MUGBERIA GANGADHAR MAHAVIDYALAYA
P.O.–BHUPATINAGAR, Dist.–PURBA MEDINIPUR, PIN.–721425, WEST BENGAL, INDIA
NAAC 4th Cycle Re-Accredited 'A' Level Govt. Aided College
CPE (Under UGC XII Plan) & NCTE Approved Institutions
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DEPARTMENT OF MATHEMATICS, MUGBERIA GANGADHAR MAHAVIDYALAYA, BHUPATINAGAR, PURBA MEDINIPUR-721425

PROGRAMME OUTCOME (PO), COURSE OUTCOME (CO) AND PROGRAMMESPECIFIC OUTCOME (PSO) FOR END SEMESTER STUDENTS POSTGRADUATE COURSE: 2023-2024

Programme Name: M.SC(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, makes effective presentation to develop other branches of sciences, to think existing open programme in mathematics using C –language, MATLAB, Lingo software. Also Study skill development Course on LaTeX

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 appropriate questions are formed on related fields.

PROGRAMME SPECIFIC OUTCOME:

PSO1: Thinking every topic 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, and 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: 2023-24

CO21: (MTM-401-Functional Analysis)

CO21:1: Idea about Normed Space, fundamental properties of Normed Space, bounded linear transformation B(X,Y), Banach Space, Hahn- Banach Extension Theorem.

CO21:2: Idea about Conjugate Space, Reflexive Spaces, Uniform Roundedness Principle, Closed Graph theory, Open Mapping Theorem. Fundamental concept of Inner Product Space, orthonormal Basis, Varies properties of Inner Product Space and related theorem like Parallelogram law, Cauchy-Schwarz inequality, Projection Theorem.
Learn about weak and strong convergence.

CO22: (MTM-402.1- Fuzzy Mathematics with Application, MTM402.2-Soft Computing)

CO22:1: Define fuzzy sets, α-cuts, fuzzy complements.Discuss of operations on fuzzy sets, fuzzy numbers,Illustrate fuzzy relations, binary fuzzy sets, fuzzy number, fuzzy equivalence relations.State some application on fuzzy set.

CO22.2: Learnsoft computing, fuzzy logic, Genetic Algorithm, Neural networks, Application of fuzzy logic concepts in scientific problems, Solution of optimization problems using Genetic Algorithm. Neural Network approaches in scientific analysis, design, and diagnostic problems.

CO23: (MTM-403.1: Magneto Hydro-Dynamics, MTM-403.2: Stochastic Process and Regression)

CO23:1:Learn about Maxwell's electro magnetic field equations when medium in motion. Lorentz's force. To know about the equations of motion of a conducting fluid. Basic equations. Simplification of the electro magnetic field equation. Magnetic Reynolds number. Alfven theorem. Magnetic body force. Ferraro's law ofIsorotation . Laminar Flow of a viscous conducting liquid between parallel walls in transverse magnetic fields. M.H.D. Flow. Understanding past a porous flat plate without induced magnetic field. MHD Couelte Flow under different boundary conditions, Magneto hydro dynamics waves.

CO23.2: Concept of Markov chains with finite and countable state space and classification of states.Understanding of random walk, Gambler's ruin problem. Markov processes in continuous time. Poisson's process partial correlation. Multiple correlation. Advanced theory of linear estimation.

CO24: (MTM-404B Special Paper-OR: Nonlinear Optimization)

CO24.1:-To know the non-linear programming problem the nature of optimization and scope of the theory (Farka's Theorem, Existence Theorem etc.).To know about Quadratic Programming, Geometric Programming and Stochastic programming and their problems and solution

CO24.2: Game Theory (bi-matrix game)Learn Legendre and Bessel's equation and find their power series solution.

CO25:MTM-405B(Special Paper-OR: Operational Research Modelling-II)

CO25.1:-Understand the optimal control of functional using calculus of variation technique , learn Pontryagn's principle, Bang Bang Control.

CO25.2: Learn the Concept of reliability and use parallel and series system to get a reliability of machines, age, stress and mission time.Learn Entropy function, Encoding, Decoding, Noiseless Channel, marginal and conditional entropies also.

CO26:(MTM-495Special Paper-OR: Lab. on MATLAB and LINGO)

Able to solve problems on Advanced Optimization and Operations Research by using MATLAB and LINGO software in computer (Simplex Method, Revised Simplex Method, Stochastic Programming, Geometric Programming, Bi-matrix Games, Queuing Theory, Wolfe's Modified Method, IPP by Gomory's Cutting Plane Method, Inventory, Monte Carlo Simulation Technique, Dynamic Programming, Reliability).

CO27:(MTM-406: Dissertation Project Work)

Performance of dissertation Project on Tutorial/Review Work on Research Papers.

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DETAILED SYLLABUS OF ALL SEMESTER PG COURSES

Semester-I

MTM-101 RealAnalysis 50

Complete Metric spaces, compactness, connectedness (with emphasison $\mathbb{R}^n$), Heine-BorelTheorem,Separableandnon-separable metricspaces.

Functionsofboundedvariation,R-S Integral.

Measurablesets.ConceptofLebesguefunction.Innerandoutermeasure.It'ssimpleproperties.Setofmeasurezero.Cantor set,Borel setand theirmeasurability, Non-measurablesets.

Measurablefunction:Definitionandit'ssimpleproperties,Borelmeasurablefunctions,sequence of measurable functions, Statement of Lusin's theorem, Egoroff's theorem. Simplefunctionsand it's properties.

Lebesgue integral on a measurable set: Definition. Basic simple properties. Lebesgue integralof a bounded function over a set of finite measure. Simple properties. Integral of non-negativemeasurablefunctions,GeneralLebesgueintegral.Boundedconvergencetheoremforasequenceof Lebesgue integrable function, Fatou's lemma. Classical Lebesgue dominated convergencetheorem. Monotone convergence theorem, Relation between Lebesgue integral and Riemannintegral

References:

1. W.Rudin,PrinciplesofMathematicalAnalysis,3rd ed.,McGraw-Hill.
2. W.Rudin,RealandComplex Analysis,InternationalStudentEdition,McGraw-Hill.
3. T.Apostol,MathematicalAnalysis, 2nd ed.,NarosaPublishers.
4. S.Kumaresan, TopologyofMetricSpaces, 2nded.,NarosaPublishers.
5. InderK.Rana,AnIntroductiontoMeasureandIntegration(2nded.),NarosaPublishingHouse,NewDelhi.
6. P.R.Halmos,MeasureTheory,GraduateTextinMathematics,Springer-Verlag.
7. H.L.Royden,RealAnalysis,3rded.,Macmillan.

Learning Outcomes of the course:

Upon successful completion of this course, the students will learn the following:

1. Verify whether a function is a function of bounded variation and find the R-S integral of a bounded function.
2. Know the measurability of a set, integrability of any function and the Monotone convergence theorem.
3. Understand the fundamentals of measure theory and be acquainted with the proofs of the fundamental theorems underlying the theory of integration.
4. They will develop a perspective on the broader impact of measure theory and have the ability to pursue further studies in this and related area.
5. Explain the concept of length, area, volume using Lebesgue's theory.
6. Apply the general principles of measure theory and integration in such concrete subjects as the theory of probability or financial mathematics.

MTM-102 ComplexAnalysis 50

The definition of an analytic function. Cauchy- Riemann differential equation. Construction ofanalytic function. Jardan arc. Contour. Rectifiable arcs. Cauchy's theorem. Cauchy's integralformula.Morer'stheorem.Liouville'stheorem.Taylor'sandLaurent'sseries.Maximummodulusprinciple.

Residues and Poles:Isolated Singular Points, Residues, Cauchy's Residue Theorem ,ResidueatInfinity,TheThreeTypesofIsolatedSingularPoints,ResiduesatPoles,ZerosofAnalytic Functions, ZerosandPoles,BehaviorofFunctionsNearIsolatedSingular

Application of Residues: Evaluation of Improper Integrals, Improper Integrals from FourierAnalysis, Jordan's Lemma, Indented Paths, An Indentation Around a Branch Point, IntegrationAlong a Branch Cut, Definite Integrals Involving Sines and Cosines, Argument Principle,Rouch´e'sTheorem,Inverse LaplaceTransforms

MappingbyElementaryFunctions:LinearTransformations,Mappingsby1/z,LinearFractionalTransformations,AnImplicitForm, Mappingsof the UpperHalfPlane,The Transformationw = sin z, Mappings by z^2 and Branches of $z^{1/2}$, Square Roots of Polynomials, Riemann SurfacesConformalMapping:PreservationofAngles,ScaleFactors,LocalInverses,HarmonicConjugates,TransformationsofHarmonicFunctions,TransformationsofBoundaryConditions,The Schwarz–Christoffel Transformation: Mapping the Real Axis Onto a Polygon, Schwarz–ChristoffelTransformation, Trianglesand Rectangles, DegeneratePolygons.

References:

1. ComplexVariableandApplications,J.W.BrownandR.V.Churchill,8thEdition,GcGrawHill.
2. FoundationsofComplex Analysis,S.Ponnusamy,Narosa,1995.

Learning Outcomes of the course:

Upon successful completion of this course, the students will learn the following:

1. What is multi-valued function and difference from the definition of single-real valued function?
2. How the residue theorem can be applied to calculate some of the improper as well as definite integrals.
3. Mapping by different elementary functions
4. What is conformal mapping and how it can be applied to some of the fluid dynamics problem.
5. What is analytic continuation?

MTM-103 OrdinaryDifferentialEquationsandSpecialFunctions 50

Differentialequation:Homogeneouslineardifferentialequations,Fundamentalsystemofintegrals,Singularityofalineardifferentialequation,Solutionintheneighbourhoodofasingularity, Regular integral, Equation of Fuchsian type, Series solution by Frobenius method.Hypergeometricequation.Hypergeometricfunctions,Seriessolutionnearzero,oneandinfinity,Integralformulaforthehypergeometricfunction,Differentiationofhypergeometricfunction,Theconfluenthypergeometricfunction,Integralrepresentationofconfluenthypergeometricfunction.

Legendre equation: Legendre functions, Generating function, Legendre functions of first kindand second kind, Laplace integral, Orthogonal properties of Legendre polynomials, Rodrigue'sformula,Schlaefli's integral.

Bessel equation: Bessel function, Series solution of Bessel equation, Generating function,IntegralsrepresentationsofBessel'sfunctions,Hankelfunctions,Recurrencerelations,Asymptoticexpansion of Bessel functions.

Green'sFunction:Green'sFunctionanditsproperties,Green'sfunctionforordinarydifferentialequations,Application to BoundaryValue Problems.

EigenValueProblem:OrdinarydifferentialequationsoftheStrum-Liouvilletype,PropertiesofStrumLiouvilletype,ApplicationtoBoundary ValueProblems,EigenvaluesandEigenfunctions,Orthogonalitytheorem, Expansion theorem.

SystemofLinearDifferentialEquations:SystemsofFirstorderequationsandtheMatrixform,Representation of nth order equations as a system, Existence and uniqueness of solutions ofsystemofequations, Wronskian of vectorfunctions.

References:

1. G.F.Simmons:DifferentialEquations,TMHEdition,NewDelhi,1974.
2. M.S.P.Eastham:TheoryofOrdinaryDifferentialEquations,VanNostrand,London,1970.
3. S.L.Ross:DifferentialEquations(3rdedition),JohnWiley&Sons,New York,1984.

Learning Outcomes of the course:

Upon successful completion of this course, the students will learn the following:

1. Three important topics of ODEs such as the Sturm-Liouville problem, Green‟s function and systems of linear differential equations.
2. On solving the SL problem, a broad idea can be carried on eigen value and eigen function which helps a lot to solve real-life problems.
3. Green's function approach for solving complex initial and boundary value problems involving differential equations.
4. Modelling real-life problems as a system of linear differential equations and its solution method.
5. Learners achieve the overall concept for solving system of differential equations which have a great impact to extract the solutions for real-life problems.
6. The three important special functions such as Hypergeometric differential equation, Legendre differential equation, Bessel's function and their properties.
7. Learners mainly achieve the solution procedure of special type differential equations which have many applications in engineering design problems and these are more related with real-life complex problems also

MTM-104 AdvancedProgramminginCand MATLAB 50

Programming in C: Review of basic concepts of C programming**,** Arrays, structureand union, Enum, pointers, pointers and functions, pointers and arrays, array ofpointers, pointers and structures, strings and string handling functions, Dynamicmemory allocation: using of malloc(), reallc(), calloc() and free(), file handlingfunctions: use of fopen, fclose, fputc, fgets, fputs, fscanf, fprintf, fseek, putc, getc,putw,getw,append,lowlevelprogrammingandCpreprocessor:Directive,#define,MacroSubstitution,conditionalcompilation, #if,#ifdef,#ifndef,#else, #endif.

ProgramminginMATLAB:TheMatlabworkspace,datatypes,variables,assignment statements, arrays, sets, matrices, string, time, date, cell arrays andstructures, introduction to M – file scripts, input and output functions, conditionalcontrolstatements,loop controlstatements,break, continueand returnstatements.

References:

1. Kernighan BW,RitchieDM.TheCprogramminglanguage.2006.
2. BalagurusamyE. programminginANSIC. Tata McGraw-Hill Education;2012.
3. ByronGottfriedandJitenderChhabra,ProgrammingwithC(Schaum'sOutlinesSeries),2017
4. GilatA.MATLAB:an IntroductionwithApplications.NewYork:Wiley; 2008.
5. PalmIIIWJ.IntroductiontoMATLABfor Engineers.NewYork:McGraw-Hill;2011.
6. ChapmanSJ.MATLABprogrammingwithapplicationsforengineers.CengageLearning;2012.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,studentswilllearnthefollowing:

1. ThefeaturesofnumericcomputationadvancedgraphicsandvisualizationusingMATLAB.
2. Arraysandmatricestosolvethevarioustypesofproblemssuchasalgebraic,differential,statistical,plottingetc usingMATLAB.
3. Pointersinfunction,structure,union,dynamicmemorymanagementtoconstructlinkedlistusingC Language.
4. Pointersinfunction,structure,union,dynamicmemorymanagementtoconstructlinkedlistusingC Language.

MTM-105 ClassicalMechanicsandNon-linearDynamics 50

Motion of a system of particles. Constraints. Generalized coordinates. Holonomic and non-holonomic system. Principle of virtual work. D'Alembart's Principle. Lagrange's equations.Plane pendulum and spherical pendulum. Cyclic co-ordinates.Coriolis force. Motion relativeto rotatingearth.

Principle of stationary action. Hamilton's principle. Deduction of Lagrange from Hamilton'sprinciple.Brachitochroneproblem.Lagrange'sequationsfromHamilton'sprinciple..Invariancetransformations.Conservationlaws. Infinitesimaltransformations.Space-timetransformations.

Hamiltonian. Hamilton's equations. Poisson bracket. Canonical transformations. Liouville'stheorem.
Small oscillation about equilibrium. Lagrange's method. Normal co-ordinates. Oscillationsunder constraint. Stationary character of a normal mode. Small oscillation about the state ofsteadymotion.Normalcoordinates
Orientation and displacement of a rigid body. Eulerian angles. Principal axis transformation.Eulerequations of motion.Motion of afreebodyabout a fixed point.
Special theory of relativity in Classical Mechanics:-Postulates of special relativity. Lorentztransformation.ConsequencesofLorentztransformation.Forceandenergyequationsinrelativisticmechanics.
Nonlinear Dynamics: Linear systems. Phase portraits: qualitative behavior.Linearization at afixed point. Fixed points. Stability aspects. Lyapunov functions (stability theorem). Typicalexamples.Limitcycles.Poincare-Bendixsontheory.Bifurcations.Differenttypesofbifurcations.

References:

1. H.Goldstein,*ClassicalMechanics,*Addison-Wesley,Cambridge,1950.
2. A.S.Gupta,*CalculusofVariationswithApplications*,Prentice-HallofIndia,NewDelhi,2005.
3. B.D.GuptaandS.Prakash,*ClassicalMechanics*,KedarNathRamNath,Meerut,1985.
4. T.W.B.Kibble,*ClassicalMechinics*,OrientLongman,London,1985.
5. N.C.RanaandP.S.Joag,*ClassicalMechanics*,TataMcGraw-HillPublishingCompanyLimited,NewDelhi, 2004.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentscandothefollowing:

1. The student will able to apply the Lagrangian formalism to analyze problems in Mechanics;dissect and describe the dynamics of systems of particles, rigid bodies, and systems in noninertialreferenceframes.
2. The student will deconstruct complex problems into their building blocks. Translate physicalproblems into appropriate mathematical language and apply appropriate mathematical tools toanalyze and solvethe resultingequations.
3. Students will demonstrate the ability to apply basic methods of classical mechanics towardssolutions of various problems, including the problems of complicated oscillatory systems, themotionof rigid bodies, etc.

MTM-106 GraphTheory 25

Basic graph theoretical concepts: paths and cycles, connectivity, trees, spanning subgraphs,bipartite graphs, Hamiltonian and Euler cycles. Distance and centre, Cut sets and cut vertices.Colouring and matching. Four colour theorem (statement only). Planar graphs, Dual graph.Directed graphs and weighted graphs. Matrix representation of graphs, Algorithms for shortestpathandspanningtrees,Intersectiongraph,Applicationsof graphsinoperationsresearch.

References:

1. West,D.B. (2001).*Introductionto graphtheory*, UpperSaddleRiver: Prenticehall.
2. Deo,N.(2017).*Graphtheorywithapplicationstoengineeringandcomputerscience*.CourierDover Publications.
3. Chartrand,G.(2006).*Introductiontographtheory*.TataMcGraw-HillEducation.
4. Gross,J.L.,&Yellen, J.(2005). *Graphtheoryand itsapplications*.CRCpress.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Understandandapplythefundamentalconceptsingraphtheory.
2. Modellingof real-lifeproblemsusingtheconceptsof graph theory.
3. Conceptofthe graph,tree,Eulergraph, planar graph, cutsetandCombinatorics. Solvingcapabilityfor solvingpractical problemsinscience,businessandindustry

MTM-197 Lab.1:(ComputationalMethods:UsingMATLAB) 25

Problem:20marks;Lab. NoteBookandViva-Voce:5.

Workingwithmatrix:Generatingmatrix,Concatenation,Deletingrowsandcolumns.Symmetric matrix, matrix multiplication, Test the matrix for singularity, magic matrix. Matrixanalysis using function: norm, normest, rank, det, trace, null, orth ,rref, subspace, inv, expm,logm,sqrtm,funm. Array:Addition,Subtraction,Element-by-elementmultiplication,Element-by-elementdivision,Element-by-element left division, Element-by-element power. Multidimensional Arrays, CellArrays,Characters and Text in array,
GraphPlotting:PlottingProcess,CreatingaGraph,GraphComponents,FigureTools,Arranging Graphs Within a Figure, Choosing a Type of Graph to Plot, Editing Plots, PlottingTwo Variables with Plotting Tools, Changing the Appearance of Lines and Markers, AddingMore Data to the Graph, Changing the Type of Graph, Modifying the Graph Data Source,AnnotatingGraphs forPresentation, ExportingtheGraph.
Using Basic Plotting Functions: Creating a Plot, Plotting Multiple Data Sets in One Graph,Specifying Line Stylesand Colors, Plotting Lines and Markers, Graphing Imaginary andComplexData,AddingPlotstoanExistingGraph,FigureWindows,DisplayingMultiplePlotsinOneFigure,Controllingthe Axes, AddingAxisLabels and Titles,SavingFigures.
Programming:ConditionalControl–if,else,switch,LoopControl–
for,while,continue,break,ErrorControl – try, catch, Program Termination–return.
ScriptsandFunctions:Scripts,Functions,TypesofFunctions,GlobalVariables,PassingStringArgumentstoFunctions,TheevalFunction,FunctionHandles,FunctionFunctions,Vectorization,Preallocation.
LinearAlgebra:SystemsofLinearEquations,InversesandDeterminants,Factorizations,Powersand Exponentials, Eigenvalues, SingularValues.
Polynomials:PolynomialfunctionsintheMATLAB®environment,RepresentingPolynomials,EvaluatingPolynomials,Roots,Derivatives,Convolution,PartialFractionExpansions,PolynomialCurveFitting, CharacteristicPolynomials.

References:

1. GilatA.MATLAB:an IntroductionwithApplications.NewYork:Wiley; 2008.
2. Palm IIIWJ.IntroductiontoMATLABforEngineers.NewYork:McGraw-Hill;2011.
3. ChapmanSJ.MATLABprogrammingwithapplicationsforengineers.CengageLearning;2012.
4. LopezC.MATLABprogrammingfornumericalanalysis.Apress;2014.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Theinteractiveexamplesandhands-onproblem-solvingtechniques.
2. Theutilityof basic MATLABand its demonstration.
3. Vectorandmatrixmanipulations,plottingoffunctionsanddata,solutionODEanditsgraph,andthe creation ofuser interfaces, etc.
4. Applicationsinvariousdisciplinessuch asengineeringscienceandeconomics.

Semester –II

MTM-201 Fluid Mechanics 50

Compressible/Incompressible flow, Newtonian/Non-Newtonian fluids, Rotational/irrotationalflows, Steady/Unsteady Flow, Uniform/Non uniform Flow, One, Two or three DimensionalFlow, Laminaror TurbulentFlow), Preliminaries for the derivation of governing equation(Coordinate systems: Lagrangian description and Eulerian description)Models of the flow(Finite Control Volume andInfinitesimal Fluid Element),Substantial Derivative, Source ofForces)

DerivationofGoverningEquations:DerivationofContinuityEquation,DerivationofMomentum Equation, Special case (Incompressible Newtonian Fluid), Physical interpretationofeach term, Derivation ofEnergyEquation, BoundaryConditions.

Boundary Layer Theory: Prandtl's Concept of Boundary Layer, Boundary Layer Flow along aFlat Plate, Governing Equations, Boundary Conditions , Exact Solution of the Boundary-LayerEquationsforPlaneFlows (SimilaritySolution, Vorticity, Stress).

Exact/AnalyticalSolutionofNavier-StokesEquation**:**Reynoldsnumber,Non-dimensionalization,ImportanceofReynoldsnumbertoNavier-StokesEquation,ExactSolutionofNavier-StokesEquation(Couette-Poisseuilleflow,FlowofaViscousFluidwithFreeSurfaceonanInclined Plate)

Incompressible Viscous Flows via Finite Difference Methods: Variable arrangement (Cellcenter / Colocated arrangement orStaggered Gird), One-Dimensional Computations by FiniteDifferenceMethods,Spacediscretisation(SimpleandgeneralmethodsbasedonTaylor'sseriesfor first, second, and fourth order accuracy, and hence Accuracy of the Discretisation Process),Time discretization(Explicit Algorithm, Implicit Algorithm, and Semi-implicit Algorithm),Solutionof Couette flow usingFTCSand Crank-Nicolson methods.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Thegeneral conceptof what isfluid and itsproperties, anddifferentkinds offlows.
2. Preliminaries(substantialderivative,differenttypesofforces,etc)forthederivationof governingequation forfluid flow.
3. DerivationofGoverningEquations(Continuity,Navier-StokesandEnergy)inamathematicalflavour.
4. Implementationof Initial andBoundaryConditionsforthegoverningequations.
5. ExactSolutionoftheNavier-StokesEquationinsomeofthespecialcases,like,Couette-Poisseuilleflow.
6. Calculatemomentumandthermalboundarylayerthickness,thefrictionofforceonthe plate,flowrate,point ofseparation andreattachment,governingequations forboundarylayer flows
7. Scaling theequationsofmotionand tosee therole of nonlinear terms intheNavier-Stokesequation,derivation ofReynolds averageNavier-Stokes (RANS) equation.

MTM-202 NumericalAnalysis 50

Cubicsplineinterpolation.Lagrange'sbivariateinterpolation.Approximationoffunction.Chebyshev polynomialMinimaxproperty.Curvefittingby leastsquaremethod.Useoforthogonalpolynomials.Economization ofpowerseries Numericalintegration:Newton-Cotesformulae-opentype.GaussianquadratureGauss-Legendre,Gauss-ChebyshevIntegration byMonteCarlo method.

Rootsofpolynomialequation:Bairstowmethod.Solutionofasystemofnon-linearequationsby fixed point method and Newton-Raphson methods. Convergence and rate of convergence.Solutionofasystemoflinearequations:Matrixinverse.LUdecompositionmethodSolution oftri-diagonalsystem ofequationsIll-conditioned linearsystems Relaxationmethod.

Eigenvalueproblem.Powermethod.Jacobi'smethod.Solution of ordinary differential equation: Runge-Kutta method to solve a system of equationsand second order IVP. Predictor-corrector method: Milne's method. StabilitySolution ofsecondorder boundaryvalue problem byfinite differenceand finiteelement methods.Partial differential equation: Finite difference scheme. Parabolic equation: Crank-Nicolsonmethod.Iteration methodtosolve Elliptic and hyperbolicequations.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Interpolationusingsplineinterpolation.
2. Approximationofafunction usingtheleast square method,orthogonal polynomials.
3. IntegrationusingGaussianquadrature.
4. SolutionofordinarydifferentialequationsusingRK-methods,predictor-correctormethod,finitedifferencemethod,the finite elementmethod.
5. Solutionofasystemoflinearandnon-linear equationsandmatrixinversionwithpivoting.
6. Computationoftheeigenvaluesandeigenvectorsofamatrix.
7. Solution of the partial differential equations (finite difference method) and analysis of stabilityofthe methods to solve ODEs and PDEs.
8. Student will understand the theory behind these methods. The programming skill will increaseafter this course and hence they can write computer programs of any mathematical and logicalproblems.

MTM-203 Unit-1:AbstractAlgebra 25

Groups: Morphism of groups. Quotient groups. Fundamental theorem on homomorphism ofgroups.Isomorphismtheorems.Automorphism.Solvablegroups andtheoremson them.
Directproduct.Conjugacy. Conjugateclasses.Classequation.Theoremsonfinitegroups.Cauchy's theorem. Sylow's theorem. Application of Sylow's theorem, Simple groups,Permutationgroups, Cayleytheorem, Groupactions.
Rings and Field: Integral domain. Fields. Skew fields. Quotient rings. Morphism of rings.Ideals(Primeandmaximal).Isomorphismtheorem.Euclideandomain.Principalidealdomain.Uniquefactorizatio n domain. Polynomial rings.
Field extensions, Finite, algebraic and finitely generated field extensions, Classical ruler andcompass constructions, Splitting fields and normal extensions, algebraic closures. Finite fields,Cyclotomicfields, Separable and inseparableextensions.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Analyze anddemonstrateexamplesofsolvablegroupsandtheirpropertiesofthem.
2. Understandthe importanceof fieldextension.
3. Analyzeanddemonstrate examplesof theclassicalrulerandcompassconstructions,normalextensionsand separableextensions.
4. Understandthe Galois group ofafield extension.

Unit-2: Linear Algebra25

Review of Linear transformations and matrix representation of Linear transformation, Linearoperators, Isomorphism, Isomorphism theorems, Invertibility and change of coordinate matrix,Thedual space, Minimal polynomial,Diagonlization.
CanonicalForms:Triangularcanonicalform,Nilpotenttransformations,Jordancanonicalform,Therational canonical form.
Inner product spaces, Hermitian, Unitary and Normal transformations, Spectral theorem.Bilinearforms,SymmetricandSkew-symmetricbilinearforms,Sylvester's lawofinertia.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Theconceptofalineartransformation,innerproductspace,bilinearforms,quadraticforms,canonicalfor ms, minimal polynomial and Jordan canonicalforms.
2. Diagonalisationprocessofalinearoperator.
3. Adetailsunderstandingofinner-productspace,dualspace and quotientspace.
4. Acompleteideaaboutbilinearform.

MTM-204B HISTORY OF MATHEMATICS 50

Ancient Mathematical Sources, Mathematics in Ancient Mesopotamia, The Numeral Systemand Arithmetic Operations, Geometric and Algebraic Problems, Mathematical Astronomy,MathematicsinAncientEgypt,Geometry,AssessmentofEgyptianMathematics,Greek Mathematics,TheDevelopmentofPureMathematics,ThePre-EuclideanPeriod,TheElements,The Three Classical Problems, Geometry in the 3rd Century BCE, Archimedes, Apollonius,AppliedGeometry,LaterTrendsinGeometryandArithmetic,GreekTrigonometryandM ensuration, Number Theory, Survival and Influence of Greek Mathematics. Mathematics inthe Islamic World (8th–15th Century), Origins, Mathematics in the 9th Century, Mathematicsinthe10thCentury,OmarKhayyam,IslamicMathematicstothe15thCenturyTheFounda tionsof Mathematics : Ancient Greece to the Enlightenment, Arithmetic or Geometry, Being VersusBecoming,Universals,TheAxiomaticMethod,NumberSystems,TheReexaminationofInfinit y,CalculusReopensFoundationalThePhilosophyofMathematics:MathematicalPlatonism,Traditio nalPlatonism,NontraditionalVersions,MathematicalAnti-Platonism,Realistic Anti-Platonism, Nominalism, Logicism, Intuitionism, and Formalism, MathematicalPlatonism:ForandAgainst,TheFregeanArgumentforPlatonism,TheEpistemological Argument,Against Platonism.

Learningoutcomesofthecourse:Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Ageneralideaoftheevolutionofsome ofthe majorconceptsofmodernmathematics.

2. Understandbasic,fundamentalargumentsthatweredevelopedcenturiesagoandarestillofcentralimportancetoday.

Stress: Body force. Surface forces. Cauchy's stress principle. Stress vector. State of stress at apoint.Stresstensor.Thestressvector–stresstensorrelationship.Forceandmomentequilibrium.Stresstensorsymmetrystressquadricof Cauchy.Stresstransformationlaws.Principalstress.Stressinvariant. Stress ellipsoid.

Strain:DeformationGradients.DisplacementGradientDeformationtensor.Finitestraintensors.Small deformation theory-infinitesimal strain tensor. Relative displacement. Linear rotationtensor. Interpretation of the linear strain tensors. Strength ratio. Finite strain interpretation.Principal strains. Strain invariant. Cubical dilatation . Compatibility equation for linear strain.Strain energy function. Hook's law. Saint –Venant's principal. Airy's strain function. Isotropicmedia.Elasticconstrains.Moduliofelasticityofisotropicbodiesandtheirrelation.Displacementequation ofmotion. Waves inisotropic elastic media.

Perfectfluid:Kinematicsoffluid.Lagrangianmethod..Eulerianmethod.Acceleration.Equationof continuity. The boundary surface..Stream lines and path lines. Irrotational motion and itsphysical interpretation. Velocity potential. Euler's equation of motion of an in viscid fluid.Cauchy's integral. Bernoulli's equation. Integration of Euler's equation. Impulsive motion offluid.Energyequation.Motionintwodimensions.ThestreamfunctionsComplexpotential.

Source, sink and doublet and their images. Milne-Thompson circle theorem and its application.Vorticity.Flowandcirculation.Kelvin'scirculationtheorem.Kelvin'sminimumenergytheorem.

References:

1. ContinuumMechanics:T.J.Chung,Prentice–Hall.
2. Continuum Mechanics: Schaum's Outline of Theory and Problem of ContinuumMechanics:GedrgeR. Mase, McGraw Hill.
3. Mathematical Theory of Continuum Mechanics: R.N.Chatterjee, Narosa PublishingHouse.

ContinuumMechanics:A.J.M.Spencer,Longman

Learning outcomes of the course:

Upon successful completion of this course, the students will learn the following:

1. The concept of strain deformation of an object as a continuum which assumes that the substance of the object completely fills the space it occupies.
2. The knowledge about stress vector which is applied on material points in an object.
3. The relationship between strain tensor and stress tensors in an elastic substance.
4. Fundamental physical laws such as the conservation of mass, the conservation of momentum, and the conservation of energy to be applied to such models to derive differential equations describing the behavior of such objects, and some information about the particular material studied to be added through constitutive relations.

MTM-206 General Topology 25

TopologicalSpaces:opensets,closedsets,neighborhoods,basis,sub-basis,limitpoints,closures, interiors, continuous functions, homeomorphisms. Examples of topological spaces:subspacetopology,producttopology,metrictopology,ordertopology,Quotient Topology.
Connectedness and Compactness: Connected spaces, connected subspaces of the real line,Componentsandlocalconnectedness,Compactspaces,Local–compactness,Tychnoff'sTheoremon compact spaces.
Separation Axioms: 1st and 2nd countable spaces, Hausdorff spaces, Regularity, CompleteRegularity,Normality.
UrysohnLemma,UrysohnMetrizationTheorem, TietzeExtensiontheorem(statementonly).

References:

1. J.R.Munkres,Topology,2nd Ed.,PearsonEducation(India).
2. M.A.Armstrong, BasicTopology,Springer (India).
3. K.D.Joshi,IntroductiontoGeneralTopology,NewAge International,NewDelhi.
4. G.F.Simmons,IntroductiontoTopologyandModernAnalysis,McGraw-Hill,NewYork.
5. J.L.Kelley,GeneralTopology,Van Nostrand,Princeton.

Learning outcomes of the course:

Upon successful completion of this course, students will learn the following:
1. How the topology on a space is determined by the collection of open sets, by the collection of closed sets, or by a basis of neighbourhoods at each point.
2. Subspace topology, order topology, product topology, metric topology and quotient topology.
3. What it means for a function to be continuous?
4. Urysohn Lemma and the Tietze extension theorem and can characterize metrizable spaces.

MTM-301 PartialDifferentialEquations andGeneralizedFunctions 50

Differential Equations: First order PDE in two independent variables and the Cauchyproblem. Semi-linear and quasilinear equations in two-independent variables. Second orderlinear PDE. Adjoint and self-adjoint equations. Reduction to canonical forms. Classifications.Fundamentalequations: Laplace, Waveand Diffusionequations.

Hyperbolic equations: Equation of vibration of a string. Existence. uniqueness and continuousdependenceofthesolutionontheinitial conditions.Methodofsepearationofvariables.D'Alembert's solution for the vibration of an infinite string. Domain of dependence.Higher-dimensionalwaveequations.

Elliptic equations: Fundamental solution of Laplace's equations in two variables. Harmonicfunction. Characterization of harmonic function by their mean value property. Uniqueness.Continuous dependence and existence of solutions. Method of separation of variables for thesolutions of Laplace's equations. Dirichlet's and Naumann's problems. Green'sfunctions forthe Laplace's equations in two dimensions. Solution of Dirichlet's and Naumann's problem forsometypical problemslike adisc andasphere.Poisson's general solution.

Parabolic equations:Heat equation- Heat conduction problem for an infinite rod- Heatconductionin a finite rod-existenceand uniqueness of the solution.

GeneralizedFunctions:Diracdeltafunctionanddeltasequences.Testfunctions.Linearfunctionals.Regularandsingulard istributions.Sokhoski-Plemeljformulas.Operationsondistributions. Derivatives. Transformation properties of delta function. Fourier transform ofgeneralizedfunctions.

References:

1. Y.PinchoverandJ.Rubinstein,AnIntroductiontoPartialDifferentialEquations,Cambridge UniversityPress.
2. F.John,PartialDifferential Equations,3rd ed.,NarosaPubl.Co.,NewDelhi.
3. L.C.Evans,PartialDifferentialEquations,GraduateStudiesinMathematics,Vol.19,AMS,Providence.
4. E.Zauderer,PartialDifferentialEquationsofAppliedMathematics,2nded.,JohnWileyandSons, New York.
5. S.Rao,IntroductiontoPartialDifferentialEquations,3rdEdition,PHILearning PrivateLimited,NewDelhi.

J.J. Duistermaatand J.A. C. Kolk,DistributionsTheoryand Applications, Birkhauser

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Usetheknowledgeoffirstandsecondorderpartialdifferentialequations(PDEs),thegeneralstructureof solutions, and analyticmethods forsolutions.
2. ClassificationofPDEs, analyticalmethods, andphysicallyinterpretationof thesolutions.
3. SolutionofstandardPDEs(Wave,Heat&Laplaceequations)usingseparationofvariablesandAnalyset he stabilityandconvergenceproperties ofthis method.
4. FindingthesolutionofDirichlet'sandNeumann'sproblemsforsometypicalproblemslikeaDiscan d asphere.
5. Usetheknowledgeoffirstandsecondorderpartialdifferentialequations(PDEs),thegeneralstructureof solutions, and analyticmethods forsolutions.
6. ClassificationofPDEs, analyticalmethods, andphysicallyinterpretationof thesolutions.

MTM-302 TransformsandIntegral Equations 50

Fourier Transform: Fourier Transform, Properties of Fourier transform, Inversion formula,Convolution, arseval's relation, Multiple Fourier transform, Bessel's inequality, Application oftransformto Heat,WaveandLaplaceequations(Partial differentialequations).

Laplace Transform: Laplace Transform, Properties of Laplace transform, Inversion formula ofLaplace transform (Bromwich formula), Convolution theorem, Application to ordinary andpartialdifferential equations.

WaveletTransform: Time-frequencyanalysis,Multi-resolutionanalysis,Splinewavelets,Sealingfunction,Short-timeFouriertransforms,Waveletseries,Orthogonalwavelets,Applicationsto signal and imageprocessing.

IntegralEquation: FormulationofintegralequationsIntegralequationsofFredholmandVolterra type, Solution by successive substitutions and successive approximations, ResolventKernel Method, Integral equations with degenerate kernels, Abel's integral equation, IntegralEquations of convolution type and their solutions by Laplace transform, Fredholm's theorems,Integral equations with symmetric kernel, Eigen value and Eigen function of integral equationandtheirsimple properties, Fredholm alternative.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Understandingofintegraltransformation,suchasLaplace,FourierandWavelettransforms.
2. SolutionofODEandPDE, particularlyIVPor BVP, usingintegraltransformation.
3. Determinationofthe exact locationofthesolution using Wavelettransforms.
4. Formationandsolutionmethod ofintegralequations.
5. Solutionmethodofdynamicalproblemsandappliedbasedpracticalproblemsusingintegralequations.

MTM-303 Unit-1:DynamicalOceanologyandMeteorology 25

DynamicalOceanology:PropertiesofSeaWaterrelevanttoPhysicalOceanography:Measurementofdensity,temperatureandsalinity,Relativedensity,sigma-tandspecificvolume,Densityand specificvolumeas functions of temperature,salinityand pressure;The Basic Physical Laws used in Oceanography and Classifications of Forces and Motions intheSea: Basiclaws, Classifications of forces andmotions;TheEquationofContinuityofVolume:Theconceptofcontinuityofvolume,Thederivationofth eequation ofcontinuityofvolume.he Equation of Motion in Oceanography: The form of the equation of motion, Obtainingsolutions to the equations, including boundary conditions, The derivation of the terms in theequation of motion, The pressure term,Transforming from axes fixed in space to axes fixed intherotating earth,Gravitation and gravity,TheCoriolis terms,Other accelerations.

Dynamical Meteorology:Dynamical Meteorology: Composition of Atmosphere, AtmosphericStructure,BasicThermodynamicsoftheatmosphere,Poisson'sEquation,Potentialtemperature, Equation of state of dry air,hydrostatic equation, variation of Pressure withaltitude,hypsometricequation,dryadiabaticlapserate,Equationofmoistair,Virtualtemperature,mixingratio ,specifichumidity,absolutehumidityandrelativehumidity,fundamentalatmospheric forces, derivation of momentum equation of an air parcel in vectorandCartesian form, Geostrophic wind and Gradient wind.

References:

1.Introductory Dynamical Oceanology, 2nd Ed, Pond, Stephen; Pickard, George L.,Butterworth-HeinemannLtdLinacreHouse, JordanHill,Oxford 0X28DP

Learningoutcomesofthecourse: Uponsuccessfulcompletionofthiscourse,studentswilllearnthefollowing:

1. Different thermodynamics laws are applied in the atmosphere to get a state of dry and moist airintheatmosphere.
2. Theunderstandingofthebasicphysicalprocessesoccurringintheatmosphereinamathematicalperspective.
3. Measurement formulaoftheheightinthe atmosphere.
4. Measurementofhumidityvariables.
5. Stabilityanalysis of theatmosphere.

MTM-305BSpecialPaper-OR:AdvancedOptimizationandOperationsResearch50

Revised simplex method (with and without artificial variable). Modified dual simplex.LargeScale LinearProgramming:DecompositionPrincipleofDantzigandWolf.

Parametricandpost-optimalanalysis:Changeintheobjectivefunction.Changeintherequirementvector,Additionofavariable,Additionofaconstraint,Parametricanalysisofcostandrequirement vector.

SearchMethods:Fibonacciand goldensectionmethod.Gradient Method: Method of conjugate directions for quadratic function, Streepest descent andDavodon-Fletcher-Powellmethod.Methodsoffeasibledirectionandcuttinghyperplanemethod.

Integer Programming: Gomory's cutting plane algorithm, Gomory's mixed integer problemalgorithm,A branchandbound algorithm.Goal Programming: Introduction, Difference between LP and GP approach, Concept of GoalProgramming, Graphical solution-method of Goal Programming, Modified simplex method ofGoalProgramming.OptimizationforSeveralVariables:Algebraicapproach,Algebraicgeometricalapproach,costdifferentapproach,Inequalityapproach.

References:

1. S.S. Rao. *Engineering optimization: theoryand practice*. John Wiley&Sons, 2009.
2. Taha,HamdyA.*Operationsresearch:An introduction*.PearsonEducationIndia,2004.
3. Belegundu,AshokD.,andTirupathiR.Chandrupatla.*Optimizationconceptsandapplicationsin engineering*. CambridgeUniversityPress, 2011.

Sharma,S.D.OperationsResearch,KedarNathRamNath&Co.,Meerut

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Identificationanddevelopmentofoperationalresearchmodelsfromtheverbaldescriptionofthereal system.
2. Understandingthemathematical toolsthat areneeded tosolve optimizationproblems.
3. Useof mathematical softwareto solve theproposedmodels.
4. Development of report that describes the model and the solving technique, analyse the resultsand propose recommendations in language understandable to the decision-making processes inmanagementengineering.

MTM-306BSpecialPaper-OR:OperationalResearchModelling-I50

DynamicProgramming:Introduction,Natureofdynamicprogramming,Deterministicprocesses, Non-Sequential discrete optimization, Allocation problems, Assortment problems,Sequential discrete optimization, Long-term planning problem, Multi-stage decision process,ApplicationofDynamic Programminginproduction schedulingand routingproblems.

Inventory control:Probabilisticinventory control(withandwithoutleadtime),Dynamicinventory models. Basic concept of supply – chain management and two echelon supply chainmodel.

Network: PERT and CPM: Introduction, Basic difference between PERT and CPM, Steps ofPERT/CPMTechniques,PERT/CPMNetworkcomponentsandprecedencerelationships,Critical path analysis, Probability in PERT analysis, Project Time-Cost, Trade-off, Updating oftheproject, Resourceallocation — resourcesmoothingandresourceleveling.

ReplacementandMaintenanceModels:Introduction,FailureMechanismofitems,Replacementof items deteriorates with time, Replacement policy for equipments when value of moneychanges with constant rate during the period, Replacement of items that fail completely—individual replacement policy and group replacement policy, Other replacement problems — staffingproblem, equipment renewal problem.

Simulation:Introduction,Stepsofsimulationprocess,Advantagesanddisadvantagesofsimulation, Stochastic simulation and random numbers— Monte Carlo simulation, Randomnumber,Generation,Simulationof InventoryProblems,SimulationofQueuingproblems,Roleofcomputers in Simulation, Applications of Simulations.

References:

1. Taha,HamdyA.Operationsresearch:Anintroduction.PearsonEducationIndia,2004.

Learningoutcomesofthecourse:

Uponsuccessfulcompletionofthiscourse,thestudentswilllearnthefollowing:

1. Inventorymanagementtechniquesin deterministicandprobabilisticenvironments.
2. Understandingofnetworkoptimizationtechniques.
3. Analysis ofnetworkusingCPM and PERT.
4. Understandingoftheprojecttime-cost,trade-off,updatingoftheprojectandresourceallocationtechniques.

MTM 401: Functional Analysis Credits 04

Course Content:

(a) Normed spaces , Continuity of linear maps , Bounded linear transformation. Set of all bounded linear transformation ,Banach space Quotioent of normed linear spaces and its consequences. Hahn-Banach Extension theorem and Its applications ,BanachSpaces. A NLS is Banachiff every absolutely convergent series is convergent. Conjugate spaces, Reflexive spaces.

(**b**) Uniform Boundedness Principle and its applications. Closed Graph Theorem, Open Mapping Theorem and their applications.Inner product spaces, Hilbert spaces, Orthonormal basis, Complete Orthonormal basis ,Cauchy-Schwarz Inequality, Parallelogram law. Projection theorem ,Inner product is a continuous operator. Relation betweenIPS and NLS. Bessel's inequality. Parseval's identity.

(**c**)Strong and Weak convergence of sequence of operators. Reflexivity of Hilbert Space. Riesz Representation theorem for bounded linear functional on a Hilbert space. Definition of self-adjoint operator, Normal, Unitary and Positive operators, Related simple theorems.

MTM 401:Unit-1: Fuzzy Mathematics with Applications :Credit 02

Course Content:

Basic concept and definition of fuzzy sets. Standard fuzzy sets operations and its properties.

Basic terminologies such as Support, α-Cut, Height, Normality, Convexity, etc. Fuzzy relations, Properties of α-Cut, Zadeh's extension principle, Interval arithmetic, Fuzzy numbers and their representation, Arithmetic of fuzzy numbers. Basic concept of fuzzy matrices. Basic concepts of fuzzy differential equations.

Linear Programming Problems with fuzzy resources:

(i) Vendegay's approach

(ii) Werner's approach

L.P.P. with fuzzy resources and objective: Zimmermann's approach. L.P.P. with fuzzy Parameters in the objective function. Definition of Fuzzy multiobjective linear programming problems.

Unit-2: Soft ComputingCredit 02

Course Content:

Introduction of soft computing, fuzzy logic, Genetic Algorithm, Neural networks, Application of fuzzy logic concepts in scientific problems, Solution of optimization problems using Genetic Algorithm. Neural Network approaches in scientific analysis, design, and diagnostic problems.

MTM-403 : Unit-1: Magneto Hydro-Dynamics Credit 02

Course Content:

Maxwell's electromagnetic field equations when medium in motion. Lorentz's force. The equations of motion of a conducting fluid. Basic equations. Simplification of the electromagnetic field equation. Magnetic Reynolds number. Alfven theorem. Magnetic body force. Ferraro's law of Isorotation. Laminar Flow of a viscous conducting liquid between parallel walls in transverse magnetic fields. M.H.D. Flow Past a porous flat plate without induced magnetic field. MHD Couelte Flow under different boundary conditions, Magneto hydro dynamics waves. Hall currents. MHD flow past a porous flat plate without induced magnetic field.

Unit-2: Stochastic Process and Regression Credit 02

Course Content:

Stochastic Process: Markov chains with finite and countable state space. Classification of states. Limiting behaviour of n state transition probabilities. Stationary distribution.Branching process. Random walk. Gambler's ruin problem. Markov processes in continuous time. Poisson's process Partial correlation. Multiple correlations. Advanced theory of linear estimation.

MTM-404B Special Paper-OR: Nonlinear Optimization Credit-04

Course content:

Optimization:The nature of optimization and scope of the theory, The optimality criterion of Linear programming, An application of Farka's theorem, Existence theorem for linear systems, Theorems of the alternatives, Slater's theorem of alternatives, Motzkin theorem of alternatives, Optimality in the absence of differentiability and constraint qualification, Karlin's constraint qualification, Kuhn-Tucker's saddle point necessary optimality theorem, Fritz-John saddle point optimality theorem, Optimality criterion with differentiability and Convexity, Kuhn-Tucker's sufficient optimality theorem, Fritz-John stationary point optimality theorem, Duality in non-linear programming, Weak duality theorem, Wolfe's duality theorem, Duality for quadratic programming. Quadratic Programming ,Wolfe's modified simplex method, Beale's method, Convex programming. Stochastic Programming ,Chance constraint programming technique. Geometric Programming ,Geometric programming (both unconstrained and constrained) with positive and negative degree of difficulty. Games:Preliminary concept of continuous game, Bi-matrix games, Nash equilibrium, and solution of bi-matrix games through quadratic programming (relation with nonlinear programming). Multi-objective Non-linear Programming:Introductory concept and solution procedure.

MTM-405B Special Paper-OR: Operational Research Modelling-II Credit-02

Course Content:

Optimal Control:Performance indices, Methods of calculus of variations, Transversally

Conditions, Simple optimal problems of mechanics, Pontryagin's principle (with proof assuming smooth condition), Bang–bang Controls. Reliability:Concept, Reliability definition, System Reliability, System Failure rate, Reliability of the Systems connected in Series or / and parallel. MTBF, MTTF, optimization using reliability, reliability and quality control comparison, reduction of life cycle with reliability, maintainability, availability, Effect of age, stress, and mission time on reliability. Information Theory:Introduction, Communication Processes— memory less channel, the channel matrix, Probability relation in a channel, noiseless channel. A Measure of information- Properties of Entropy function, Measure of Other information quantities marginal and joint entropies, conditional entropies, expected mutual information, Axiom for an Entropy function, properties of Entropy function. Channel capacity, efficiency and redundancy. Encoding-Objectives of Encoding. Shannon-Fano Encoding Procedure, Necessary and sufficient Condition for Noiseless Encoding.

MTM-495B Special Paper-OR: Lab. (OR methods using MATLAB andLINGO) Credit -02

Course Content:

Problems on Advanced Optimization and Operations Researchare to be solved by using

MATLAB (one question carrying 9 marks) and LINGO (one question carrying 6 marks)

(Total: 15 Marks)

1. Problems on LPP by Simplex Method.

2. Problems on LPP by Revised Simplex Method.

3. Problems on Stochastic Programming.

4. Problems on Geometric Programming.

5. Problems on Bi-matrix Games.

6. Problems on Queuing Theory.

7. Problems on QPP by Wolfe's Modified Method.

8. Problems on IPP by Gomory's Cutting Plane Method.

9. Problems on Inventory.

10. Problems on Monte Carlo Simulation Technique.

11. Problems on Dynamic Programming.

12. Problems on Reliability.

MTM-406 :Dissertation Project Work **Credit-04**

Course Content

Dissertation Project will be performed on Tutorial/ Review Work on ResearchPapers. For Project Work one class will be held in every week. Marks are divided as the following: Project Work-25, Presentation-15, and Viva-voce-10. Project Work of each student will be evaluated by the concerned internal teacher/supervisor and one External Examiner. The external examiner must be present in the day of evaluation.

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MAPPING OF CO, PO, PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO21.1	✔	✔				✔	✔		✔			✔	
CO21.2	✔	✔			✔			✔		✔		✔	
CO22.1	✔	✔		✔			✔		✔			✔	
CO22.2	✔	✔		✔			✔	✔	✔		✔		
CO23.1	✔	✔		✔				✔		✔	✔		
CO23.2	✔	✔		✔			✔		✔		✔		
CO24.1	✔	✔			✔			✔	✔				✔
CO24.2	✔	✔				✔	✔	✔				✔	
CO25.1	✔	✔			✔		✔		✔		✔		
CO25.2	✔	✔	✔			✔		✔		✔			
CO26	✔	✔		✔				✔		✔	✔		
CO27	✔	✔			✔		✔		✔		✔		

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

	Mapping	Correlation	Justification
CO21.1	PO1	HIGH	Acquire knowledge on how functional analysis uses and unifies ideas from vector spaces,

			the theory of metrics, and complex analysis.
	PO2	HIGH	Students make questioning and reasoning to enrich in theory of normed and Banach-spaces, including the Hahn-Banach theorem, the Uniform Boundedness principle.
	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 courses.
	PSO2	HIGH	Students will able to Identify critical problems related tothe theory ofnormed and Banachspaces, including the Hahn-Banach theorem,
	PSO5	HIGH	Student realize to evaluate the problemofthe open mapping theorem, the closed graph theorem,
CO21.2	PO1	HIGH	Students will able to obtain vast fundamental knowledge of theory of Hilbert spaces to other areas, including Fourier series,the theory of self-adjoin operator
	PO2	HIGH	Student learn about the questioning on normal operators, unitary operators and positive Operator.
	PO5	HIGH	Student apply knowledge on bounded linear transformation in self directed way.
	PSO1	MODERATE	Students will think the topics of the Hilbert space theory, including Riesz representation theorem and weak convergence,
	PSO3	LOW	Student realize how tocritically reflect over chosen strategies and methods in problem solving.
	PSO5	HIGH	Student will able to understand the Uniform Boundedness principle by mathematical& statistical method
CO22.1	PO1	HIGH	Students will able to obtain vast fundamental knowledge of fuzzy sets, numbers, matrix, knowledge of various operations on above fuzzy sets.
	PO2	HIGH	Student learn about the questioning on the fuzzy ordinary differential equation, fuzzy linear programming problems, and fuzzy multi-objective linear programming problems.
	PO4	HIGH	Students apply the knowledge of fundamental uncertain programming solving skill which occur almost all decision making problem
	PO7	HIGH	Student able to think in advance topics related this subject and improve research skill
	PSO2	HIGH	Students able to he problems and analyze to find information correctly in this course
	PSO5	HIGH	Students acquired more detailed knowledge about the problem of this course by mathematical& statistical method
CO22.2	PO1	HIGH	Students learn the concept.the basic concepts Soft computing like how it resemble biological processes more closely than traditional techniques.
	PO2	HIGH	Acquire knowledge of questioning and reasoning onthe fuzzy logic and system control.
	PO3	HIGH	Students will able to build their interdisciplinary pathway by choosing genetic algorithm and hands on solving optimization problems.
	PSO1	MODERATE	Students will able to think critical problems related to this course.
	PSO2	HIGH	To help the learners for solving complex mathematical modeling of various real-life practical problems.

	PSO4	HIGH	Student will able to identify and formulate the basic neural network models and illustrate with numerical examples.
CO23.1	PO1	HIGH	Students acquired sound and sufficient knowledge the basic concepts and the equations of flow of viscous fluids and the electromagnetic induction mechanism..
	PO2	HIGH	To understand how to make appropriate questions and reasoning in ability to translate a magnetic hydrodynamic problem in an appropriate mathematical form and to interpret the solutions of the equations established in physical terms.
	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 Skills in analysis and synthesis; the application of knowledge and problem solving,critical thinking and independent learning.
CO23.2	PO1	HIGH	Obtain knowledge on basic concepts from the theory of Markov chains
	PO2	HIGH	Acqrire knowledge about critical reasoning and questioning in Poisson processes and birth and death processes. The student also knows about Wiener Process and branching process
	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 derive the expression for three or more dimensional curve fitting, including multiple and partial correlations for relevant practical systems of metric space in a unique way
CO24.1	PO1	HIGH	Obtain concepts on Non-linear Optimization such as Geometric Programming, Quadratic Programming, Nash Equilibrium, Bimatrix Game, Stochastic Programming, Multi-Objective Programming
	PO2	HIGH	Students make questioning and reasoning to enrich in specific subject
	PO5	HIGH	Students apply the knowledgefor solving complex mathematical modeling of various real-life practical problemsinself 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
CO24.2	PO1	HIGH	Acquire knowledge on tackling of random parameters in optimization problems through stochasticprogramming
	PO2	HIGH	Students make questioning and reasoning to enrich in Bimatrix Game, Stochastic Programming
	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.Multi-objective Non-linear Programming.

	PSO5	HIGH	Student realize to evaluate the problem of this course by mathematical& statistical method
CO25.1	PO1	HIGH	Obtain clear concept to Prepare and motivate future specialists to continue in their study by having an insightful overview of operations research.
	PO2	HIGH	Students make questioning and reasoning to enrich in Understand the technique to solve the problem using Optimal Control theory.
	PO5	MODERATE	Students gather the knowledge of Pontryagin's principle and Bang–bang Controls to solve mechanical and other real life problems 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 Optimal Control in a unique way.
CO25.2	PO1	HIGH	Students obtain a vivid knowledge thorough understanding of reliability of a component and a system of components.
	PO2	HIGH	Acquire knowledge of questioning and reasoning onEntropy and its measurement and properties
	PO3	MODERATE	Students will able to build their interdisciplinary pathway by choosing Reliability and Information Theory.
	PO6	HIGH	Students will able to identify problems, solve using constructive reasoning on this course.
	PSO1	HIGH	Students will able to think critical problems Shannon-Fano Encoding procedure and necessary and sufficient condition for noiseless encoding
	PSO3	MODERATE	Student realize how to evaluate the problems of this course by figures and models
CO26	PO1	HIGH	Learn vividly about Collecting data from different sources for the real-life optimization problems
	PO2	HIGH	To understand how to make appropriate questions and reasoning of the programming.
	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	HIGH	Student realize how to evaluate the problem by figures and models of this course
	PSO4	MODERATE	Student will able to identify and formulate the problems and learners will handle the real-life application of optimization problemsin a unique way
CO27	PO1	HIGH	Obtain clear concept to demonstrate appropriate referencing and develop skills in other aspects of academic writing.
	PO2	HIGH	Identify key research questions within the field of Demography on which students will carry out independent research.
	PO5	HIGH	Apply the demographic/statistical research training acquired in the taught element of the programme by designing an appropriate research strategy and research methodology to carry out research in self directed way.
	PO7	MODERATE	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 demonstrate knowledge and understanding of report writing in a unique way.

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ARTICULATION MATRIX OF CO WITH PO & PSO

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO21.1	3	3				2	3		3			3	
CO21.2	3	3			3			2		3		3	
CO22.1	3	3		3			3		3			3	
CO22.2	3	3		3			3	3	3		3		
CO23.1	3	3		2				3		1	3		
CO23.2	3	3		2			3		3		1		
CO24.1	3	3			3			2	3				3
CO24.2	3	3				2	3	3				3	
CO25.1	3	3			2		1		3		3		
CO25.2	3	3	2			3		3		2			
CO26	3	3		2				3		3	2		
CO27	3	3			3		2		3		3		
Target	3	3	2	2.4	2.7	2.3	2.6	2.7	3	2.3	2.5	3	3

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

Department of Mathematics (UG & PG)

Attainment of Course &ProgrammeOutcomes

(http://www.vidyasagar.ac.in/admission/PGProgrammes.aspx#)

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.

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**
			Assignment Tests	Twice in a semester	**20%**
			Internal Assessment	Twice in a semester	
			Home Assignments	Selected Topic	
			Practical	Weekly	
Assessment	**Direct**	**Internal**	MOCK Practicals	Once in a semester	

Tools		**Tools**	MCQ		
			Seminar/Presentations		
			Mini Projects		
			Preliminary Examination	Once in a semester	
		External Tools	End Semester Examination	Once in a semester	**80%**
			End Semester Practical	Once in a semester	
			End Semester Project	Only one paper(MTM 406) in IV Semester	**100%**
			End Semester Field Visit	Only one paper(MTM 405) in IV Semester	**10%**
	Indirect	**--**	Course Exit Survey/ Examiners' feedback	Once in a Semester	**On Marks Allotted but As Per NAAC / IQAC Guideline**

DIRECT METHOD

Academic Session: 2023-2024(**Semester IV)**

Attainment report for M. SC in Mathematics

Target Level	**Level Description Marks student scoring**	**50 → indicates % and above in the questions in Internal and External tests**
1	Below 40%	
2	**Below 40%-49%**	
3	50% & about	

Student Name	Roll Number	SEM I SGPA	SEM II SGPA	SEM III SGPA	SEM IV SGPA	CGPA	Marks Obtained	Total Marks	% of mark
Amarnath Rana	0001	8.17	8.33	7.67	9.75	8.48	949	1200	79.08
Ayantika Mondal	0003	6.17	5.92	6.50	8.83	6.86	751	1200	62.58
Basudev Maity	0004	7.58	7.92	7.83	9.58	8.23	923	1200	76.92
Chayan Kumar Jana	0005	6.50	8.17	8.50	9.50	8.17	897	1200	74.75
Dipak Paria	0006	6.08	7.33	7.17	9.25	7.46	822	1200	68.50
Hemarjun Datta	0007	7.17	7.58	6.83	9.58	4.49	854	1200	71.17
Lalita Patra	0011	6.25	6.33	6.00	9.17	6.94	763	1200	63.58
Manoj Maity	0012	5.83	6.75	6.67	8.75	7.00	771	1200	64.25
Nayanika Bhunia	0014	7.00	8.58	7.67	9.42	8.17	910	1200	75.83
Puja Sahoo	0016	6.67	8.17	7.67	9.25	7.94	884	1200	73.67
Sampa Bhunia	0018	8.92	7.67	7.50	9.58	8.42	932	1200	77.67
Santu Bera	0019	5.92	7.67	6.17	9.08	7.21	786	1200	65.50
Sayantani Giri	0020	7.50	8.08	8.33	9.50	8.35	935	1200	77.92
Shipra Jana	0021	8.33	9.33	8.83	9.92	9.10	1032	1200	86.00

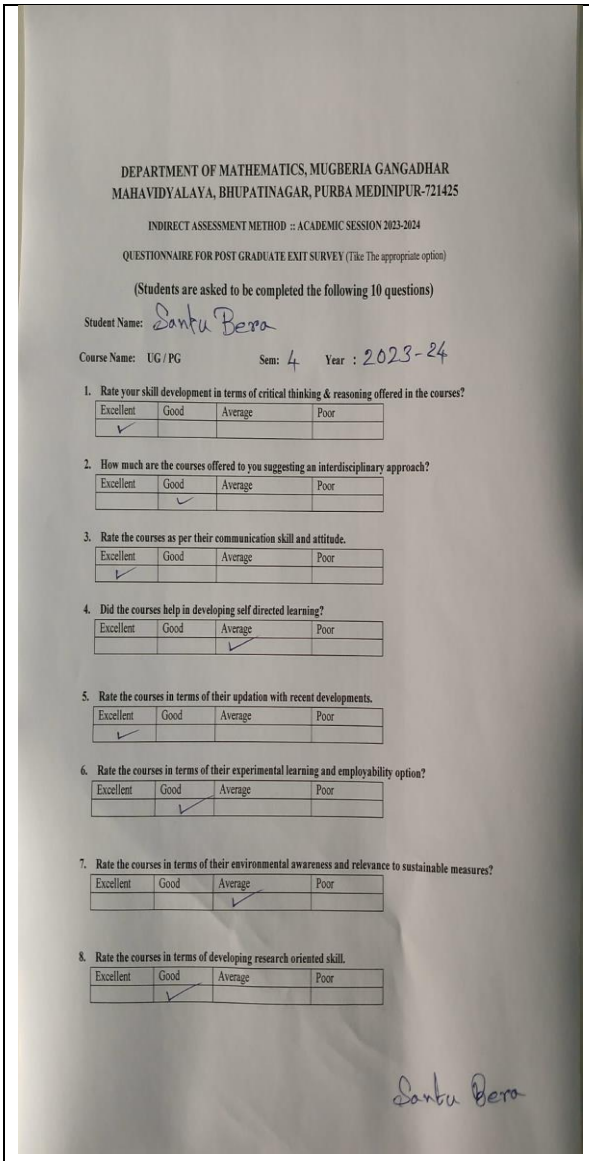
Shubhashree Bishal	0022	5.25	5.58	5.33	8.17	6.08	658	1200	54.83
Soumitra Das	0026	7.75	6.83	6.33	9.08	7.50	830	1200	69.17
Sudipta Hazra	0028	4.92	5.75	5.33	7.67	5.92	643	1200	53.58
SuryadipBarik	0029	6.75	7.75	7.17	9.00	7.67	850	1200	70.83
Ipsita Mishra	0030	5.58	6.83	6.83	8.75	7.00	772	1200	64.33
Sanchayan Laha		8.25	7.17	7.00	8.92	7.84	867	1200	72.25

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

COs, POs &PSOs INDIRECTATTAINMENTINDIRECT METHOD
Academic Session: 2021-2022
Semester IV

Programme Name: M. SC. (MATHEMATICS)

EXIT FORM SURVEY/ EXAMINER'S FEEDBACK IS CONDUCTED THROUGH QUESTIONNAIRE METHODS. OUT OF 10 QUESTIONS, FIRST 7 OF THEM RELATE DIRECTLY TO THE COs &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 2023-2024

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

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

Student Name: Santu Bera

Course Name: UG / PG Sem: 4 Year : 2023-24

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
	✓		

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
		✓	

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
	✓		

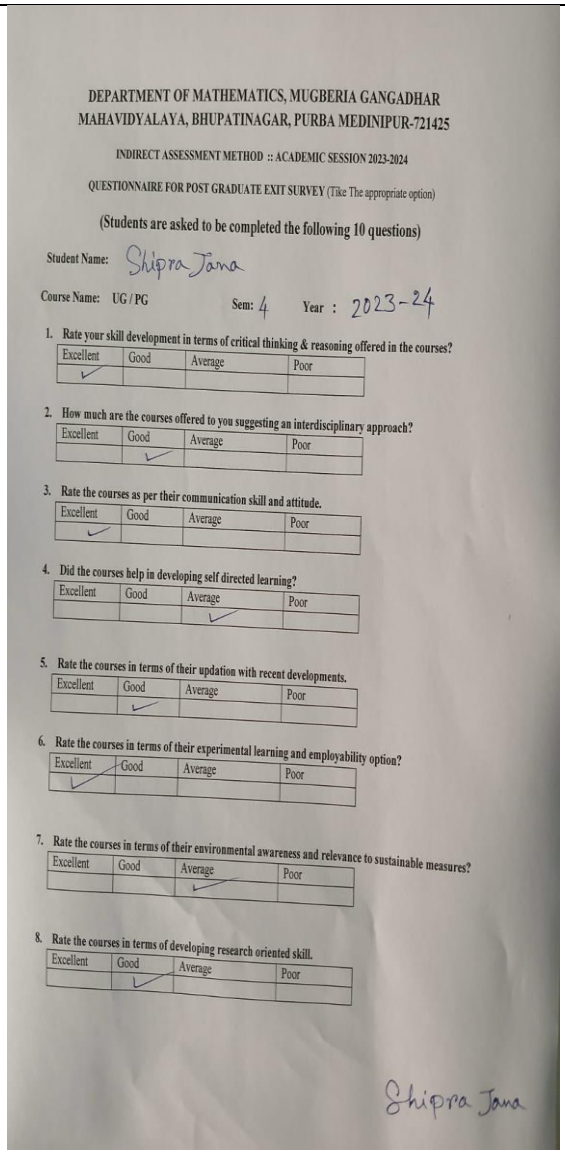
7. Rate the courses in terms of their environmental awareness and relevance to sustainable measures?

Excellent	Good	Average	Poor
		✓	

8. Rate the courses in terms of developing research oriented skill.

Excellent	Good	Average	Poor
	✓		

Santu Bera



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

INDIRECT ASSESSMENT METHOD :: ACADEMIC SESSION 2023-2024

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

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

Student Name: Shipra Jana

Course Name: UG / PG Sem: 4 Year : 2023-24

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
	✓		

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
		✓	

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

Excellent	Good	Average	Poor
	✓		

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

Excellent	Good	Average	Poor
✓			

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

Excellent	Good	Average	Poor
		✓	

8. Rate the courses in terms of developing research oriented skill.

Excellent	Good	Average	Poor
	✓		

Shipra Jana

Programme Name:M. Sc (MATHEMATICS)

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

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 (Out of 38 Students)
1. Did you acquire sound & sufficient knowledge of the courses taught?	**3.7**

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?	**3.5**
4. Rate the courses as per their communication skill and attitude	**3.8**
5. Did the courses help in developing self directed learning?	**3.4**
6. Rate the courses in terms of their updation with recent developments.	**3.3**
7. Rate the courses in terms of their experimental learning and employability option?	**2.7**
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?	**3.9**

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
Questionier	**Q1, Q3, Q2**	**Q1,Q 4,Q5**	**Q1, Q7, Q5**	**Q1, Q5, Q3**	**Q2, Q4, Q9**	**Q1, Q6, Q3**	**Q1, Q5, Q9**	**Q1,Q 10,Q6**	**Q1,Q 4,Q7**	**Q2,Q 6,Q9**	**Q1,Q 6,Q8**	**Q1, Q3, Q8**	**Q1, Q7, Q10**
Average Rating	**3.57**	**3.63**	**3.27**	**3.53**	**3.7**	**3.5**	**3.67**	**3.63**	**3.4**	**3.53**	**3.57**	**3.63**	**3.43**

Mugberia Gangadhar Mahavidyalaya

DEPARTMENT OF MATHEMATICS

FINAL ATTAINMENT OF CO, PO&PSO

PROGRAMME NAME: M.Sc. IN MATHEMATICS

Direct Method: Average COs of all courses

	CO	CO	CO	CO	CO	CO	CO	CO	CO
	21.1, 21.2	22.1	22.2	23.1	23.2	24.1 24.2	25.1 25.2	26	27
Direct Attainment	3	3	3	3	3	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	PSO4	PSO5	PSO6
	1	2	3	4	5	6	7	8	9	10	11	12	13
Indirect Attainment	3.57	3.63	3.27	3.53	3.7	3.5	3.67	3.63	3.4	3.53	3.57	3.63	3.43

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

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

The following list of students from 2023-2024 Batch have taken admission into HEIs for higher studies:

Name of student enrolling into higher education PG Course (2021-2022)	Program Post Graduated from	Name of institution joined	Name of Programme admitted to
Soumitra Das	Department of Mathematics	Gandhari college	B.ED
Sudipta Hazra	Department of Mathematics	Yogodasatsangapalparamahavidyalaya	B.ED
Nayanika Bhunia	Department of Mathematics	Odalchua PTTI& B.ED College	B.ED
Sampa Bhunia	Department of Mathematics	Prabhat Kumar college	B.ED
Dipak paria	Department of Mathematics	Netaji Subhas Primary Teachers Training Institute	B.ED
Sayantani Giri	Department of Mathematics	Netaji Subhas Primary Teachers Training Institute	B.ED
Suryadipbarik	Department of Mathematics	Netaji Subhas Primary Teachers Training Institute	B.ED
Puja sahoo	Department of Mathematics	Gandhari college	B.ED

The above document of COs & POs of Mathematics Departments is original and correct to best of the knowledge.

06/12/24
Bikash Panda
State Aided College Teacher
Dept of Mathematics

06/12/24
Dr. Kalipada Maity
HOD & Associate Professor
Dept of Mathematics

06.12.2024
Dr. Swapan Kumar Misra
Principal
Mugberia Gangadhar Mahavidyalaya

Dr. Kalipada Maity
Associate Professor of Mathematics
Mugberia Gangadhar Mahavidyalaya

Principal
Mugberia Gangadhar Mahavidyalaya

Mugberia Gangadhar Mahavidyalaya
ESTD.-1964
Purba Medinipur
Bhupatinagar