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STRUCTURE OF COURSE OUTCOMES

FOR

M.SC. (FOUR SEMESTER PROGRAMME)

SUBJECT: MATHEMATICS

Shri Lal Bahadur Shastri Degree College, Gonda

Department of Mathematics

NATIONAL EDUCATION POLICY-2020

PROGRAM OUTCOME AND COURSE OUTCOME

FOR

M.SC. (FOUR SEMESTER PROGRAMME)

SUBJECT: MATHEMATICS

Programme Outcomes

An M.Sc. in Mathematics can significantly enhance both students academic knowledge and their career prospects. Here are some key benefits:

1. **Advanced Knowledge and Specialization**: An M.Sc. allows students to delve deeper into specialized areas of mathematics such as algebra, analysis, statistics, applied mathematics, or mathematical modeling. This advanced knowledge can set students apart in the job market and open doors to more specialized career paths.
2. **Research Opportunities**: With a master's degree, students have the opportunity to engage in research, either as part of student's studies or in a professional capacity. This can lead to contributions to academic knowledge or innovative solutions to practical problems.
3. **Career Advancement**: An M.Sc. in Mathematics can qualify students for higher-level positions and roles with greater responsibilities in various fields such as finance, data science, academia, and technology. It can also be a stepping stone to doctoral studies if students are interested in pursuing a Ph.D.
4. **Enhanced Problem-Solving Skills**: The advanced coursework and research involved in an M.Sc. program further hone student's analytical and problem-solving skills, making students more effective in tackling complex issues.
5. **Higher Earning Potential**: Generally, holding a master's degree can lead to higher earning potential compared to just a bachelor's degree. Many specialized roles in finance, technology, and research offer competitive salaries to those with advanced mathematical expertise.
6. **Teaching and Academia**: An M.Sc. can qualify students for teaching positions at colleges and universities, as well as opportunities to engage in academic research. It also provides a solid foundation for pursuing a Ph.D., should students choose to continue in academia.
7. **Industry Demand**: Many industries value the advanced analytical and quantitative skills developed through an M.Sc. in Mathematics. This degree can lead to roles in high-demand fields such as data analysis, actuarial science, operations research, and software development. The practical's in computer programming language such as Python sharpens student availability to think logically. This knowledge plays a very important role in understanding the concepts and techniques of the machine learning course offered by the department.

8. **Professional Development**: The rigorous training and research experience gained during an M.Sc. program can enhance student's critical thinking, project management, and communication skills, which are valuable in many professional settings.
9. **Networking Opportunities**: Graduate programs often provide opportunities to connect with professionals, researchers, and academics in the field of mathematics, which can be valuable for career development and collaboration.
10. **Contributions to Innovation**: Advanced mathematical knowledge enables students to contribute to cutting-edge technologies and innovations, from developing new algorithms to solving complex scientific and engineering problems.

Overall, an M.Sc. in Mathematics offers a deeper understanding of mathematical theories and applications, enhanced career opportunities, and the potential for significant contributions to both academic and practical fields.

Course Outcomes

M.A./M.Sc. I SEMESTER-I), PAPER- I

ADVANCED ABSTRACT ALGEBRA

Course Code: B030701T	**Credit-5 Max.** **Marks: 25+75**	**Core** **paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Advanced Abstract Algebra**	

Course outcomes:

1: The students will be able to define Isotropic groups, solvable groups, cauchy's theorem for finite abelian group.

2: The students will be able to define Maximal subgroups, simple groups, composition series, normal and subnormal series, Jordan-Holder theorem, modules, Schur's leema, Jordan canonical and rational canonical forms.

3: The students will be able to define Field extensions, splitting or decomposition field, normal and seperable field extension, perfect field.

4: The students are able to analyse Galois group, fundamental theorem of Galois group.

5: The student is equipped with standard concepts and tools at advance level that will serve him/her well towards pursuing research in algebra.

M.A./M.Sc.I SEMESTER-I), PAPER- II

ADVANCED REAL ANALYSIS

Course Code: B030702T	Credit-5 Max. Marks: 25+75	Core paper
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Advanced Real Analysis**	

Course outcomes:

1: The students will be able to analyse Sequence and series of functions of real numbers, Uniform convergence.

2: The students will be able to analyse Riemann-Stieltjes integration and their properties, Relation between Riemann and R-S integrals.

3: The students will be able to analyse Functions of several variables, Taylor's theorem, Young's Theorem and Schwarz's theorem.

4: The students will be able to analyse Functions of bounded variation and their properties, Absolutelycontinuous functions and their properties, Relation between absolute continuity and function of bounded variation**.**

M.A./M.Sc.I SEMESTER-I), PAPER- III

Topology

Course Code: B030703T	Credit-5 Max. Marks: 25+75	Core paper
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Topology**	

Course outcomes:

1: The students are able to analyse Topological space, open and closed sets in Topological space, neighborhoods, closure, interior, exterior, derived and dense sets, bases and sub-bases.

2: The students are able to analyse Continuous functions and Homeomorphism, first and second countable spaces and separability.

3: The students are able to understand various concepts like: T_0, T_1, T_2, T_3, T_4 spaces and basic

properties.

4: The students are able to understand various concepts like: Compactness, Connectedness and Tychonoff product topology.

5: It provides the students useful tools for studying local properties of a space. Without the knowledge of topology, it is rather impossible even to conceive the idea of learning mathematics at higher level.

M.A./M.Sc.I SEMESTER-I), PAPER- IV

Mathematical Modelling

Course Code: B030704T	**Credit-5 Max. Marks: 25+75**	**First Elective paper**
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Mathematical Modelling**	

Course outcomes:

1: The **s**tudents will be able to convert a real-world problem into a mathematical model.

2: The **s**tudents will be able to analyse mathematical modelling: need, classification, modelling process, Elementary mathematical models, Role of mathematics in problem solving and Single speciespopulation model.

3: The students will be able to do mathematical modelling through ordinary differential equations of first order and second order and Some applications in economics, ecology, Modelling in epidemiology(SIS, SIR, SIRS models) and basic reproduction number.

4: The students will be able to do mathematical modelling through difference equations, Somesimple models, Basic theory of linear difference equations with constant coefficients.

5: The students will be able to do mathematical modelling through partial differential equations.

M.A./M.Sc.I SEMESTER-I), PAPER- IV

Riemannian Geometry

Course Code: B030705T	**Credit-5 Max. Marks: 25+75**	**First Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**COURSE TITLE: Riemannian Geometry**	

Course outcomes:

1: Students will be able to define Riemannian space, metric, Curvature of a curve, curvature

ofcurve and Geodesic and its applications.

2: Students will be able to define Congruences of curves, Ricci coefficient of rotation, Curvatureof a congruence, Geodesic congruence, normal and irrotational congruence.

3: Students will be able to define congruences and orthogonal ennuples and Ricci's coefficients ofrotation, curvature of congruence.

4: Students will be able to analyse Curvature tensor and Ricci tensor, Bianchi's Identity, Theorem of schur, Projective and Conformal transformation, Weyl's Curvature tensor and Conformal curvaturetensor with their fundamental properties.

5: Students will be able to analyse Hypersurfaces, Meusnier's theorem, Line of curvature**.**

M.A./M.Sc.I SEMESTER-I), PAPER- IV

Fuzzy Sets

Course Code: B030706T	**Credit-5 Max. Marks: 25+75**	**First Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Fuzzy Sets**	

Course outcomes:

1: The **s**tudents will be able to define Fuzzy sets and representations of Membership functions and types of Fuzzy sets.

2: The students will be able to define Fuzzy numbers, Fuzzy cardinality, Fuzzy arithmeticoperations on intervals and Fuzzy equations.

3: Students will be able to analyse Fuzzy relations.

4: Students will be able to define Fuzziness, Shannon Entropy, Fuzzy linear programming problems.

M.A./M.Sc.I SEMESTER-I), PAPER- V

PROGRAMMING IN PYTHON-I

Course Code: B030707P	**Credit-5 Max. Marks: 25+75**	**Second Elective Paper**
Total No. of Lectures-Practicals (in hoursper week) : 4 + 2	**Course Title: PROGRAMMING IN PYTHON-I**	

Course outcomes:

1: The **s**tudents will be able to describe the basic principles of Python programming language.

2: The students will be able to implement object-oriented concepts.

3: The students will be able to making use of software easily right out of the box.

4: The students will be able to experience with an interpreted language.

M.A./M.Sc.I SEMESTER-I), PAPER- V

Computational Techniques using C

Course Code: B030708P	**Credit-5** **Max. Marks: 50 + 50**	**Second Elective Paper**
Total No. of Lectures-Practicals (in hours per week): 4 + 2	**Course Title: Computational Techniques using C**	

Course outcomes:

1: The **s**tudents will be able to learn and use basic principles of C programming language.

2: The students will be able to define and manage various type of data and data- structures basedon problems subject domain.

3: The students will be able to have ability to handle possible errors during program execution.

4: The students will be able to define various types of functions and able to apply various types ofdecision making, statements/loops.

5: The students will be able to able to apply in various fields of Mathematics.

M.A./M.Sc.I (SEMESTER-II), PAPER-I

Analytical Dynamics

Course Code: B030801T	**Credit-5** **Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Analytical Dynamics**	

Course outcomes:

1: The students will be able to classify dynamical systems, and define generalized coordinates,Classification of Dynamical System and D'Alembert's Principle, Lagrange's equations.

2: The students will be able to define Hamilton's canonical equations, Hamilton's principle andprinciple of least action**.**

3: The students will be able to define two-dimensional motion of rigid bodies, Euler's dynamicalequations for the motion of a rigid body about an axis, theory of small oscillations and

examples.

4: The students will be able to define Lagrange Bracket, Poisson Bracket, Canonical Transformation, Jacobi Identity, Hamilton Jacobi Theorem and Poisson's Theorem.

M.A./M.Sc.I (SEMESTER-II), PAPER- II

Theory of Differential Equation and BoundaryValue Problem

Course Code: B030802T	**Credit-5 Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Theory of Differential Equation and BoundaryValue Problem**	

Course outcomes:

1: The students will be able to analyse Laplace's Equation, Harmonic functions, Heat and Wave equationsand their Fundamental solutions.

2: The students will be able to analyse Existence and uniqueness theorem, initial value problems and picardes theorem, Peano's existence theorem and corollaries.

3: The students will be able to analyse Ordinary Differential Equations of Sturm-Liouville boundary valueproblem, Green's function, Poisson representation formula.

4: The students will be able to analyse Application of Laplace transform to solve differential equationsand Fourier transforms to boundary value Problems.

M.A./M.Sc.I (SEMESTER-II), PAPER- III

Measure and Integration

Course Code: B030803T	**Credit-5 Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Measure and Integration**	

Course outcomes:

1 : Students will be efficient to know the measurability of a set calculating meter and inner measure only meter measure gives the measurability of a set. Student will easily classify some measurable and non -measurable sets.

2 : Students will enable themselves to know measurable and non-measurable functions. Countability and measurability of a set is clearly known to students with Boral.

3 : Students will be defined Lebesgue integral, Relation between Riemann integral and Lebesgueintegral, Lebesgue integral of bounded measurable function and it's properties.

4 : The students will be able to analyse L^p-space, some basic definitions and theorem, Holder'sinequality, Minikowski inequality, Schwarz's and Jensen Inequality.

M.A./M.Sc.I (SEMESTER-II), PAPER- IV

HISTORY OF MATHEMATICS

Course Code:B030804T	**Credit-5** **Max. Marks: 25+75**	**Third Elective Paper**
Total No. of Lectures-Tutorials (in hoursper week): 4+1=5	**Course Title: HISTORY OF MATHEMATICS**	
Course outcomes: **1:** The students will be able to know that how the concepts have been developed in Mathematics.		

M.A./M.Sc.I (SEMESTER-II), PAPER- IV

Indian Contribution in Mathematics

Course Code:B030805T	**Credit-5** **Max. Marks: 25+75**	**Third Elective Paper**
Total No. of Lectures-Tutorials (in hoursper week): 4+1=5	**Course Title: Indian Contribution in Mathematics**	
Course outcomes: **1:** The students will be able to know Vedic period and some Indian contribution in Mathematics.		

M.A./M.Sc.I (SEMESTER-II), PAPER- IV

Elementary Statistics

Course Code: B030806T	**Credit-5** **Max. Marks: 25+75**	**Third Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Elementary Statistics**	
Course outcomes: **1:** Students will learn basic concepts of statistics used in various disciplines **2:** Students will be able to study various measures of dispersion like range, mean deviation, quartiledeviation and standard deviation.		

3: Students will be able to analyze and solve various concepts related to probability and probabilitydistributions.

4: Students will be able to learn and use concepts confidence intervals, hypothesis testing, linear Regression.

M.A./M.Sc.I (SEMESTER-II), PAPER- IV

PROGRAMMING IN PYTHON-II

Course Code: B030807P	**Max. Marks: 50 + 50**	**Fourth Elective Paper**
Total No. of Lectures-Practicals (in hoursper week) : 4 + 2	**Course Title: PROGRAMMING IN PYTHON-II**	

Course outcomes:

1: The students will be able to analyze the data by plotting Bar chart/Pie chart/Histogram using Pythonprogramming.

2: The students will be able to solve simultaneous equations by using Python Programming.

3: The students will be able to solve ordinary and partial differential equations by using PythonProgramming.

4: The students will be able to find roots of equations by using different methods with Python programming.

M.A./M.Sc.I (SEMESTER-III), PAPER- I

Functional Analysis

Course Code: B030901T	**Credit-5 Max. Marks: 25+75**	**Core Paper**
Total No. of Lectures-Tutorials (in hours per week): 4+1=5	**Course Title: Functional Analysis**	

Course outcomes:

1: The students will be able to analyse Normed linear space, Banach space.

2: The students will be able to analyse l^n , l_p, l_2 *and* l_∞ Banach spaces, Banach space C(X) , Riesz

P

– Fisher theorem , Continous and Bounded linear Transformation.

3: The students will be able to analyse Isometric Isomarphism, Topological Isomarphism,

Equivalent norm, Riesz- Lemma, Convexity, Hahn- Banach Theorem, Open mapping Theorem, Closed Graph Theorem.

4: The students will be able to analyse Hilbert space, Riesz representation theorem.

M.A./M.Sc.I (SEMESTER-III), PAPER- II

INTEGRAL EQUATIONS

Course Code:B030902T	**Credit-4** **Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (in hoursper week): 4	**Course Title: INTEGRAL EQUATIONS**	

Course outcomes:

1 . Understand the methods to reduce Initial value problems associated with linear differential equations tovarious integral equations.

2 . Categories and solve different integral equations using various techniques.

3 . The students will be able to analyze Fredholm and Volterra integral equations, Solution by the successive approximations, Neumann series and resolvent kernel, equations with convolution type kernels.

4 . The students will be able to analyze and solve the solution of integral equations by transform methods.

M.A./M.Sc.I (SEMESTER-III), PAPER- III

MACHINE LEARNING

Course Code: B030903T	**Credits-4** **Marks: 25+75**	**Core paper**
Total No. of Lectures (in hours per week) –4	**Course Title: MACHINE LEARNING**	

Course outcomes:

1: The students will be able to understand the need for machine learning for various problem solving. **2**: The students will be able to understand a wide variety of learning algorithms and know how to evaluate models generated from data.

3: The students will be able to understand the latest trends in machine learning.

4: The students will be able to identify appropriate machine learning algorithms for general real-world problems and apply these algorithms to solve these problems.

M.A./M.Sc.I (SEMESTER-III), PAPER- III

GENERAL RELATIVITY

Course Code: B030904T	Credits-4 Max. Marks: 25+75	Fifth Elective paper
Total No. of Lectures (in hours perweek) – 4	Course Title: GENERAL RELATIVITY	

Course outcomes:

1: The students will be able to understand metric tensor and Riemannian space.

2: The students will be able to learn Ricci tensor, Bianchi Identities, examples of symmetricspace time.

3: The students will be able to understand Einstein's field equation, gravitational waves in empty space.

M.A./M.Sc.I (SEMESTER-III), PAPER- III

FINSLER GEOMETRY

Course Code: B030905T	Max. Marks: 25+75	Fifth Elective paper
Total No. of Lectures (in hours perweek) – 4	Course Title: Finsler Space	

Course outcomes:

1: The students will be able to analyse Finsler space and homogeneity properties of g_{ij} and C_{ijk}, Geodesics.

2: The students will be able to analyse Fundamental postulates of Cartan, Cartan covariant derivatives, Properties of Cartan covariant derivatives, Berwald's connection, Covariant derivatives of Berwald's and it's properties, Relation between connection coefficients of Cartan and Berwald.

3: The students will be able to find Commutation formulae, The three Curvature tensors of Cartan, Identities satisfied by the Curvature tensors and Bianchi identities.

4: The students will be able to analyse Curvature tensor of Berwald, The Lie-derivatives in a Finsler space and Motion in a Finsler space.

M.A./M.Sc.I (SEMESTER-III), PAPER- IV

Advanced Discrete Mathematics

Course Code: B030906T	**Credit-5 Max. Marks: 25+75**	**Fifth Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Advanced Discrete Mathematics**	

Course outcomes:

1: Understand the basics of combinatorics, and be able to apply the methods from these subjects inproblem solving.

2: Be able to use effectively algebraic techniques to analyse basic discrete structures and algorithms.

3: To provide a formal connection between algorithmic problem solving and the theory of languages andautomata and develop them into a mathematical (abstract) view towards algorithmic design and in general computation itself.

M.A./M.Sc.I (SEMESTER-III), PAPER- V

Introduction to SCILAB /MATLAB

Course Code: B030907P	**Credit-5 Max. Marks: 50 + 50**	**Sixth Elective paper**
Total No. of Lectures-Practicals (in hoursper week): 2+6	**Course Title: Introduction to SCILAB /MATLAB**	

Course outcomes:

1: The students will be able to use SciLab/MATLAB in their mathematical problem solving.

2: The students will be able to use these software in working problems related to polynomials and Linear Algebra.

M.A./M.Sc.I (SEMESTER-III), PAPER- V

Introduction to LaTex

Course Code: B030908P	**Credit-5 Max. Marks: 50+50**	**Sixth Elective paper**
Total No. of Lectures-Practicals (in hours per week): 2+6	**Course Title: Introduction to LaTex**	

Course outcomes:

1: The students will be able to know that how the concepts have been developed in Mathematics.

2: The students will be able to different typesetting Mathematical formulae and equations.

3: The students will be able to typeset in different formats including research paper, report and thesis.

M.A./M.Sc.I (SEMESTER-IV), PAPER-I

Advanced Operation Research

Course Code: B031001T	**Credit-4Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (in hours per week): 4	**Course Title: Advanced Operation Research**	

Course outcomes:

1: Student will be able to define Inventory theory and Models.

2: Student will be able to define Quening theory and its characteristics, stochastic Processes understeady and transient states. Study of M/M/1 and M/M/s quening models and Parametric Linear Programming

3: Student will be able to analyse Network analysis, CPM and PERT.

4: Student will be able to define Game theory and Solution of rectangular game with saddle point, Solution of 2×2 game without saddle point. Graphical method of solution for 2×n and m×2 games.

5: Student will be able to solve Integer Programming problem and Branch and Bound technique.

M.A./M.Sc.I (SEMESTER-IV), PAPER-II

FLUID DYNAMICS

Course Code: B031002T	**Credit-4 Max. Marks: 25+75**	**Core paper**
Total No. of Lectures-Tutorials (inhours per week): 4	**Course Title: FLUID DYNAMICS**	

Course outcomes:

1: The Students will be able to identify the fundamental concepts of Fluid dynamics and their role inmodern mathematics and applied contexts.

2: The Students will be able to apply the Fluid dynamics concepts to diverse situations in physics, engineering, and other mathematical contexts.

M.A./M.Sc.I (SEMESTER-IV), PAPER-III

Special Functions

Course Code: B031003T	**Credit-5 Max. Marks: 25+75**	**Seventh Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Special Functions**	

Course outcomes:

1:Student will be able to define Fundamental System of Integrals, Singularity of a Linear DifferentialEquation. Series solution to Legendre, Bessel differential equations by Frobenius method.

2: Student will be able to define Hermite equation and its solution, Generating function, Rodrigue's formula, Recurrence relations, Orthogonal Properties of Hermite Polynomials.

3: Student will be able to define Lagurre equation and its solution.

4: Student will be able to define Hypergeometric Functions and Series Solution.

M.A./M.Sc.I (SEMESTER-IV), PAPER-III

Differential Geometry of Manifolds

Course Code: B031004T	**Credit-5 Max. Marks: 25+75**	**Seventh Elective paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Differential Geometry of Manifolds**	

Course outcomes:

1: Students will be able to explain the concept of a manifold and give examples.

2: Students will be able to define Connections.

3: Students will be able to define Lie – bracket, Lie – derivative.

4: Students will be able to analyse Riemannian manifold, Riemannian connection, Riemannian curvature tensor, Ricci tensor, scalar curvature, Bianchi identities, constant curvature, definition of Einstein manifold, Geodesic in Riemannian manifold, Projective curvature tensor.

M.A./M.Sc.I (SEMESTER-IV), PAPER-III

Advanced Numerical Methods

Course Code: B031005T	**Credit-5 Max. Marks: 25+75**	**Seventh Elective Paper**
Total No. of Lectures-Tutorials (inhours per week): 4+1=5	**Course Title: Advanced Numerical Methods**	

Course outcomes:

1: Student will be able to solve System of Linear Algebraic Equations, ordinary differential equations,and Partial differential equations.

2: The students will be able to understand and apply various iterative techniques for solving system ofalgebraic equations.

3: The students will be able to analyze the consistency and convergence of a given numerical scheme.

4: The students will be able to demonstrate familiarity with the basics of finite difference methods for thenumerical solution of partial differential equations.