FACULTY OF SCIENCES

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

(Under Continuous Evaluation System)

Session: 2019-20

The Heritage Institution

KANYA MAHA VIDYALAYA
JALANDHAR
(Autonomous)

Master of Science (Mathematics)
Session 2019-20
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 2019-20

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.

Kanya Maha Vidyalaya , Jalandhar(Autonomous)

Curriculum and Scheme of Examinations of Two Year Degree Programme

Master of Science (Mathematics) Semester-I

Session 2019-20

Master of Science (Mathematics) Semester-I							
Course Code	**Course Title**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MMSL-1331	Real Analysis-I	C	100	80	-	20	3
MMSL-1332	Complex Analysis	C	100	80	-	20	3
MMSL-1333	Algebra-I	C	100	80	-	20	3
MMSL-1334	Mechanics-I	C	100	80	-	20	3
MMSL-1335	Differential Equations	C	100	80	-	20	3
Total			**500**				

C-Compulsory

Curriculum and Scheme of Examinations of Two Year Degree Programme

Master of Science (Mathematics) Semester-II

Session 2019-20

Master of Science (Mathematics) Semester II								
Course Code	**Course Name**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MMSL-2331	Real Analysis-II	C	100	80	-	20	3
MMSL-2332	Tensors and Differential Geometry	C	100	80	-	20	3
MMSL-2333	Algebra-II	C	100	80	-	20	3
MMSL-2334	Mechanics-II	C	100	80	-	20	3
MMSL-2335	Differential and Integral Equations	C	100	80	-	20	3
Total			**500**				

C-Compulsory

Curriculum and Scheme of Examinations of Two Year Degree Programme

Master of Science (Mathematics) Semester-III

Session 2019-20

Master of Science (Mathematics) Semester-III							
Course Code	**Course Title**	**Course Type**	**Marks**				**Examination time (in Hours)**
			Total	**Ext.**		**CA**	
				L	**P**		
MMSL-3331	Functional Analysis-I	C	100	80	-	20	3
MMSL-3332	Topology-I	C	100	80	-	20	3
MMSL-3333	Integral Transforms	C	100	80	-	20	3
MMSL-3334	Statistics-I	C	100	80	-	20	3
MMSL-3335	Operations Research-I	C	100	80	-	20	3
Total			**500**				

C-Compulsory

Curriculum and Scheme of Examinations of Two Year Degree Programme

Master of Science (Mathematics) Semester-IV

Session 2019-20

Master of Science (Mathematics) Semester-IV								
Course Code	**Course Title**	**Course Type**	**Marks**					**Examination time (in Hours)**
			Total	**Ext.**		**CA**		
				L	**P**			
MMSL-4331	Functional Analysis-II	C	100	80	-	20		3
MMSL-4332	Topology-II	C	100	80	-	20		3
MMSL-4333	Number Theory	C	100	80	-	20		3
MMSM-4334	Statistics-II	C	100	60	20	20		3
MMSL-4335	Operations Research-II	C	100	80	-	20		3
Total			**500**					

C-Compulsory

Master of Science (Mathematics)

Semester-I

Session 2019-20

REAL ANALYSIS-1

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 2019-20

REAL ANALYSIS-1

Course Code : MMSL-1331

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

Set Theory: Finite, countable and uncountable sets. Metric spaces: Definition and examples, open sets, closed sets, compact sets, elementary properties of compact sets, k- cells, compactness of k- cells, Compact subsets of Euclidean space Rk, Perfect sets, The Cantor set.

Unit –II

Separated sets, connected sets in a metric space, Connected subsets of real line, Components, Functions of Bounded Variation, Sequences in Metric Spaces: Convergent sequences (in Metric Spaces), subsequences, Cauchy sequences, Complete metric spaces, Cantor's Intersection Theorem

Unit –III

Baire's theorem, Banach contraction principle, Continuity: Limits of functions (in metric spaces) Continuous functions, Continuity and Compactness, Continuity and Connectedness, Discontinuities, Monotonic functions, Uniform Continuity.

Unit –IV

The Riemann Stieltje's Integral: Definition and existence of Riemann Stieltje's integral, Properties of integral. Integration and Differentiation. Fundamental Theorem of Calculus, Ist and 2nd Mean Value Theorems of Riemann Stieltje's integral.

<u>BOOKS RECOMMENDED:</u>

1. Walter Rudin : Principles of Mathematical Analysis (3rd Edition) McGraw-Hill Ltd Ch.2, Ch.3, (3.1-3.12), Ch.4, Ch.6, (6.1-6.22)
2. Simmons, G.F. : Introduction to Topology and Modern Analysis, McGraw- Hill Ltd(App.1) pp337-338, Ch.2(9-13)
3. Shanti Narayan : A course of Mathematical Analysis.
4. Apostol, T.M. : Mathematical Analysis 2nd Edition 7.18(Th.7.30&7.31)
5. Malik, S.C. : Mathematical Analysis, Wiley Eastern Ltd.

Master of Science (Mathematics)

Semester-I

Session 2019-20

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 2019-20

COMPLEX ANALYSIS

Course Code : MMSL-1332

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit –I

Functions of complex variables, continuity and differentiability. Analytic functions, Conjugate function, Harmonic function. Cauchy Riemann equations (Cartesian and Polar form). Construction of analytic functions, Complex line integral, Cauchy's theorem, Cauchy's integral formula and its generalized form.

Unit –II

Cauchy's inequality. Poisson's integral formula, Morera's theorem. Liouville's theorem, Conformal transformations. Bilinear transformations. Critical points, fixed points, cross-ratio. Problems on cross-ratio and bilinear transformation, Analytic Continuation, Natural Boundary, Schwartz Reflection Principle.

Unit –III

Power Seires, Taylor's theorem, Laurent's theorem. Maximum Modulus Principle. Schwarz's lemma. Theorem on poles and zeros of meromorphic functions. Argument principle. Fundamental theorem of Algebra and Rouche's theorem.

Unit-IV

Zeros, Singularities, Residue at a pole and at infinity. Cauchy's Residue theorem, Jordan's ∞∫lemma. Integration round Unit circle. Evaluation of integrals of the type of ∞- f (x)dx and integration involving many valued functions.

BOOKS RECOMMENDED:

1. Copson, E.T.: Theory of functions of complex variables.
2. Ahlfors, D. V.: Complex analysis.
3. Kasana, H.S. : Complex variables theory and applications.
4. Conway, J.B.: Functions of one complex variable
5. Shanti Narayan : Functions of Complex Variables.

Master of Science (Mathematics)

Semester-I

Session 2019-20

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 2019-20

ALGEBRA-I

Course Code : MMSL-1333

Time: 3Hrs | **Max. Marks: 100**
Theory:80
CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit –I

Groups: Definition & examples, Subgroups, Normal subgroups and Quotient Groups, Lagrange's Theorem, Generating sets, Cyclic Groups.

Unit –II

The Commutator subgroups, Homomorphism, Isomorphism Theorems, Automorphisms, Permutation groups, the alternating groups, Simplicity of A_n, $n \geq 5$, Cayley's theorem. Direct Products: External and Internal. Fundamental theorem of finitely generated Abelian groups (Statement only) and applications.

Unit –III

Structure of finite Abelian groups. Conjugate elements, class equation with applications, Cauchy's Theorem, Sylow's Theorems and their simple applications, Solvable Groups, Composition Series, and Jordan Holder Theorem.

Unit –IV

Rings, Subrings, Ideals, Factor Rings, Homomorphism, Integral Domains. Maximal and prime ideals.

<u>BOOKS RECOMMENDED:</u>

1. Herstein, I.N. : Topics in Algebra, Willey Eastern 1975.
2. Fraleigh, J. B : An Introduction to Abstract Algebra.
3. Surjit Singh : Modern Algebra.

Master of Science (Mathematics)

Semester-I

Session 2019-20

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: Differentiate between angular body about a fixed point and about fixed axes.

CO 9: Understand the concept of Kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid and coplanar distribution.

Master of Science (Mathematics)

Semester-I

Session 2019-20

MECHANICS –I

Course Code : MMSL-1334

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

Velocity and acceleration of a particle along a curve, Radial & Transverse components (plane motion). Relative velocity and acceleration. Kinematics of a rigid body rotating about a fixed point. Vector angular velocity, General motion of a rigid body, General rigid body motion as a screw motion. Composition of angular velocities. Moving axes. Instantaneous axis of rotation and instantaneous centre of rotation.

Unit-II

Newton's laws of motion, work, energy and power. Conservative forces, potential energy. Impulsive forces, Rectilinear particle motion:- (i) Uniform accelerated motion (ii) Resisted motion (iii) Simple harmonic motion (iv)Damped and forced vibrations. Projectile motion under gravity, constrained particle motion, angular momentum of a particle. The cycloid and its dynamical properties.

Unit-III

Motion of a particle under a central force, Use of reciprocal polar coordinates, pedal- co-ordinates and equations. Kepler's laws of planetary motion and Newton's Law of gravitation. Disturbed orbits, elliptic harmonic motion (scope and standard of syllabus is the same as given by Chorlton).

Unit-IV

Moments and products of Inertia, Theorems of parallel and perpendicular axes, angular motion of a rigid body about a fixed point and about fixed axes. Principal axes, Kinetic energy of a rigid body rotating about a fixed point, Momental ellipsoid, equimomental systems, coplanar distribution.

BOOKS RECOMMENDED:

1. Chorlton, F : Text Book of Dynamics
2. Loney, S.L. : Dynamics of rigid body
3. Rutherford, D.E. : Classical Mechanics.

Master of Science (Mathematics)

Semester-I

Session 2019-20

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-I

Session 2019-20

DIFFERENTIAL EQUATIONS

Course Code : MMSL-1335

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Existence and uniqueness theorem for solution of the equation f (x, y) dx , The method of=dy successive approximation, general properties of solution of linear differential equation of order n, adjoint and self-adjoint equations, Total differential equations. Simultaneous differential equations, orthogonal trajectories, Sturm Liouville's boundary value problems. Sturm comparison and Separation theorems, Orthogonality solution.

Unit-II

Laplace Transform: Definition, existence, and basic properties of the Laplace transform, Inverse Laplace transform, Convolution theorem, Laplace transform solution of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit-III

Fourier Transform: Definition, existence, and basic properties, Convolution theorem, Fourier transform of derivatives and Integrals, Inverse Fourier transform, solution of linear ordinary differential equations, Complex Inversion formula.

Unit-IV

Special Functions: Solution, Generating function, recurrence relations and othogonality of Legendre polynomial, Bessel functions, Hermite and Laguerre polynomials.

<u>BOOKS RECOMMENDED:</u>

1. Rainvile: Special Functions.
2. Piaggio: Differential equations.
3. Ross, S.L.: Differential equations.
4. Watson, G.N.: A treaties on the theory of Bessel functions.
5. Coddington, E.A.: Introduction to Ordinary Differential Equations.

Kanya Maha Vidyalaya , Jalandhar(Autonomous)

Master of Science (Mathematics)

Semester-II

Session 2019-20

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 2019-20

REAL ANALYSIS-II

Course Code : MMSL-2331

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

Sequence and Series of functions: Discussion of main problem, Uniform Convergence, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Equicontinuous families of functions, Arzela's Theorem, Weierstrass Approximation theorem.

Unit-II

Outer Measure, Lebesgue Measure, Properties of Measurable Sets, Non Measurable Sets, Measurable Functions: Definition & Properties of Measurable functions.

Unit-III

Characteristic functions, Step Functions and Simple Functions, Little wood's three Principles, Lebesgue Integral: Lebesgue Integral of bounded function, Comparison of Riemann and Lebesgue Integral, Integral of a non negative function, General Lebesgue Integral, Convergence in measure.

Unit-IV

Differentiation and Integration: Differentiation of monotone functions, Differentiation of an integral, Absolute Continuity.

<u>BOOKS RECOMMENDED:</u>

1. Walter Rudin :Principles of Mathematical Analysis (3rd edition) McGraw Hill Ltd. Ch. 7 (7.1-7.27)
2. Malik, S.C. :Mathematical Analysis, Wiley Eastern
3. Royden, H.L. :Real Analysis, Macmillan Co. (Ch. 3, 4, 5 excluding section 2, 5)
4. Jain, P.K. and Gupta, V.P. : Lebesgue Measure and Integration.
5. Barra, G De. : Introduction to Measure Theory, Van Nosh and Reinhold Company

Master of Science (Mathematics)

Semester-II

Session 2019-20

TENSORS AND DIFFERENTIAL GEOMETRY

Course Code : MMSL-2332

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 2019-20

TENSORS AND DIFFERENTIAL GEOMETRY

Course Code : MMSL-2332

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

Notation and summation convention, transformation law for vectors, Kronecker delta, Cartesian tensors, addition, multiplication, contraction and quotient law of tensors. Differentiation of Cartesians tensors, metric tensor, contra-variant, covariant and mixed tensors, Christoffel symbols. Transformation of christoffel symbols and covariant differentiations of a tensor.

Unit-II

Theory of Space Curves: Tangent, principal normal, bi-normal, curvature and torsion. Serretfrenet formulae.Contact between curves and surfaces. Locus of centre of curvature, spherical curvature, Helices. Spherical indicatrix, Bertrand curves.

Unit-III

Surfaces, envelopes, edge of regression, developable surfaces, two fundamental forms. Unit-IV Curves on a surface, Conjugate Direction, Principle Directions, Lines of Curvature, Principal Curvatures, Asymptotic Lines. Theorem of Beltrami and Enneper, Mainardi- Codazzi equations.

Unit-IV

Geodesics, Differential Equation of Geodesic, torsion of Geodesic, Geodesic Curvature, Clairaut's theorem, Gauss- Bonnet theorem, Joachimsthal's theorem, Geodesic Mapping, Tissot's theorem.

<u>BOOKS RECOMMENDED:</u>

1. Lass, H.: Vector and Tensor Analysis
2. Shanti Narayan: Tensor Analysis

3. Weather burn, C.E.: Differential Geometry
4. Willmore, T.J.: Introduction to Differential Geometry
5. Bansi Lal. Differential Geometry

Master of Science (Mathematics)

Semester-II

Session 2019-20

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 2019-20

ALGEBRA-II

Course Code : MMSL-2333

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

The field of Quotients of an integral domain. Principal Ideal domains, Euclidean Rings. The ring of Gaussian Integers, Unique Factorization domains, Polynomial Rings, Gauss's theorem and irreducibility of a polynomial.

Unit-II

Extension Fields: Finite and Infinite, Simple and Algebraic Extensions, Splitting fields: Existence and uniqueness theorem. Separable and inseparable extensions, perfect fields, finite fields.

Unit-III

Existence of GF(pn), construction with straight edge ruler and compass, Galois Theory: Group of automorphisms of a field. Normal extensions and Fundamental Theorem of Galois theory. Symmetric rational functions, Solvability by radicals.

Unit-IV

Modules, Cyclic Modules, simple modules, Free Modules, Fundamental structure theorem for finitely generated modules over a P.I.D. (Statement only).

<u>BOOKS RECOMMENDED:</u>

1. Herstein, I.N. : Topics in Algebra, Willey Eastern 1975.
2. Fraleigh, J. B. : An Introduction to Abstract Algebra.
3. Surjit Singh : Modern Algebra.
4. Bhattacharya, P.B., Jain, : Basic Abstract Algebra (1997); Ch-14 (Sec. 1-5) S.K. & Nagpal S.R.

Master of Science (Mathematics)

Semester-II

Session 2019-20

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 2019-20

MECHANICS – II

Course Code : MMSL-2334

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

General motion of a rigid body, linear momentum of a system of particles. Angular momentum of a system, use of centroid, moving origins, impulsive forces. Problems in two-dimensional rigid body motion, law of conservation of Angular momentum, illustrating the laws of motion, law of conservation of energy, impulsive motion.

Unit-II

Euler's dynamical equations for the motion of a rigid body about a fixed point, further properties of rigid body motion under no forces. Problems on general three-dimensional rigid body motion.

Unit-III

Generalized co-ordinates and velocities Virtual work, generalized forces. Lagrange's equations for a holonomic system and their applications to small oscillation. Lagrange's equations for impulsive forces. Kinetic energy as a quadratic function of velocities. Equilibrium configurations for conservative holonomic dynamical systems. Theory of small oscillations of conservative holonomic dynamical systems (Scope and standard of the syllabus is the same as given by Chorlton).

Unit-IV

Linear functional, Extremal. Euler's - Lagrange's equations of single independent and single dependent variable. Brachistochrone problem, Extension of the variational method. Hamilton's Principle, Principle of Least action. Distinctions between Hamilton's Principle and the Principle of Least Action. Approximate solution of boundary value problems:- Rayleigh-Ritz Method.

BOOKS RECOMMENDED:

1. Chorlton, F.: Text Book of Dynamics.
2. Elssgists, L.: Differential equations and the calculus of variations.
3. Gupta: Calculus of Variation with Application. (PHI Learning Pvt. Ltd.)

Master of Science (Mathematics)

Semester-II

Session 2019-20

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-II

Session 2019-20

DIFFERENTIAL AND INTEGRAL EQUATIONS

Course Code : MMSL-2335

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

Unit-I

Partial Differential Equations of First Order: origin of first order partial differential equations. Cauchy problem of first order equations. Integral surface through a given curve. Surface orthogonal to given system of surfaces. Non linear p.d.e of first order, Charpit's method and Jacobi's method. Partial differential equations of the 2nd order. Origin of 2nd order equations. Linear p.d.e. with constant coefficients and their complete solutions.

Unit-II

Second order equation with variable coefficient and their classification and reduction to standard form. Solution of linear hyperbolic equation. Non-linear equations of second order, Monge's Method. Solution of Laplace, wave and diffusion equations by method of separation of variables and Fourier transforms. Green function for Laplace, waves and diffusion equation.

Unit-III

Volterra Equations : Integral equations and algebraic system of linear equations. Volterra equation L2 Kernels and functions. Volterra equations of first & second kind. Volterra integral equations and linear differential equations.

Unit-IV

Fredholm equations, solutions by the method of successive approximations. Neumann's series, Fredholm's equations with Pincherte-Goursat Kernel's, The Fredholm theorem (Scope same in chapters I and II excluding 1.10 to 1.13 and 2.7 of integral equations by F.G. Tricomi's.)

BOOKS RECOMMENDED:

1. Piaggio: Differential equations.
2. Tricomi, F.G.: Integral equation (Ch. I and II)

3. Kanwal R, P: Linear integral equations
4. Sneddon, I.N.: Elements of partial differential equations.
5. Levitt, W.W.: Integral Equations.
6. Mikhlin: Integral Equations.

Master of Science (Mathematics)

Semester-III

Session 2019-20

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 paces like LP(n), LP (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 2019-20

Course Title: Functional Analysis-I

Course Code: MMSL-3331

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Normed linear spaces, Banach spaces, subspaces, quotient spaces, L^p-spaces: Holder's and Minkowski's Inequalities, Convergence and Completeness, Riesz-Fischer Theorem, Continuous linear transformations, equivalent norms.

UNIT-II

Finite dimensional normed linear spaces and compactness, Riesz Theorem, The conjugate space N*, The Hahn-Banach theorem and its consequences, natural imbedding of N into N**, reflexivity of normed spaces.

UNIT-III

Open mapping theorem, projections on a Banach space, closed graph theorem, uniform boundedness principle, conjugate operators.

UNIT-IV

Inner product spaces, Hilbert spaces, orthogonal complements, orthonormal sets, the conjugate space H*.

BOOKS RECOMMENDED:

1. G.F. Simmons: Introduction to Topology and Modern Analysis, Ch. 9 & 10 (Sections 52-55), McGraw-Hill International Book Company, 1963.
2. Royden, H. L.: Real Analysis, Ch 6 (Sections 6.1 -6.3), Macmillan Co. 1988.
3. Erwin Kreyszig: Introduction to Functional Analysis with Applications, John Wiley & Sons, 1978.
4. Balmohan V. Limaye: Functional Analysis, New Age International Limited.
5. P.K.Jain, O.P Ahuja & Khalil Ahmed: Functional Analysis, New Age International (P) Ltd. Publishers, 1995.
6. K. Chanrashekhra Rao: Functional Analysis, Narosa, 2002

7. D. Somasundram: A First Course in Functional Analysis, Narosa, 2006.

Master of Science (Mathematics)

Semester-III

Session 2019-20

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 2019-20

Course Title: Topology-I

Course Code: MMSL-3332

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:
Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Topological Spaces, Basic concepts, closure, interior, exterior and boundary of a set. Dense sets, Closure operator [Kuratowski function] and Interior operator. Neighbourhood's andNeighbourhood system, Coarser and finer topologies. Local bases, bases and sub – bases for a topological space. Convergence of a sequence. First and second countable spaces. Lindeloff spaces, Separable spaces. Sub-spaces, Hereditary properties.

UNIT-II

Separated sets, connected sets, Connected and disconnected spaces, Connectedness on real line. Components, locally connected space. Totally disconnected space. Continuous functions, Restriction and extension of a mapping. Sequential continuity at point.Invariants under a continuous mapping. Open and closed mappings. Homeomorphism and embedding. Topological properties.

UNIT-III

Separation Axioms: T0, T1, T2 – spaces. Regular spaces, T3 – spaces, Normal spaces, T4 – space. Tychonoff lemma, Urysohn lemma, Tietze extension theorem.

UNIT-IV

Product of two spaces, The product of n spaces. Base for a finite product topology. General product spaces. Sub-base and base for product topology. Productive properties. Quotient spaces.

BOOKS RECOMMENDED:

1. T.O. Moore : Elementary general Topology (Chapters 2–8).
2. J.L. Kelley: General Topology (Chapters 1–5).
3. J.R. Munkres : Topology.
4. G.F. Simmons : Introduction to Topology and Modern Analysis.
5. S.W. Davis : Topology, McGraw Hill 2005.

Master of Science (Mathematics)

Semester-III

Session 2019-20

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 2019-20

Course Title : Integral Transforms

Course Code: MMSL-3333

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Finite Fourier Transforms : Finite Fourier sine, cosine transforms, inversion formula for sine & cosine transforms, multiple finite Fourier transforms, problems related to finite Fourier transforms, Applications of Fourier transforms in initial and boundary value problems.

UNIT-II

Application of Laplace Transforms in Initial and Boundary Value Problems: Heat conduction equation, wave equation, Laplace equation and problems based on above equations.

UNIT-III

Hankel Transforms: Hankel transforms, inversion formula for the Hankel transform, infinite Hankel transform, Hankel transform of the derivative of a function, Parseval's theorem. The finite Hankel transforms, Applications of Hankel transform in boundary value problems.

UNIT-IV

Z- Transform, Convergence, properties of Z-Transform, convolution theorem, Inverse Z-transforms, Applications to Difference equations.

BOOKS RECOMMENDED:

1. Ian N.Sneddon: The Uses of Integral Transforms
2. Churchill, R.V.: Operational Mathematics
   [Chapters I, II, III (28-36), IV (40-49), VI (65-68, 70), VII, XI (119-124,129), XII, XIII (138-144), XIV (148-150,152)]

Master of Science (Mathematics)

Semester-III

Session 2019-20

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 2019-20

Course Title: Statistics-I

Course Code: MMSL-3334

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Measures of central tendency and dispersion, moments, Measures of skewness and kurtosis, Classical and axiomatic approach to the theory of probability, additive and multiplicative law of probability, conditional probability and Bayes theorem. Random variable, probability mass function, probability density function, cumulative distribution function

UNIT-II

Two and higher dimensional random variables, joint distribution, marginal and conditional distributions, Stochastic independence, function of random variables and their probability density functions, Mathematical expectations and moments, moment generating function and its properties

UNIT-III

Chebyshev's inequality and its application, stochastic convergence, central limit (Laplace theorem Linder berg, Levy's Theorem). Discrete Probability Distributions: Uniform hyper geometric, Binomial, Poisson, Geometric, Hyper geometric, Multinomial.

UNIT-IV

Continuous probability distributions: Uniform, Exponential,Gamma, Beta, Normal distributions. Least square principle, correlation and linear regression analysis for bi-variate data, partial and multiple correlation coefficients, correlation ratio, association of attributes.

Books Recommended:

1. Hogg, R.V., Mckean, J.W. and Craig, A.T.: Introduction to Mathematical Statistics.
2. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics.
3. Mukhopadhyay, P: Mathematical Statistics.
4. Goon,A.M.,Gupta, M.K. & Dasgupta B. : An Outline of Statistical Theory Vol.-I.

Master of Science (Mathematics)

Semester-III

Session 2019-20

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-III

Session 2019-20

Course Title: Operations Research-I

Course Code: MMSL-3335

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

The linear programming problem, properties of a solution to the linear programming problem, generating extreme point solution, simplex computational procedure, development of minimum feasible solution, the artificial basis techniques, a first feasible solution using slack variables, two phase and Big-M method with artificial variables.

UNIT-II

General Primal-Dual pair, formulating a dual problem, primal-dual pair in matrix form, Duality theorems, complementary slackness theorem, duality and simplex method, economic interpretation of duality, dual simplex method, General transportation problem, transportation table, duality in transportation problem, loops in transportation tables, LP formulation, solution of transportation problem, test for optimality, degeneracy, transportation algorithm (MODI method), time- minimization transportation problem.

UNIT-III

Mathematical formulation of assignment problem, assignment method, typical assignment problem, the traveling salesman problem. Game Theory: Two-person zero-sum games, maximin- minimax principle, games without saddle points(Mixed strategies), graphical solution of 2 * n and m * 2 games, dominance property, arithmetic method of n * n games, general solution of m * n rectangular games.

UNIT-IV

Integer Programming: Gomory's all I.P.P. method, constructions of Gomory's constraints, Fractional cut method-all integer and mixed integer, Branch-and-Bound method, applications of integer programming. Dynamic Programming: The recursive equation approach, characteristics of dynamic programming, dynamic programming algorithm, solution of-Discrete D.P.P. , some applications, solution of L.P.P. by Dynamic Programming.

BOOKS RECOMMENDED:

1. Gass, S. L.: Linear Programming
2. Handley, G.: Mathematical Programming
3. Kambo, N. S.: Mathematical Programming
4. Panneerselvam, R. : Operations Research
5. Taha, H.A.: Operations Research
6. Kanti Sawrup, Gupta,: P.K. and Manmohan Operations Research

Master of Science (Mathematics)

Semester-IV

Session 2019-20

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 2019-20

Course Title: Functional Analysis-II

Course Code: MMSL-4331

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each)are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Strong and weak convergence in finite and infinite dimensional normed linear spaces. Weak convergences in Hilbert spaces, weakly compact sets in Hilbert spaces, The adjoint of an operator, self adjoint operators, normal operators, Unitary operators.

UNIT-II

Projections on a Hilbert space. Finite dimensional spectral Theory.: Eigen- values and Eigen vectors, Spectrum of a bounded linear operator, spectrum of self-adjoint, positive and Unitry operators. Spectral Theorem for normal operators.

UNIT-III

Compact Linear Operator on normed spaces, properties of compact linear operators, spectral properties of compact linear operators.

UNIT-IV

Banach algebras: definitions and simple examples. Regular and singular elements. Topological divisors of zero, Spectrum of an element of Banach Algebra, formula for spectral radius.

BOOKS RECOMMENDED:

1.Simmons, G.F.: Introduction to Topology and Modern Analysis Ch. X (Sections 56-59), Ch. XI (Sections 61-62) , Ch. 12 (Sections 64-68), Mc Graw- Hill (1963)International Book Company.

2. Erwin Kreyszig: Introduction to Functional Analysis with Applications, Ch 8, Sections 8.1-8.3, John Wiley & Sons(1978).

3. Limaye, Balmohan V.: Functional Analysis, New Age International Limited., 1996.

4. Jain, P.K., Ahuja, O.P & : Khalil Ahmed Functional Analysis, New Age International (P) Ltd. Publishers, 1995.

5. Chandrasekhra Rao, K.: Functional Analysis, Narosa, 2002.

6. Somasundram, D.: A First Course in Functional Analysis, Narosa, 2006.

Master of Science (Mathematics)

Semester-IV

Session 2019-20

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 2019-20

Course Title: Topology-II
Course Code : MMSL-4332

Time: 3Hrs **Max. Marks: 100**
Theory:80
CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each)are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Higher Separation Axioms: Completely regular spaces. Tychonoff spaces, Completely normal space, T5 – spaces. Metric spaces as Hausdorff regular, normal and completely normal space. Product of metric spaces.

UNIT-II

Compact spaces, Compact sets, Subsets of compact space. Finite intersection property. Compactness of subsets of real line. Relation of compact spaces with Hausdorff spaces, Regular spaces and normal spaces. Sequentially compact spaces, Bolzano Weierstrass property. Countably compact spaces. Locally compact spaces. Compactness in terms of base elements and sub – base elements. Tychonoff theorem. One point compactification.

UNIT-III

The Stone-Čech compactification, Evaluation mappings, Separate point family, Separate point and closed set family. Embedding lemma, Tychonoff cube, Embedding theorem, Metrization. Urysohn metrization theorem.

UNIT-IV

Directed sets and nets. Convergence of a net in a space, Clustering of a net, nets and continuity, Nets in product spaces, Ultra nets. Compactness in term of nets, Topologies determined by nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa. Ultra-filters and compactness.

BOOKS RECOMMENDED:

1. T.O. Moore :Elementary general topology (Chapter 2 to 8).
2. J.L. Kelley:General Topology (Chapter 1to 5).
3. J.R. Munkres :Topology.
4. G.F. Simmons :Introduction to Topology and Modern Analysis.
5. S.W. Davis :Topology, McGraw Hill 2005.

Master of Science (Mathematics)

Semester-IV
Session 2019-20
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 2019-20
Course Title: Number Theory

Course Code : MMSL-4333

Time: 3Hrs **Max. Marks: 100**
Theory:80
CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each)are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Simultaneous Linear Congruences, Chinese Remainder theorem with applications, Wolsten- Holme's theorem, Lagrange's proof of Wilson theorem, Fermat numbers, The order of an integer modulo n. Primitive roots, Existence and number of primitive roots.

UNIT-II

Indices and their applications, Quadratic residues , Euler's criterion, Product of quadratic residues and quadratic non-residues, The Legendre symbol and its properties, Gauss's Lemma, Quadratic reciprocity law, Jacobian symbol and its properties..

UNIT-III

Arithmetic functions τ (n), σ (n), σ_k (n), μ (n) , Perfect numbers, Mobius inversion formula, Diophantine equation $x^2 + y^2 = z^2$ and its applications to $x^n + y^n = z^n$ when n=4. Criterion for an integer to be expressible as sum of two squares and sum of four squares.

UNIT-IV

Farey series, Farey dissection of a circle and its applications to approximations of irrationals by rationals. Finite and Infinite simple continued fractions, periodic and purely periodic continued fractions, Lagrange's Theorem on periodic continued fractions. Applications to Pell's equation. The fundamental solution of Pell's equation.

BOOKS RECOMMENDED:

1.Hardy and Wright: Theory of Numbers
2.Niven and Zuckerman: An introduction to number Theory
3.Burton, David M.: Elementary Number Theory ,McGraw Hill 2002

Semester-IV

Session 2019-20

Course Title: Statistics-II

Course Code : MMSM-4334

Course Outcomes

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

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.

Master of Science (Mathematics)

Semester-IV

Session 2019-20

Course Title:Statistics-II

Course Code : MMSM-4334

Time: 3Hrs **Max. Marks: 100**

Theory:60

Practical:20

CA:20

Instructions for the paper setters/examiners:

Eight questions of equal marks (16 marks each)are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section

UNIT-I

Sampling Distributions: Chi-square, t and F-distributions with their properties, distribution of sample mean and variance, distribution of order statistics and sample range from continuous populations.

UNIT-II

Point Estimation: Estimators, Properties of unbiased ness, consistency, sufficiency, efficiency, completeness, uniqueness, methods of estimation, Testing of Hypothesis: Null hypothesis and its test of significance, simple and composite hypothesis, M.P. test, UMP test.

UNIT-III

Likelihood tests (excluding properties of Likelihood Ratio Tests), Applications of Sampling Distributions: Test of mean and variance in the normal distribution, Tests of single proportion and equality of two proportions, Chi-square test, t-test, F-test.

UNIT-IV

Linear Estimation: Gauss Markoff linear models, BLUE, Gauss Markoff Theorem, estimation with linear restrictions on parameters, residual sum of squares, analysis of variance, analysis of variance for one way and two way classified data with one observation per cell.

BOOKS RECOMMENDED:

1. Hogg R.V., Mckean, J.W. and Craig A.T. : Introduction to Mathematical Statistics
2. Hoel P.G. : Introduction to Mathematical Statistics
3. Gupta S.C. and Kapoor V.K. : Fundamentals of mathematical statistics
4. Mukhopadhyay,P : Mathematical statistics
5. Goon,A.M.,Gupta M.K. & Dasgupta B. : Fundamental of statistic, Vol. I
6. Goon,A.M.,Gupta M.K. & Dasgupta B. : An outline of statistical theory, Vol. I

Master of Science (Mathematics)

Semester-IV

Session 2019-20

Course Title: Operations Research-II
Course Code : MMSL-4335
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 (Mathematics)

Semester-IV

Session 2019-20

Course Title: Operations Research-II

Course Code : MMSL-4335

Time: 3Hrs **Max. Marks: 100**

Theory:80

CA:20

Instructions for the paper setters/examiners

Eight questions of equal marks (16 marks each)are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Queueing Theory: Introduction, Queueing System, elements of queueing system, distributions of arrivals, inter arrivals, departure and service times. Classification of queueing models, single service queueing model with infinite capacity (M/M/1): (∞/FIFO), Queueing Models: (M/M/1): (N/FIFO), Generalized Model: Birth-Death Process

UNIT-II

(M/M/C): (∞/FIFO), (M/M/C) (N/FIFO), (M/M/R) (KIGD), Power supply model. Inventory Control: The inventory decisions, costs associated with inventories, factors affecting Inventory control, economic order quantity (EOQ), Deterministic inventory problems with no shortage and with shortages, EOQ problems with price breaks, Multi item deterministic problems.

UNIT-III

Replacement Problems: Replacement of equipment/Asset that deteriorates gradually, replacement of equipment that fails suddenly, recruitment and promotion problem, equipment renewal problem.

UNIT-IV

Need of simulation, methodology of simulation. Simulation models, event- type simulation, generation of random numbers, Monto-carlo simulation, simulation of inventory problems, queueing systems, maintenance problem, job sequencing.

BOOKS RECOMMENDED:

1. Handley, G.:	Mathematical Programming
2. Kambo, N.S.:	Mathematical Programming
3. Panneerselvam, R. :	Operations Research
4. Taha, H.A.:	Operations Research
5. Kanti Sawrup, Gupta,: P.K. and Manmohan	Operations Research