FACULTY OF SCIENCES

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

(Under Credit Based Continuous Evaluation Grading System)

Session: 2022-24

The Heritage Institution

KANYA MAHA VIDYALAYA
JALANDHAR
(Autonomous)

Master of Science (Mathematics)

Session: 2022-24

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)
Semester-I
Session: 2022-24
Course Title: Real Analysis-I
Course Code: MMSL-1331

Course outcomes

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

CO 1: Demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts of open set, closed set, derived set, closure of a set and compact set.

CO 2: Give argument related to convergence, continuity, completeness, compactness, connectedness in metric spaces.

CO 4: Understand and derive proofs of mathematical theorems related to limit and continuity, continuity and compactness, continuity and connectedness and uniform continuity.

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: 2022-24
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. Define a function of complex variable and carry out basic mathematical operations with complex numbers. State and prove the Cauchy Riemann Equation and use it to show that a function is analytic.

CO2.Understand the principle of analytic Continuation and concerned results , critical points and fixed points.

CO3.To understand the modulus of complex values functions and result regarding that and to develop manipulation skills in the use of Rouche's theorem,

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

Master of Science (Mathematics)
Semester-I
Session: 2022-24
Course Title: Algebra-I
Course Code: MMSL-1333
Course Outcomes

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

CO 1: Understand the importance of the algebraic properties with regard to working with various number systems, explain the significance of the notion of a normal subgroup, quotient group, simple group.

CO 2: Know and recognize the concepts of homomorphism, isomorphism and automorphism and understand permutation group, external and internal products.

CO 3: Describe the structure of finite abelian group using Sylow's theorems.

CO 4: State the definitions of ring, subring, ideal, ring homomorphism.

Master of Science (Mathematics)
Semester-I
Session: 2022-24
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. Apply knowledge of angular velocity in circular motion to explain natural physical process and related technological advances.

CO 2: 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. Define Work, energy, power, conservative forces, impulsive forces, uniform resisted motion, and simple harmonic motion. 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 3: 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 4: 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: 2022-24
Course Title: Differential Equations
Course Code: MMSL-1335
Course outcomes

After studying this course students will be able to

CO 1: Understand uniqueness and existence criterion of solution of Initial Value Problem. They will learn properties of solution of linear differential equation of order n, concept of simultaneous and total differential equations and will able to recognize Sturm Liouville's Problem and then to find Eigen values and Eigen functions of the same.

CO 2: Find Laplace Transform, Inverse Laplace Transform of a Function and then apply both to find solution of linear differential equations and simultaneous linear differential equations with constant coefficients

CO 3: Find Infinite Fourier Transform of various functions using definition and learn properties like linear property, change of scale property, shifting theorem, derivative theorem etc. of Fourier Transform. They will be able to use Finite Fourier Sine and Cosine Transform in finding the solution of Boundary Value Problems.

CO 4: Understand the concept of Bessel's Function, Legendre's Function etc. with their properties like Orthogonal Property, Recurrence Relations, and Generating Function etc. and to recognize some of the Partial Differential Equations that can be solved by application of Special Functions.

Master of Science (Mathematics)

Semester-II
Session: 2022-24
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: 2022-24
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 and the reason why the tensor analysis is used and explain usefulness of the tensor analysis.

CO 2: Able to explain the concept of theory of space curve, contact between curves and surfaces, locus of centre of curvature, helix spherical curvature as well as to calculate the curvature and torsion of a curve.

CO 3: 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 4: : Manage to solve problems related to Geodesics curvature, mean curvature, curvature lines, and asymptotic lines.

Master of Science (Mathematics)
Semester-II
Session: 2022-24
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. State the definitions and examples 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 3: Describe Galois field. Relate the concept of solvability by radicals to Galois groups and State the definition of constructible point, line and number. Relate constructability to field extension degrees.

CO 4: Check if a given set is a module or not. State the definitions of a sub module and quotient module, free module, cyclic module. State the definitions of module homomorphism's, Isomorphism theorems for modules and apply them where appropriate to analyze structure of modules.

Master of Science (Mathematics)
Semester-II
Session: 2022-24
Course Title: Differential and Integral Equations
Course Code: MMSL-2335
Course Outcomes

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

CO 1: Formulate a Partial Differential Equation of order one and two and also able to classify it as linear and non-linear. They will be able to find solution of a non-linear partial differential equation of order one using Charpit and Jacobi Method.

CO 2: Classify Second order partial differential equation as parabolic, elliptic or hyperbolic. They will understand construction of three type of partial differential equations: Heat, Wave and Laplace and able to find their solution using separation of Variables.

CO 3: Understand concept of Integral equations, Volterra Integral Equation of first and second kind and to find their solution using various techniques.

CO 4: Identify Fredholm Integral Equation and to find its solution using method of successive approximations. They will be able to find solution of a Fredholm Integral Equation with Separable Kernel.

Master of Science (Mathematics)
Semester-III
Session: 2022-24
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 normed linear spaces like, $L^{P(n)} l$(infinite), quotient and LP-spaces.

CO 3: Recognize the examples related to Finite dimensional normed linear spaces and compactness, conjugate space N* and understand The Hahn-Banach theorem and its consequences.

CO 3: Demonstrate the open mapping theorem, closed graph theorem and uniform bounded principal.

CO 4: Describe the concept of Inner product spaces, Hilbert spaces, orthogonal complements, orthonormal sets, the conjugate space H*.

Master of Science (Mathematics)
Semester-III
Session: 2022-24
Course Title: Discrete Mathematics-I
Course Code: MMSL-3333(OPT-I)
Course Outcomes

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

CO 1: Work with Relations and functions and investigate their Properties.

CO 2: Use the Truth Tables for the Expressions involving the Logical Connectives, and Apply the Standard Logical Equivalences and Determine if a Logical Arguments is valid or invalid.

CO 3: Understand the concept of Semi groups and Monoids

CO 4: Learn Recursive Functions and Solve Recurrence Relations and Apply Basic and Advanced Principles of Counting.

Master of Science (Mathematics)
Semester-III
Session: 2022-24
Course Title: Statistics-I
Course Code: MMSL-3334(OPT-III)

Course Outcomes

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

CO 1: Distinguish between different types of data and interpret examples of methods for summarizing data sets, including common graphical tools such as histogram and summary statistics such as mean, median, mode, variance skewness and kurtosis. Further student will understand the basic concepts and applications of probability in real life scenarios

CO 2: Contrast between discrete and continuous random variable and apply general properties of expectations and variance.

CO 3: Compute probabilities for discrete and continuous distributions.

CO 4: Understand and interpret the knowledge regarding correlation of variables in real time data.

Master of Science (Mathematics)
Semester-III
Session: 2022-24
Course Title: Operations Research-I
Course Code: MMSL-3335 (OPT-IV)
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 and mathematical tools that are needed to solve optimization problems. They will be able to differentiate feasible, basic feasible and optimum solution of a linear programming problem and Plan optimum allocation of various limited resources such as men, machines, material, time, money etc. for achieving the optimum goal.

CO 2: Plan, forecast and make rational decisions and construct linear programming and integer linear programming models. They will be able to identify the situations where integer linear programming models are desirable and discuss the solution techniques and applications of linear programming. Understand and apply the Duality concepts to find the solutions of the primal problem and the relationship between the primal and dual linear programming problems.

CO 3: Analyze the transportation and assignment problems and solve those using mathematical models. They will become able to handle cases of unequal supply and demand, unacceptable routes etc. for a transport problem and become familiar with the types of problems such as travelling salesman problem that can be solved by applying an assignment model.

CO 4: Solve Zero Sum games, games without saddle points, graphical solution of 2*n and m*2 games. Able to understand approach of Dynamic Programming and find the solution of LPP Using Dynamic Programming.

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 and to describe the different operator like, adjoint of an operator, self adjoint operator, and unitary operator.

CO 2: Demonstrate how to find the Eigen values and Eigen vectors for finite dimensional spaces and State and Prove Spectral Theorem for normal operators.

CO 3: Understand the concept of Compact Linear Operators on Normed space.

CO 4: To know the topological division of zeros and formulate for spectral radius and to classify the regular and singular elements.

Master of Science (Mathematics)
Semester-IV
Session 2022-24
Course Title: Topology-II
Course Code: MMSL-4332
Course Outcomes

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

CO 1: Know and understand the concepts related to higher separation axioms such as Completely regular spaces, T5 – spaces and Tychonoff spaces etc.

CO 2: Understand and interpret the knowledge regarding Compact spaces, Relation of compact spaces with Hausdorff spaces, Countably compact spaces and One point compactification.

CO 3: Demonstrate knowledge and understanding of Metric spaces & Metrizability of topological spaces.

CO 4: Understand terms, definitions & theorems related to Net, Filter, Ultra filter and convergence of net and filters.

Master of Science Mathematics Semester-IV
Session 2022-24
Course Title: Number Theory
Course Code: MMSL-4333(OPT-VII)
Course Outcomes

Successful completion of this course will enable the students to:

CO 1: Prove results involving divisibility and greatest common divisors and solve system of given linear and non linear congruences. Further the student will be able to apply the Wilson's and Euler- Fermat's theorem to solve numerical problems.

CO 2: Understand the properties and application of Quadratic residue and corresponding symbols.

CO 3: Find integral solutions of specified Diophantine equation and understand the criterion for an integer to be expressed as sum of two squares and sum of four squares.

CO 4: Understand the basic concept of periodic and purely periodic continued fractions and apply the Pell's equation to real life problems.

Master of Science (Mathematics)
Semester-IV
Session 2022-24
Course Title: Operations Research-II
Course Code: MMSL-4334 (OPT-IX)
Course Outcomes

After the completion of the course, the student will be able to:

CO 1: Identify where waiting line problems occur and realize why it is important to study such problems. Understand how Poisson distribution is used to describe arrivals and exponential distribution to describe service times. Study operating characteristics of a queuing model: Single Service Channel with Poisson arrivals, exponential service times and finite or infinite calling population.

CO 2: Study operating characteristics of a queuing model: Multi Service Channel with Poisson arrivals, exponential service times and finite or infinite calling population. Learn where inventory costs occur and why it is important to hold Inventory. Learn Economic order quantity model and extend its basic approach to inventory systems involving production lot size, planned shortages and quantity discounts.

CO 3: Decide optimal replacement policy of an item that deteriorates gradually and of an item that fails suddenly. Apply various techniques to find optimum replacement age of an item so that cost is minimized.

CO 4: Understand what simulation is and how it is helpful in the analysis of a problem. Discuss simulation of inventory models, queuing system, maintenance problems and job sequencing.

Master of Science (Mathematics)
Semester-IV
Session 2022-24
Course Title: Statistics-II
Course Code: MMSL-4335(OPT-VIII)

Course Outcomes

After the completion of the course, the student will be able to:

CO 1:Understand the concept of sampling distribution of statistics and in particular describe the behaviour of sample mean, sample variance and order statistics and to distinguish between population and sample and between parameter and statistic.

CO 2:Describe the property of unbiasedness, consistency, sufficiency, efficiency, uniqueness and completeness and to recognize M.P. test, UMP test and BLUE.

CO 3:Identify the Applications of Chi-square, t and F Distributions in terms of different tests and Compute or approximate the probable value of test statistic and explain two types of errors.

CO 4: Demonstrate the techniques of one way and two ways ANOVA.