variables and transformation of variables. Marginal and conditional distributions, Sum law and roduct law of expectation, two dimensional expectation and conditional expectation, Correlation and regression. Tchebycheff's inequality, convergence in probability, Bernoulli's limit theorem, weak law of large numbers. Central limit theorem (statement only). Poissons approximation to Binomial distribution, Normal approximation to Binomial distribution. Detailed understanding of hyper-geometric binomial, negative binomial and Poisson distributions and (b) rectangular, gamma, beta and normal distributions, *x2* and t distributions.

Group – C

Mathematical Statistics **Marks: 25**

Collection of data, Tabulation and graphical representation of data, Qualitative and quantitative characteristics of discrete and continuous variables, Frequency table and its graphical representation. Measures of central tendency: mean (simple and weighted), median mode. Measures of dispersion: range, mean deviation and standard deviation, coefficient of variation, moments, skewness and kurtosis. Random sampling, sampling distribution of a statistic. Sampling distribution of a sample means (normal population case) and sample proportion. Statistical inference. Point estimation of a parameter unbiased and consistent estimates. Method of maximum likelihood. Bivariate data, Scattered diagram, simple correlation and regression, curve fitting (linear and parabolic). Statistical hypothesis: Simple and composite, critical region of a test. Type-I and Type- II error. Confidence interval and confidence coefficients: Confidence interval for a single variance (normal distribution), Neyman-Pearson theorem (statement only). Testing of Hypothesis (large and small sample, Normal distribution only).

Paper - VIII
(Marks: 100, No. of Lectures: 150, Tutorials: 40)

Group - A

Numerical Analysis **Marks: 25**

Basic concepts: approximation of numbers, significant figures, absolute, relative and percentage errors, truncation and round off errors, accumulation and propagation of errors.

Polynomial interpolation and application: Lagrangian interpolation problem. Linear interpolation formula. Lagrange's formula.

Differences: Forward, backward and divided difference tables, linear difference equations with constant coefficients. Newton's general interpolation formula with remainder term, Newton's forward and backward formulae, error in these formulae. Numerical differentiation based on Newton's forward and backward formulae.

Numerical integration: Newton's Cotes formulae, trapezoidal rule, Simpson's one third rule and inherent errors, Weddle's rule, Summation of finite series by Euler-Maclaurin series (statement only).

Solution of equations (algebraic and transcendental) : Solution of a single equation by –
i. Graphical method,
ii. Method of bisection,
iii. Regula falsi method,
iv. Fixed point iteration method,
v. Newton-Raphson method.
Geometrical interpretation of these methods. Convergence of fixed-point iteration and Newton-Raphson method.

Gauss-elimination, Gauss-Siedal method for the solution of a system of linear equations.

Solution of differential equations: Solution of a first order differential equation by Euler's method and modified Euler's method. Runga-Kutta (2nd and 4th order) methods (emphasizing the problem only).

Group - B

Real Analysis – III **Marks: 25**

Real Valued functions defined on a subset (may not be an interval) of real numbers; limit of a real-valued function at a limit point of the domain (subset of *R)* of the functions, sequential and Cauchy's criteria for the existence of a limit of a function at a point. Algebra of limits in this context.

Continuity of a function at a point on a subset of *R*, Sequential criteria for continuity at a point, continuity on a set. Algebra of continuous functions as a consequence of algebra of limits, continuity of composites of continuous functions. Uniform ontinuity on a set. If f is continuous on a closed and bounded subset of R, then f is uniformly continuous there. If f is uniformly continuous on a subset of real numbers then it is uniformly continuous on the closure of S.

Sequence of functions: Pointwise and uniform convergence, Cauchy's criteria for Uniform convergence, Weierstrass M-test, boundedness, continuity, differentiability and integrability of the limit function in case of uniform convergence.

Series of functions: Pointwise and uniform convergence, Cauchy's criteria for uniform convergence, Boundedness and continuity of the sum function in case of uniform convergence. Term by term integration and differentiation. Weierstrass M test for uniform and absolute convergence.

Power series: Cauchy-Hadamard theorem, Radius of convergence, uniform convergence of power series and their related properties, uniqueness of a power series.

Fourier series. Dirichlet's condition of convergence at a point. Full range and half range series.

Group – C

Linear Algebra-II **Marks: 10**

Linear Transformation on Vector spaces: Definition, Null space, range space, rank and nullity, Sylvester's law, simple applications, non-singular linear transformation, inverse of linear transformation. An (m x n) real matrix as a linear transformation from R^n to R^m.

Group-D

(Classes per week: 3 periods)

Computer Practical **Marks: 30**

List of programs using FORTRAN or C

1. General programs

(i) Area of circle, triangle, (ii) Summation of finite and convergent infinite series, (iii) Maximum and minimum among three number and n numbers, (iv) Roots of a quadratic equation, (v) G.C.D. and L.C.M. between two integers, (vi) Testing of prime numbers, (vii) Split a number into digits, (vii) Computation of *nPr* and *nCr*, (viii) Searching and sorting (bubble sort only).

2. Problems on matrices

(i) Addition and subtraction, (ii) Product, (iii) Trace and (iv) Transpose

3. Problems on strings

(i) Counting of words in a string, (ii) Palindrome testing, (iii) Conversion from upper case to lower case and lower case to upper case, (iv) Sorting of names, (v) Rewrite name of a person in short form, (vi) searching a sub-string among a set of strings.

4. Problems on Numerical Methods

(i) Interpolation by Lagrange's and Newton forwards difference methods, (ii) Finding of roots by bisection, regula-falsi, fixed point iteration and Newton- Rapshon methods, (iii) Integration by trapezoidal and Simpson 1/3 rule, (iv) Solution of a system of equations by Gauss-Siedal method, (v) Solution of a differential equation by Runge-Kutta methods.

5. Problems on Statistical methods

(i) Preparation of grouped frequency table, (ii) Mean, median and mode for simple and grouped frequency distribution, (iii) Standard deviation, mean deviation, (iv) Moments, skewness and kurtosis, (v) Correlation and regression, (vi) Fitting of straight and parabolic curve.

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DEPARTMENT OF MATHEMATICS

MAPPING OF CO, PO, PSO

	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	✔	✔			✔		✔		✔		✔		
CO17	✔	✔		✔			✔		✔		✔		

CO18	✔	✔			✔			✔		✔		✔	
CO19	✔	✔	✔			✔		✔		✔			
CO20	✔	✔	✔					✔	✔		✔		
CO21	✔	✔		✔				✔		✔	✔		
CO22	✔	✔		✔			✔		✔		✔		
CO23	✔	✔			✔			✔	✔				✔

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

	Mapping	Correlation	Justification
CO -1	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
CO-2	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	HIGH	Students make questioning and reasoning to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of LPP , Simulation..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 LPP in a unique way.
CO-3	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-4	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
C0-5	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
CO-6	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	HIGH	Students make questioning and reasoning to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of LPP , Simulation..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 LPP in a unique way.
C0-7	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.
C0-8	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
CO-9	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	HIGH	Students make questioning and reasoning to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of LPP , Simulation..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 LPP in a unique way.

CO-10	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-11	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
CO-12	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
CO-13	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	HIGH	Students make questioning and reasoning to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of LPP , Simulation..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 LPP in a unique way.
CO-14	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-15	PO1	HIGH	Obtain clear concept on Simulation, sensitivity analysis etc.
	PO2	HIGH	Students make questioning and reasoning to enrich in subject of this course.
	PO5	MODERATE	Students apply the knowledge of LPP , Simulation..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 LPP in a unique way.
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.
	PO1	HIGH	Acquire knowledge on Laplace transform & its application on ODE,PDE

	Mapping	Correlation	Justification
CO17	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.
CO18	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.
CO19	PO1	HIGH	Students obtain a vivid knowledge on polynomial Ring ,consequences

	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
CO20	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
CO21	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
CO22	PO1	HIGH	Obtain knowledge on Mobius Inversion, residues, dirichlet's product
	PO2	HIGH	Acqrire knowledge about critical reasoning and questioning in Mobius Inversion, residues
	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 metric space in a unique way
CO23	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
	PSO5	HIGH	Student realize to evaluate the problem of this course by mathematical& statistical method

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		1	2		3		
C0-6	3	3	3					2	3		3		
C0-7	3	3				3		3	2		3		
CO-8	3	3	3					2	3		3		
CO-9	3	3				3	3	3				3	
CO-10	3	3	3					2	3		3		
CO-11	3	3				3	3	3				3	
CO-12	3	3	3					2	3		3		
CO-13	3	3				3		2	2		3		
CO-14	3	3	3					2	3		3		
CO-15	3	3		3			3		3		2		
CO-16	3	3			3			2		1		3	
CO-17	3	3	2			3		3		2			
CO-18	3	3	3					2	3		3		
CO-19	3		3	2				3		3	3		
CO-20	3	3		2			3		3		3		
CO-21	3	3			3			2	3				3
CO-22	3	3				3	3	3				3	
CO-23	3	3			2	1			3		3		
Target	3	3	2.8	2.3	2.6	2.45	3	2.2	2.8	2	2.8	3	3

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

DEPARTMENT OF MATHEMATICS

Attainment of Course & Programme Outcomes

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, annual 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 year	The Internal Assessment marks in a theory paper shall be based on two tests generally conducted in the month of September and December of each year. 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 yearly Examination	Once in a year	Annual examination (theory or

4.	Practical Examination		practical) are the metric to assess whether all the course outcomes are attained or not framed by the course incharge. Annual Examination is more focused on attainment of all course outcomes and uses a descriptive questions.
5.	Home Assignments	Twice in a Year	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 Year	It is a metric used to continuously assess the student's understanding capabilities.
7.	Preliminary Examination	Once in a Year	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.

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 Course	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
			Assignment Tests	Twice in a Year	**10/100**
			Internal Assessment	Twice in a Year	

Assessment Tools	**Direct**	**Internal Tools**	Home Assignments	Selected Topic	
			MOCK Practicals	Once in a Year	
			MCQ		
			Seminar/Presentations		
			Mini Projects		
			Preliminary Examination		
			Practical for final year students		**30/100(Practical Paper Only)**
		External Tools	Annual Examination	Once in a Year	**90/100(Theory paper), 70/100(Practical Paper)**
	Indirect	**--**	Course Exit Survey/ Examiners feedback	Once in a Year	**On Marks Allotted but As Per NAAC / IQAC Guideline**

RESULT OF MATHEMATICS HONS.

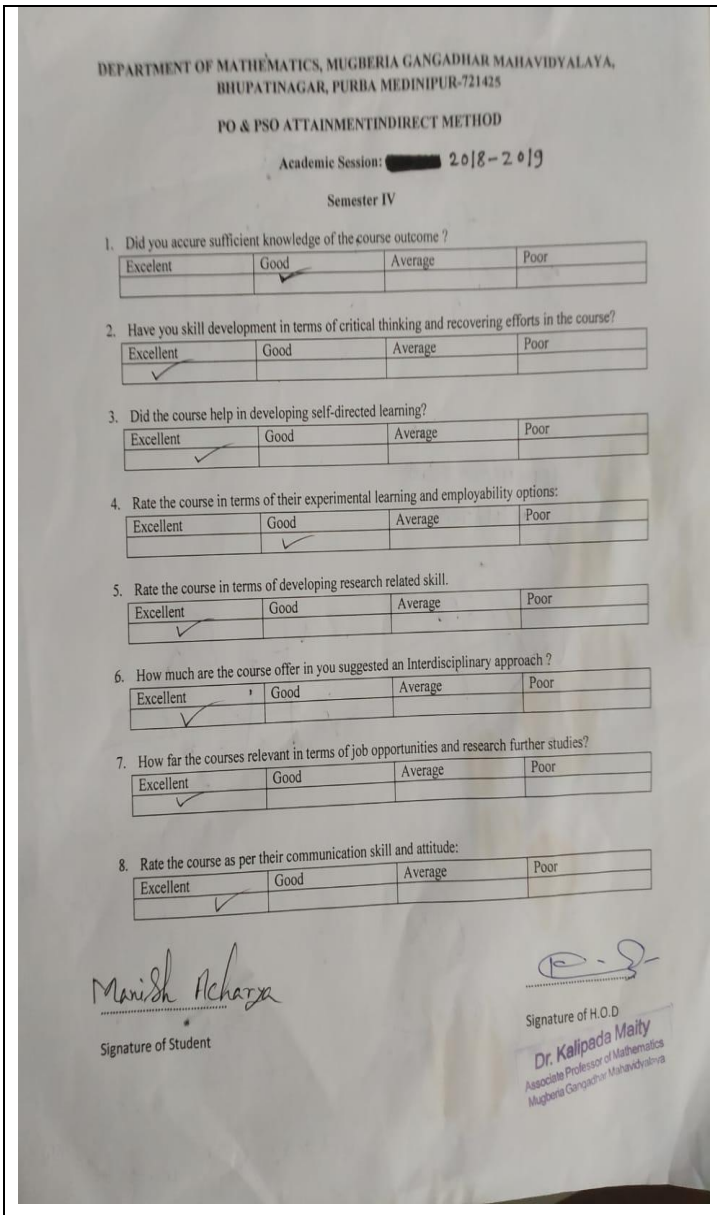
	31217129 /	
AMITAVA PATRA	0062	II
CHANDAN GIRI	0067	II
CHAYAN PRADHAN	0068	II
DEBOTTAM JANA	0069	II
DIBYAYAN JANA	0070	II
GOPAL DAS	0071	I
MANISH ACHARYYA	0074	II
MOUMITA SAHOO	0075	II
	31216129 /	
AMIT MANDAL	0050	P
ANKITA SAMANTA	0052	II
ASHARANI MANNA	0053	II
BISWAJIT PATRA	0054	II
MADHUSHREE SAHU	0058	II
MANAS BERA	0059	P
MOUMITA PRADHAN	0060	II
NANDAN MAITY	0061	II
PURNENDU MONDAL	0063	P
SAGNIK MAIKAP	0068	P
SAPTASREE BHATTACHARYA	0071	P
SUJOY KUMAR MANDAL	0077	P
SUMAN KALYAN DAS	0079	II
SWAPAN MAITY	0082	P
TANUSRI ROY	0084	P
	31215129 /	
GURUPADA JANA	0087	II
SAIKAT PRAMANIK	0096	P

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

PO & PSO ATTAINMENTINDIRECT METHOD

Academic Session: [redacted] 2018-2019

Semester IV

1. Did you accure sufficient knowledge of the course outcome ?

Excelent	Good	Average	Poor
	✓		

2. Have you skill development in terms of critical thinking and recovering efforts in the course?

Excellent	Good	Average	Poor
✓			

3. Did the course help in developing self-directed learning?

Excellent	Good	Average	Poor
✓			

4. Rate the course in terms of their experimental learning and employability options:

Excellent	Good	Average	Poor
	✓		

5. Rate the course in terms of developing research related skill.

Excellent	Good	Average	Poor
✓			

6. How much are the course offer in you suggested an Interdisciplinary approach ?

Excellent	Good	Average	Poor
✓			

7. How far the courses relevant in terms of job opportunities and research further studies?

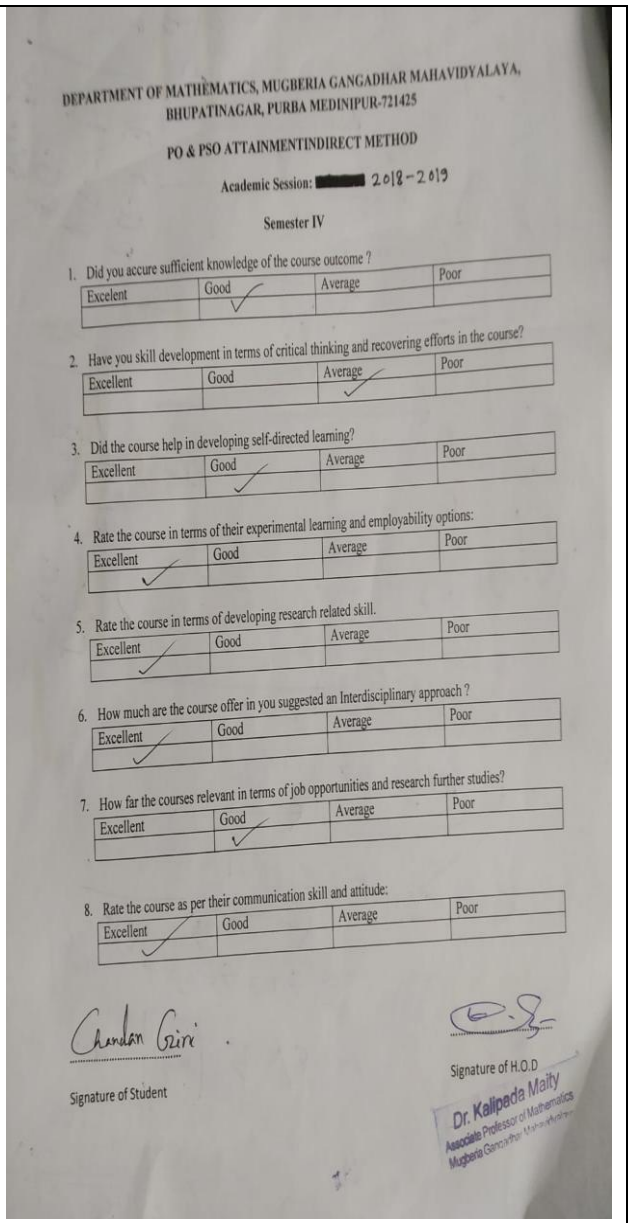
Excellent	Good	Average	Poor
✓			

8. Rate the course as per their communication skill and attitude:

Excellent	Good	Average	Poor
✓			

Manish Acharya
Signature of Student

Signature of H.O.D
Dr. Kalipada Maity
Associate Professor of Mathematics
Mugberia Gangadhar Mahavidyalaya



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

PO & PSO ATTAINMENTINDIRECT METHOD

Academic Session: [redacted] 2018-2019

Semester IV

1. Did you accure sufficient knowledge of the course outcome ?

Excelent	Good	Average	Poor
	✓		

2. Have you skill development in terms of critical thinking and recovering efforts in the course?

Excellent	Good	Average	Poor
		✓	

3. Did the course help in developing self-directed learning?

Excellent	Good	Average	Poor
	✓		

4. Rate the course in terms of their experimental learning and employability options:

Excellent	Good	Average	Poor
✓			

5. Rate the course in terms of developing research related skill.

Excellent	Good	Average	Poor
✓			

6. How much are the course offer in you suggested an Interdisciplinary approach ?

Excellent	Good	Average	Poor
✓			

7. How far the courses relevant in terms of job opportunities and research further studies?

Excellent	Good	Average	Poor
	✓		

8. Rate the course as per their communication skill and attitude:

Excellent	Good	Average	Poor
✓			

Chandan Giri
Signature of Student

Signature of H.O.D
Dr. Kalipada Maity
Associate Professor of Mathematics
Mugberia Gangadhar Mahavidyalaya

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 24 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**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO 6
Questionier	Q1, Q3, Q5	Q1, Q4, Q6	Q1, Q7, Q5	Q1, Q5, Q6	Q2, Q4, Q8	Q1, Q6, Q3	Q1, Q5, Q9	Q1, Q10, Q5	Q1, Q4, Q8	Q2, Q6, Q10	Q1, Q6, Q9	Q1, Q3, Q8	Q1, Q7, Q10
Average Rating	3	3	2.8	2.3	2.6	2.45	3	2.2	2.8	2	2.8	3	3

MUGBERIA GANGADHAR MAHAVIDYALAYA, MUGBERIA 721425

DEPARTMENT OF MATHEMATICS

The following list of students from 2018-2019 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
AMITAVA PATRA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. M.Sc. in Applied Mathematics
CHANDAN GIRI	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
CHAYAN PRADHAN	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
DEBOTTAM JANA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
DIBYAYAN JANA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
GOPAL DAS	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
MANISH ACHARYYA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
MOUMITA SAHOO	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
AMIT MANDAL	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
ANKITA SAMANTA	Mugberia Gangadhar Mahavidyalaya	Midnapore College(Autonomous)	M.Sc. in Applied Mathematics
ASHARANI MANNA	Mugberia Gangadhar Mahavidyalaya	University of Gour Banga	M.Sc. in Applied Mathematics
BISWAJIT PATRA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics

MADHUSHREE SAHU	Mugberia Gangadhar Mahavidyalaya	Vidyasagar University	M.Sc. in Applied Mathematics
MANAS BERA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
MOUMITA PRADHAN	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
NANDAN MAITY	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
PURNENDU MONDAL	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
SAGNIK MAIKAP	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
SAPTASREE BHATTACHARYA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
SUJOY KUMAR MANDAL	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
SUMAN KALYAN DAS	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
SWAPAN MAITY	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics
TANUSRI ROY	Mugberia Gangadhar Mahavidyalaya	Service	Service
GURUPADA JANA	Mugberia Gangadhar Mahavidyalaya	Mugberia Gangadhar Mahavidyalaya	M.Sc. in Applied Mathematics

The report is prepared by Mr. Bikash Panda, SACT Dept of Mathematics.

20/08/2019

Dr. Kalipada Maity

HOD & Associate Professor

Dept of Mathematics

20.08.2019

Dr. Swapan Kumar Misra

Principal

Mugberia Gangadhar Mahavidyalaya

Principal
Mugberia Gangadhar Mahavidyalaya

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