FACULTY OF SCIENCES

SYLLABUS
of
M. Sc. Mathematics (Semester: I -II)

(Under Continuous Evaluation System)

Session: 2018-19

The Heritage Institution

KANYA MAHA VIDYALAYA
JALANDHAR
(Autonomous)

M.Sc. Mathematics
Session 2018-19
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.

M.Sc. Mathematics
Session 2018-19
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.

Scheme of Studies and Examination

Session 2018-19

M.Sc. Mathematics Sem-I

<table>
<tr><th colspan="9">Semester I</th></tr>
<tr><th rowspan="3">Course Code</th><th rowspan="3">Course Name</th><th rowspan="3">Course Type</th><th colspan="4">Marks</th><th rowspan="3">Examination time (in Hours)</th></tr>
<tr><th rowspan="2">Total</th><th colspan="2">Ext.</th><th rowspan="2">CA</th></tr>
<tr><th>L</th><th>P</th></tr>
<tr><td>MMSL-1331</td><td>Real Analysis-I</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-1332</td><td>Complex Analysis</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-1333</td><td>Algebra-I</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-1334</td><td>Mechanics-I</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-1335</td><td>Differential Equations</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td colspan="3">Total</td><td colspan="4">500</td><td></td></tr>
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M.Sc. Mathematics Semester-I
Session 2018-19
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.

M.Sc. Mathematics Semester-I
Session 2018-19
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 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.

Books Recommended:

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.

M.Sc. Mathematics Semester-I
Session 2018-19
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.

M.Sc. Mathematics Semester-I
Session 2018-19
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 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.

M.Sc. Mathematics Semester-I
Session 2018-19
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

M.Sc. Mathematics Semester-I
Session 2018-19
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 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.

BOOKS RECOMMENDED:

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

M.Sc. Mathematics Semester-I
Session 2018-19
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.

M.Sc. Mathematics Semester-I

Session 2018-19

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 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.

M.Sc. Mathematics Semester-I
Session 2018-19
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.

M.Sc. Mathematics Semester-I
Session 2018-19
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 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.
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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.

BOOKS RECOMMENDED:

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.

Scheme of Studies and Examination

Session 2018-19

M.Sc. Mathematics Sem-II

<table>
<tr><th colspan="8">Semester II</th></tr>
<tr><th rowspan="3">Course Code</th><th rowspan="3">Course Name</th><th rowspan="3">Course Type</th><th colspan="4">Marks</th><th rowspan="3">Examination time (in Hours)</th></tr>
<tr><th rowspan="2">Total</th><th colspan="2">Ext.</th><th rowspan="2">CA</th></tr>
<tr><th>L</th><th>P</th></tr>
<tr><td>MMSL-2331</td><td>Real Analysis-II</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-2332</td><td>Tensors and Differential Geometry</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-2333</td><td>Algebra-II</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-2334</td><td>Mechanics-II</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td>MMSL-2335</td><td>Differential and Integral Equations</td><td>C</td><td>100</td><td>80</td><td>-</td><td>20</td><td>3</td></tr>
<tr><td colspan="3">Total</td><td colspan="4">500</td><td></td></tr>
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M.Sc. Mathematics Semester-II
Session 2018-19
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.

M.Sc. Mathematics Semester-II
Session 2018-19
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 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.

Books Recommended:

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

M.Sc. Mathematics Semester-II
Session 2018-19
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.

M.Sc. Mathematics Semester-II

Session 2018-19

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 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.

Books Recommended:

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

M.Sc. Mathematics Semester-II
Session 2018-19
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.

M.Sc. Mathematics Semester-II
Session 2018-19
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 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).

BOOKS RECOMMENDED:

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.

M.Sc. Mathematics Semester-II
Session 2018-19
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.

M.Sc. Mathematics Semester-II
Session 2018-19
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 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.)

M.Sc. Mathematics Semester-II
Session 2018-19
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.

M.Sc. Mathematics Semester-II
Session 2018-19
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 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.