FACULTY OF SCIENCES

SYLLABUS
of
Master of Science (Mathematics)
(Semester I-IV)

(Under Continuous Evaluation System)

Session: 2020-21

The Heritage Institution

KANYA MAHA VIDYALAYA
JALANDHAR
(Autonomous)

Master of Science (Mathematics)
Session :2020 -21
Programme Outcomes

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

PO 1: Solve complex Mathematical problems by critical understanding, analysis and synthesis. Students will also be able to provide a systematic understanding of the concepts and theories of Mathematics and their applications in the real world to enhance career prospects in a huge array of field.

PO 2: Have knowledge of advanced models and methods of mathematics, including same from the research frontiers of the field and expert knowledge of a well defined field of study, based on the international level of research in Maths.

PO 3: To generate skills in independently comprehending, analysing, modelling and solving problems at a high level of abstracts based on logical & structured reasoning.

PO 4: Use computer calculations as a tool to carry out scientific investigation and develop new variants.

PO 5: Use mathematical and statistical techniques to solve well defined problems and present their mathematical work, both in oral and written format.

PO 6: Propose new mathematical linear programming techniques & suggest possible software packages or computer programming to find solution to their questions.

PO 7: Apply the knowledge in modern industry or teaching or secure acceptance in high quality graduate program in maths and other fields such as the field of quantitative/mathematical finance, mathematical computing, statistics and actuarial sciences.

PO 8: Read, Understand construct correct mathematical and use the library and electronic data basis to locate information on mathematical problem.

Master of Science (Mathematics)
Session -2020-21
Program Specific outcomes

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

PSO 1: Develop a deeper and more rigorous understanding of calculus including defining terms and proving theorems about sets, functions, sequences, series, limits, continuity, derivatives, the Riemann integrals, and sequence of functions. The course will develop specialized techniques in problem solving.

PSO 2: Handle mathematical operations, analysis and problems involving complex numbers. Justify the need for a complex number system and explain how it is related to other existing number systems.

PSO 3: Understand the importance of algebraic properties with regard to working within various number systems, demonstrate ability to form and evaluate conjectures.

PSO 4: Apply differential equations to significant applied and/or theoretical problems, to model physical and biological phenomenon by differential equations and dynamical systems.

PSO 5: To describe fundamental properties including convergence, measure, differentiation and integration of the real numbers developing the theory underpinning real analysis, to appreciate how ideas and abstract methods in mathematical analysis can be applied to important practical problems.

PSO 6: To use tensor to describe measured quantities, to formulate and solve physics problems in areas such as stress, elasticity including problems in geometry, to analyze shapes in computer version and other areas of mathematical sciences.

PSO 7: To demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from field extension and Galois theory , to apply problem solving to diverse situations in physics, engineering and other mathematical contexts.

PSO 8: To understand forces linear and circular and their effects on motion, to analyze how a physical system might develop or alter over time and to study the cause of these changes.

PSO 9: Explain fundamental concepts of theory of integral equations, distinguish the difference between differential equations and integral equations, to develop, analyze and solve mathematical models for multidisciplinary problems.

Master of Science (Mathematics)
Semester-I
Session: 2020-21
Course Title: Real Analysis-I
Course Code: MMSL-1331
Course outcomes

After the completion of this course, students should be able to

CO 1: Explain the fundamental concepts of real analysis and their role in modern mathematics.

CO 2: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts of real analysis.

CO 3: Give argument related to convergence, continuity, completeness, compactness, connectedness in metric spaces.

CO 4: Understand and derive proofs of mathematical theorems. This includes understanding the role of axiom, logic and particular proof techniques such as proof by induction, proof by contradiction etc.

CO 5: To perform RS Integration on certain type of functions for carrying out the computation fluently. Also to compute integral by using the fundamental theorem of calculus.

Master of Science (Mathematics)
Semester-I
Session: 2020-21
Course Title: Complex Analysis
Course Code : MMSL-1332
Course Outcomes

Course objectives of Complex Analysis are aimed to provide an introduction to the theories for functions of complex variables. Upon successful completion of this course the student will be able to:

CO1. Justify the need for a complex number system and explain how it is related to other existing number system.

CO2. Define a function of complex variable and carry out basic mathematical operations with complex numbers.

CO3. State and prove the Cauchy Riemann Equation and use it to show that a function is analytic.

CO4. Define singularities of a function, know the different types of singularities and be able to determine the points of singularities of a function.

CO5. Understand the concept of sequences and series with respect to the complex numbers system.

Master of Science (Mathematics)
Semester-I
Session- 2020-21
Course Title: Algebra-I
Course Code : MMSL-1333
Course Outcomes

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

CO 1: Demonstrate understanding of and the ability to work within various algebraic structures.

CO 2: Demonstrate understanding of the importance of algebraic properties with regard to working with various number systems.

CO 3: Effectively write abstract mathematical proofs in a clear and logical manner.

CO 4: Explain the fundamental concepts of finite group theory and finite field theory.

CO 5: Use Lagrange's theorem to analyze the cyclic subgroups of a group.

CO 6: Explain the significance of the notion of a normal subgroup, quotient group and simple group.

CO 7: Use the concepts of homomorphism, isomorphism and automorphism to prove or disprove the given map is a homomorphism, isomorphism or automorphism.

CO 8: State isomorphism theorems and use them to work with quotient groups.

CO 9: Describe the structure of finite abelian group.

CO 10: Use Sylow's theorems to describe the structures of certain finite groups.

CO 11: State the definitions of ring, subring, ideal, ring homomorphism

Master of Science (Mathematics)

Semester-I

Session: 2020-21

Course Title: Mechanics-I

Course Code : MMSL-1334

Course Outcomes

After the successful completion of the course, the students will be able to

CO 1: Determine velocity and acceleration of a particle along a curve , differentiate between radial and transverse components.

CO 2: Apply knowledge of angular velocity in circular motion to explain natural physical process and related technological advances.

CO 3: Understand and define the concept of Newton's law of motion and identify situations from daily life that they can explain with the help of these laws.

CO 4: Define Work, energy, power, conservative forces and impulsive forces.

CO 5: Define and differentiate between uniform acceleration motion, resisted motion, and simple harmonic motion.

CO 6: Solve complex problems related to projectile motion under gravity, constrained particle motion and angular momentum of a particle; define cycloid and its dynamical properties.

CO 7: Manage to solve problems related to reciprocal polar coordinates, pedal coordinates and equation, apply Kepler's law of planetary motion and Newton's law of gravitation in real life problems.

CO 8: Understand the concept of moment of inertia of a rigid body rotating about a fixed point, Momental ellipsoid and coplanar distribution.

Master of Science (Mathematics)
Semester-I
Session:2020-21
Course Title: Differential Equations
Course Code : MMSL-1335
Course outcomes

After studying this course students will be able to

CO 1: Analyse real world scenarios to recognize when ordinary differential equations or system of ordinary differential equations are appropriate and formulate problems about the scenarios.

CO 2: Work with ordinary differential equations and system of ordinary differential equations and use correct mathematical terminology to solve these equations.

CO 3: Express the basic existence theorem for higher order linear differential equations.

CO 4: Perform Laplace Transform in finding the solution of linear differential equations and explain basic properties of Laplace transform and also express the inverse Laplace transform.

CO 5: Perform Fourier Transform in finding the solution of linear differential equations and explain basic properties of Fourier transform and also express the inverse Fourier transform.

CO 6: Solve total differential equations and simultaneous differential equations and will calculate orthogonal trajectories of different curves and will learn Sturm Comparison Theorem and Sturm Separation Theorem and also learn to apply these theorems to solve various problems.

Master of Science (Mathematics)
Semester-II
Session 2020-21
Course Title: Real Analysis-II
Course Code : MMSL-2331
Course Outcomes

After the completion of this program, students should be able to

CO 1: Differentiate between sequence and series of functions and able to solve problems related to uniform convergence and differentiation and use the polynomials to approximate a function.

CO 2: Understand the fundamentals of measure theory which include the topics of outer measure, measurable sets, non-measurable sets, measurable functions.

CO 3: Manage to understand Little wood's three principles and apply Lebesgue Integral on different kind of function and also to make comparison between Riemann Integral and Lebesgue Integral.

CO 4: Demonstrate Differentiation and Integration and Solve Problems related to Absolute Continuity.

Master of Science (Mathematics)
Semester-II
Session 2020-21
Course Title: Tensors and Differential Geometry
Course Code : MMSL-2332
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand tensor variables, metric tensor, contra-variant, covariant and mixed tensors & and able to apply tensors among mathematical tools for invariance.

CO 2: Understand the reason why the tensor analysis is used and explain usefulness of the tensor analysis.

CO 3: Able to explain the concept of theory of space curve, contact between curves and surfaces, locus of centre of curvature, spherical curvature as well as to calculate the curvature and torsion of a curve.

CO 4: Understand the concept of Spherical indicatrix, envelopes, and two fundamental forms, lines of curvature, principal curvature and to calculate the first and second fundamental forms of a surface.

CO 5: Manage to solve problems related to Geodesics curvature, mean curvature, curvature lines, and asymptotic lines.

Master of Science (Mathematics)
Semester-II
Session: 2020-21
Course Title: Algebra-II
Course Code : MMSL-2333

Course Outcomes

After passing this course, the students will be able to:

CO 1: State definitions of important classes of rings associated with factorization: Unique Factorization Domain, Principal Ideal Domain, and Euclidean Domains. Show that a given ring falls into one of these classes (or not). Relate these classes of rings to each other.

CO 2: Explain the notion of an extension of a field.

CO 3: State the definitions of algebraic extension, finite extension, simple extension, separable extensions, splitting field and Galois extension. Identify in specific examples whether an extension satisfies one of these properties.

CO 4: Describe the structure of finite fields.

CO 5: Do computations in specific examples of finite fields.

CO 6: Relate the concept of solvability by radicals to Galois groups.

CO 7: State the definition of constructible point, line and number. Relate constructability to field extension degrees.

CO 8: Check if a given set is a module or not. State the definitions of a sub module and quotient module. Compute with quotient module. State the definitions of module homomorphism's, Isomorphism theorems for modules and apply them where appropriate to analyze structure of modules.

CO 9: Define free module, generating set, cyclic module.

Master of Science (Mathematics)
Semester-II
Session :2020-21
Course Title: Mechanics – II
Course Code : MMSL-2334
Course Outcomes

On the Successful completion of this course, the students will be able to

CO 1: Define general motion of a rigid body, linear momentum of a system of particles, angular momentum of a system, use of centroid, moving origins and impulsive forces.
CO 2: Illustrate the laws of motion, law of conservation of energy and impulsive motion.
CO 3: Manage to solve Euler's dynamical equation for the motion of a rigid body about a fixed point and state the properties of a rigid body motion under no force.
CO 4: Understand the concept of generalized coordinates and velocities, virtual work, generalized forces and solve Lagrange's equation for a holonomic system and impulsive forces.
CO 5: Demonstrate the concept of Kinetic energy as a quadratic function of velocities and equilibrium configuration for conservative holonomic systems.
CO 6: Work and communicate effectively on linear functional, Euler's-Lagrange's equations of single independent and single dependent variable.
CO 7: Recognize Brachistochrone problem, Hamilton's Principle, Principle of Least action, differentiate between Hamilton's Principle and the Principle of Least action.
CO 8: Find approximate solution of BVP using Rayleigh-Ritz Method.

Master of Science (Mathematics)
Semester-II
Session: 2020-21
Course Title: Differential and Integral Equations
Course Code : MMSL-2335
Course Outcomes

On satisfying the requirements of this course, students will have the Knowledge and skills to
CO 1: Apply a range of techniques to find solutions of partial differential equations.
CO 2: Understand basic properties of standard partial differential equations.
CO 3: Demonstrate accurate and efficient use of Fourier analysis techniques and their applications in the theory of partial differential equations.
CO 4: Demonstrate capacity to model physical phenomenon using partial differential equations in particular using the Heat and Wave equations.
CO 5: Apply problem solving using concepts and techniques from partial differential equations and Fourier analysis applied to diverse situations in physics, engineering, financial mathematics and in other mathematical contexts.
CO 6: Have acquired sound knowledge of Green's functions and Fredholm and Volterra integral equations.
CO 7:Perform various techniques to solve homogeneous and non-homogeneous Fredholm and Volterra Integral equations.

Master of Science (Mathematics)

Semester-III

Session:2020-21

Course Title:Functional Analysis-I

Course Code : MMSL-3331

Course outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of normal linear spaces like,$L^{P(n)}l$(infinite), quotient and LP-spaces.

CO 2: This area combines ideas from linear Algebra and analysis in order to handle infinite dimensional reactor spaces and linear mapping theorem.

CO 3: Correlate functional analysis with mathematical physics, partial differential equation, Mathematics and numerical analysis.

CO 4: Demonstrate the open mapping theorem, closed graph theorem and uniform bounded principal.

CO 5: Describe the concept of continuous linear transformation, equation noun and compactness.

Master of Science (Mathematics)

Semester-III

Session:2020-21

Course Title :Topology-I

Course Code: MMSL-3332

Course Outcomes

. Upon successful completion of this course the student will be able to:

CO 1: Demonstrate knowledge and understanding of concepts such as open and closed sets, closure and boundary.

CO 2: Apply theoretical concepts in topology to understand real world application.

CO 3: Will understand the behaviour of sequence in different topological spaces.

CO 4:Create new topological spaces by using subspace and product topologies.

CO 5:Know and understand the concepts related to separation axioms such as T_0, T_1 and, T_2 spaces.

Master of Science (Mathematics)

Semester-III

Session-2020-21

Course Title: Integral Transforms

Course Code: MMSL-3333

Course Outcomes

Having Successfully completed this course the students will be able to:

CO 1: Understand how Integral Transforms can be used to solve a variety of Differential Equations.

CO 2: Understand purpose of Fourier series and Transformation.

CO 3: Know the use of Laplace Transform in Solving Boundary Value Problems.

CO 4: Use Z-Transform in the characterization of Linear Time Invariant System in development of Scientific Simulation algorithms.

CO 5: Recognize the different methods of finding Laplace Transforms and Fourier Transforms of different functions.

CO 6: Apply the knowledge of linear Transforms, Fourier Transforms and Finite Fourier Transforms in finding the solutions of Differential Equations ,Initial value problems and Boundary value problems.

Master of Science (Mathematics)

Semester-III

Session-2020 -21

Course Title: Statistics-I

Course Code: MMSL-3334

Course Outcomes

Upon the successful completion of course, students will be able to:

CO 1: Distinguish between different types of data

CO 2: Interpret examples of methods for summarizing data sets, including common graphical tools such as histogram and summary statistics such as mean median mode and variance.

CO 3: Find the probability of single even and complementary event

CO 4: Contrast discrete and continuous random variable.

CO 5: Apply general properties of expectations and variance.

CO 6: Compute probabilities for Binomial and Poisson distribution

Master of Science (Mathematics)

Semester-III

Session-2020-21

Course Title: Operations Research-I

Course Code: MMSL-3335

Course outcomes

After studying this course students will be able to:

CO 1: Identify and develop operational research models from the verbal description of the real system.

CO 2: Understand the mathematical tools that are needed to solve optimization problems.

CO 3: Identify optimum solutions.

CO 4: Determine better solutions in decision making problems with great speed, competence and confidence.

CO 5: Plan optimum allocation of various limited resources such as men, machines, material, time, money etc. for achieving the optimum goal.

CO 6: Find out a profit plan for the company.

CO 7: Plan, forecast and make rational decisions.

CO 8: Construct linear programming and integer linear programming models and discuss the solution techniques.

CO 9: Apply the Duality concepts to find the solutions of the primal problems.

CO 10: Analyze the transportation and assignment problems and solve those using mathematical models.

CO 11: Explain fundamentals of Dynamic Programming.

Master of Science (Mathematics)
Semester-IV
Session 2020-21
Course Title: Functional Analysis-II
Course Code: MMSL-4331
Course Outcomes

After passing this course, the students will be able to:

CO 1: Understand the concept of strong and weak convergence in finite and infinite dimensional normed linear spaces.

CO 2: Describe the different operator like, adjoint of an operator, self adjoint operator, and unitary operator.

CO 3: Demonstrate how to find the eigen values and egien vectors for finite dimensional spaces.

CO 4: Classify the regular and singular elements.

CO 5: To know the topological division of zeros and formulate for spectral radius.

Master of Science (Mathematics)
Semester-IV
Session 2020-21
Course Title: Topology-II
Course Code : MMSL-4332
Course Outcomes

After passing this course, the students will be able to:
CO 1:Demonstrate knowledge and understanding of Metric spaces & Metrizability of topological spaces.
CO 2: Understand terms, definitions & theorems related to Net, Filter,Ultra filter and Compactness.
CO 3: Apply theoretical concepts in topology to understand real world application
CO 4: Will be able to work with new ideas in mathematics
CO 5: To know the importance of topology in mathematics and its application in Physics, chemistry and human sciences.

Master of Science Mathematics Semester-IV

Session 2020-21

Course Title: Number Theory

Course Code: MMSL-4333

Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Prove results involving divisibility and greatest common divisors.

CO 2: Solve system of linear congruences.

CO 3: Find integral solutions of specified linear Diophantine equation.

CO 4: Apply Euler- Fermat's theorem to prove relation involving prime numbers.

CO 5: Apply the Wilson's theorem to solve numerical problems.

CO 6: To understand the criterion for an integer to be expressed as sum of two squares and sum of four squares.

CO 7: Apply the Pell's equation to real life problems.

CO 8: Understand the basic concept of periodic and purely periodic continued fractions.

Master of Science (Mathematics)
Semester-IV
Session- 2020-21
Course Title: Operations Research-II
Course Code: MMSL-4334
Course Outcomes

After the completion of the course, the student will be able to:
CO 1: Identify and develop operational research models from the verbal description of the real system.
CO 2: Understand the mathematical tools that are needed to solve optimization problems.
CO 3: Identify optimum solutions.
CO 4: Determine better solutions in decision making problems with great speed, competence and confidence.
CO 5: Plan optimum allocation of various limited resources such as men, machines, material, time, money etc. for achieving the optimum goal.
CO 6: Find out a profit plan for the company.
CO 7: Plan, forecast and make rational decisions.
CO 8: Solve the Queuing problems using various Queuing models.
CO 9: Define the term inventory, list the major reasons for holding inventories, and list the main requirements for effective inventory management.
CO 10: Describe the economic order quantity model and solve typical problems.
CO 11: Determine the optimum replacement policies.
CO 12: Apply the Simulation techniques to solve business and industry problems.

Master of Science in Mathematics
Semester-IV
Session 2020-21
Course Title: Statistics-II
Course Code: MMSM-4335

Course Outcomes

CO 1:Understand the concept of sampling distribution of statistics and in particular describe the behaviour of sample mean.
CO 2:Distinguish between population and sample and between parameters and statistics.
CO 3: Describe the property of unbiasedness.
CO 4: Interpret the confidence interval and confidence level.
CO 5:Identify the components of classical hypothesis test including the parameter of interest, the null and alternative hypothesis and test statistic.
CO 6: Compute or approximate the probable value of test statistic and explain two types of errors.
CO 7: State and apply the definitions of t, F and chi-square distribution in terms of standard normal.
CO 8: Demonstrate the techniques of one way and two ways ANOVA.