DEPARTMENT OF MATHEMATICS, OSMANIA UNIVERSITY

(Choice Based Credit System)

(w.e.f. the academic year 2018-2019)

M. Sc. MATHEMATICS

SEMESTER – I

Subjects	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	M 101	**Abstract Algebra**	6	5	1	100	5
Core	M 102	**Mathematical Analysis**	6	5	1	100	5
Core	M 103	**Ordinary and Partial Differential Equations**	6	5	1	100	5
Core	M 104	**Elementary Number Theory**	6	5	1	100	5
Core	M 105	**Discrete Mathematics**	5	4	1	100	4
		Seminar	2			25	1
			31				25

T* - Tutorial Class for problems solving session.

SEMESTER – II

Subjects	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	M 201	**Galois Theory**	6	5	1	100	5
Core	M 202	**Lebesgue measure & Integration**	6	5	1	100	5
Core	M 203	**Complex Analysis**	6	5	1	100	5
Core	M 204	**Topology**	6	5	1	100	5
Core	M 205	**Theory of Ordinary Differential Equations**	5	4	1	100	4
		Seminar	2			25	1
			31				25

T* - Tutorial Class for problems solving session.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM/MCS 101 **Semester-I**

Paper-I: **Abstract Algebra**

Unit-I
Automorphisms - Conjugacy and G - sets - Normal series Solvable groups - Nilpotent groups. (Pages 104 to 128 of [1])

Unit-II
Structure theorems of groups: Direct product - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow's theorems - Groups of orders p^2, pq . (Pages 138 to 155)

Unit-III
Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and prime ideals - Nilpotent and nil ideals - Zorn's lemma (Pages 179 to 211).

Unit-IV
Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD - Rings of Fractions.(Pages 212 to 228)

Text Book:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

Reference:

[1] **Topics in Algebra** by I.N. Herstein.

[2] **Elements of Modern Algebra** by Gibert& Gilbert.

[3] **Abstract Algebra** by Jeffrey Bergen.

[4] **Basic Abstract Algebra** by Robert B Ash.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM/MCS 102 **Semester - I**

Paper - II: **Mathematical Analysis**

Unit-I
Metric spaces - Compact sets - Perfect sets - Connected sets.

Unit-II
Limits of functions - Continuous functions - Continuity and compactness, Continuity and connectedness - Discontinuities - Monotone functions.

Unit-III
Riemann - Steiltjes integral - Definition and Existence of the Integral - Properties of the integral - Integration of vector valued functions - Rectifiable curves.

Unit-IV
Sequences and series of functions: Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation - Approximation of a continuous function by a sequence of polynomials.

Text Book:

Principles of Mathematical Analysis (3rd Edition) (Chapters 2, 4, 6) By Walter Rudin, Mc Graw - Hill Internation Edition.

References:

[1] The Real Numbers by John Stillwel.

[2] Real Analysis by Barry Simon

[3] Mathematical Analysis Vol - I by D J H Garling.

[4] Measure and Integral by Richard L.Wheeden and Antoni Zygmund.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM 103 **Semester - I**

Paper - III: **Ordinary and Partial Differential Equations**

Unit-I

Existence and Uniqueness of solution of $\frac{dy}{dx} = f(x, y)$ and problems there on. The method of successive approximations - Picard's theorem - Non - Linear PDE of order one - Charpit's method - Cauchy's method of Characteristics for solving non - linear partial differential equations - Linear Partial Differential Equations with constant coefficients.

Unit-II

Partial Differential Equations of order two with variable coefficients - Canonical form - Classification of second order Partial Differential Equations - separation of variables method of solving the one - dimensional Heat equation, Wave equation and Laplace equation - Sturm - Liouville's boundary value problem.

Unit-III

Power Series solution of O.D.E. – Ordinary and Singular points - Series solution about an ordinary point - Series solution about Singular point - Frobenius Method.

Lagendre Polynomials: Lengendre's equation and its solution - Lengendre Polynomial and its properties - Generating function - Orthogonal properties - Recurrance relations - Laplace's definite integrals for $P_n(x)$ - Rodrigue's formula.

Unit-IV

Bessels Functions: Bessel's equation and its solution - Bessel function of the first kind and its properties - Recurrence Relations - Generating function - Orthogonality properties.

Hermite Polynomials: Hermite's equation and its solution - Hermite polynomial and its properties - Generating function - Alternative expressions (Rodrigue's formula) - Orthogonality properties - Recurrence Relations.

Text Books:

[1] **Ordinary and Partial Differential Equations**, By M.D. Raisingania, S. Chand Company Ltd., New Delhi.

[2] **Text book of Ordinary Differential Equation**, By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.

[3] **Elements of Partial Differential Equations**, By Ian Sneddon, Mc.Graw - Hill International Edition.

Reference:

[1] Worldwide Differential equations by Robert McOwen .

[2] Differential Equations with Linear Algebra by Boelkins, Goldberg, Potter.

[3] Differential Equations By Paul Dawkins.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M 104 **Semester - I**

Paper - IV: **Elementary Number Theory**

Unit-I

The Fundamental Theorem of arithmetic: Divisibility, GCD, Prime Numbers, Fundamental theorem of Arithemtic, the series of reciprocal of the Primes, The Euclidean Algorithm.

Unit-II

Arithmetic function and Dirichlet Multiplication, The functions $\phi(n)$, $\mu(n)$ and a relation connecting them, Product formulae for $\phi(n)$, Dirichlet Product, Dirichlet inverse and Mobius inversion formula and Mangoldt function $\Lambda(n)$, multiplication function, multiplication function and Dirichlet multiplication, Inverse of a completely multiplication function, Liouville's function $\lambda(n)$, the divisor function is $\sigma_\alpha(n)$

Unit-III

Congruences, Properties of congruences, Residue Classes and complete residue system, linear congruences conversion, reduced residue system and Euler Fermat theorem, polynomial congruence modulo P, Lagrange's theorem, Application of Lagrange's theorem, Chinese remainder theorem and its application, polynomial congruences with prime power moduli

Unit-IV

Quadratic residue and quadratic reciprocity law, Quadratic residues, Legendre's symbol and its properties, evaluation of $(-1/p)$ and $(2/p)$, Gauss Lemma, the quadratic reciprocity law and its applications.

Text Book:

Introduction to analytic Number Theory by Tom M. Apostol. Chapters 1, 2, 5, 9.

References:

[1] Number Theory by Joseph H. Silverman.

[2] Theory of Numbers by K.Ramchandra.

[3] Elementary Number Theory by James K Strayer.

[3] Elementary Number Theory by James Tattusall.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M 105 **Semester - I**

Paper - V: **Discrete Mathematics**

Unit-I

Mathematical Logic: Propositional logic, Propositional equivalences, Predicates and Quantifiers, Rule of inference, direct proofs, proof by contraposition, proof by contradiction. **Boolean Algebra:** Boolean functions and its representation, logic gates, minimizations of circuits by using Boolean identities and K - map.

Unit-II

Basic Structures: Sets representations, Set operations, Functions, Sequences and Summations. Division algorithm, Modular arithmetic, Solving congruences, applications of congruences. **Recursion:** Proofs by mathematical induction, recursive definitions, structural induction,generalized induction, recursive algorithms.

Unit-III

Counting: Basic counting principle, inclusion - exclusion for two - sets, pigeonhole principle, permutations and combinations, Binomial coefficient and identities, generalized permutations and combinations. **Recurrence Relations:** introduction, solving linear recurrence relations, generating functions, principle of inclusion - exclusion, applications of inclusion - exclusion. **Relations:** relations and their properties, representing relations, closures of relations, equivalence relations, partial orderings.

Unit-IV

Graphs: Graphs definitions, graph terminology, types of graphs, representing graphs, graph isomorphism, connectivity of graphs, Euler and Hamilton paths and circuits, Dijkstra's algorithm to find shortest path, planar graphs – Euler's formula and its applications, graph coloring and its applications. **Trees:** Trees definitions – properties of trees, applications of trees – BST, Haffman Coding, tree traversals: pre - order, in - order, post - order, prefix, infix, postfix notations, spanning tress – DFS, BFS, Prim's, Kruskal's algorithms.

Text Book:

Discrete Mathematics and its Applicationsby Kenneth H. Rosen,

References:

[1] **Discrete and Combinatorial Mathematics**by Ralph P. Grimaldi

[2] **Discrete Mathematics for Computer Scientists** by Stein, Drysdale, Bogart

[3] **Discrete Mathematical Structures with Applications to Computer Science**by J.P. Tremblay, R. Manohar

[4] **Discrete Mathematics for Computer Scientists and Mathematicians** by Joe L. Mott, Abraham Kandel, Theoder P. Baker

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM 201 **Semester - II**

Paper - I: **Galois Theory**

Unit-I
Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion - Adjunction of roots - Algebraic extensions - Algebraically closed fields (Pages 281 to 299).

Unit-II
Normal and separable extensions: Splitting fields - Normal extensions - Multiple roots - Finite fields - Separable extensions (Pages 300 to 321).

Unit-III
Galois theory: Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of Algebra (Pages 322 to 339).

Unit-IV
Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials - Cyclic extensions - Polynomials solvable by radicals - Ruler and Compass constructions. (Pages 340 - 364).

Text Book:

Basic Abstract Algebra by S.K. Jain, P.B. Bhattacharya, S.R. Nagpaul.

References:

[1] **Topics in Algebra** by I.N. Herstein.

[2] **Elements of Modern Algebra** by Gibert& Gilbert.

[3] **Abstract Algebra** by Jeffrey Bergen.

[4] **Basic Abstract Algebra** by Robert B Ash.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM 202 **Semester - II**

Paper - II: **Lebesgue Measure & Integration**

Unit-I
Algebra of sets - Borel sets - Outer measure - Measurable sets and Lebesgue measure - A non - measurable set - Measurable functions - Littlewood three principles.

Unit-II
The Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non - negative function - The general Lebesgue integral.

Unit-III
Convergence in measure - Differentiation of a monotone functions - Functions of bounded variation.

Unit-IV
Differentiation of an integral - Absolute continuity - The Lp - spaces - The Minkowski and Holder's inequalities - Convergence and completeness.

Text Book:

Real Analysis (3rd Edition)(Chapters 3, 4, 5) by H. L. Royden Pearson Education (Low Price Edition).

References:

[1] **Lebesgue measure and Integration** by G.de Barra.

[2] **Measure and Integral** by Richard L.Wheeden, Anotoni Zygmund.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM/MCS 203 **Semester - II**

Paper - III: **Complex Analysis**

Unit-I

Regions in the Complex Plane - Functions of a Complex Variable - Mappings - Mappings by the Exponential Function - Limits - Limits Involving the Point at Infinity - Continuity - Derivatives - Cauchy – Riemann Equations - Sufficient Conditions for Differentiability - Analytic Functions - Harmonic Functions - Uniquely Determined Analytic Functions - Reflection Principle - The Exponential Function - The Logarithmic Function - Some Identities Involving Logarithms - Complex Exponents - Trigonometric Functions - Hyperbolic Functions

Unit-II

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals - Some Examples - Examples with Branch Cuts - Upper Bounds for Moduli of Contour Integrals – Anti derivatives - Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus Principle.

Unit-III

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series - Continuity of Sums of Power Series - Integration and Differentiation of Power Series - Uniqueness of Series Representations - Isolated Singular Points - Residues - Cauchy's Residue Theorem - Residue at Infinity - The Three Types of Isolated Singular Points - Residues at Poles - Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near Isolated Singular Points.

Unit-IV

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma - Indented Paths - Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem - Linear Transformations - The Transformation $w = 1/z$ - Mappings by $1/z$ - Linear Fractional Transformations - An Implicit Form - Mappings of the Upper Half Plane.

Text Book:

Complex Variables with applications by James Ward Brown, Ruel V Churchill.

References:

[1] Complex Analysis by Dennis G.Zill.

[2] Complex Variables by Stevan G. Krantz.

[3] Complex Variables with Applications by S.Ponnusamy, Herb Silverman.

[4] Complex Analysis by Joseph Bak, Donald J. Newman.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M 204 **Semester - II**

Paper - IV: **Topology**

Unit-I
Topological Spaces: The Definition and examples - Elementary concepts - Open bases and open subbases - Weak topologies.

Unit-II
Compactness: Compact spaces - Products of spaces - Tychonoff's theorem and locally compact spaces - Compactness for metric spaces - Ascoli's theorem.

Unit-III
Separation: T_1 - spaces and Hausdorff spaces - Completely regular spaces and normal spaces - Urysohn's lemma and the Tietze extension theorem - The Urysohn imbedding theorem.

Unit-IV
Connectedness: Connected spaces - The components of a spaces - Totally disconnected spaces - Locally connected spaces.

Text Book:

Introduction to Topology and Modern Analysis (Chapters 3,4,5,6) By G.F. Simmon's Tata Mc Graw Hill Edition.

References:

[1] Introductory Topology by Mohammed H. Mortad.

[2] Explorations in Topology by David Gay.

[3] Encyclopedia of General Topology by Hart, Nagata, Vanghan.

[4] Elementary Topology by Michael C. Gemignani.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics

M/AM 205 **Semester - II**

Paper - V: **Theory of Ordinary Differential Equations**

Unit-I

Linear differential equations of higher order: Introduction - Higher order equations - A Modelling problem – Linear Independence - Equations with constant coefficients Equations with variable coefficients - Wronskian - Variation of parameters - Some Standard methods.

Unit-II

Existence and uniqueness of solutions: Introduction - Preliminaries - Successive approximations - Picard's theorem - Continuation and dependence on intial conditions - existence of solutions in the large - existence and uniqueness of solutions of systems - fixed point method.

Unit-III

Analysis and methods of non - linear differential equations: Introduction - Existence theorem – Extremal solutions - Upper and Lower solutions - Monotone iterative method and method of quasi linearization - Bihari's inequality, Application of Bihari's inequality

Unit-IV

Oscillation theory for linear Differential Equation of Second order: The adjoint equation - Self adjoint linear differential equation of second order - Abel's formula - the number of zeros in a finite interval - The sturm separation theorem - the strum comparison theorem – the sturmpicone the Bocher Osgood theorem - A special pair of solution - Oscillation on half axis.

Text Book:

[2] **Text book of Ordinary Differential Equation**, By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.

References:

[1] **Text Book of Ordinary Differential Equations** by Earl A Coddington.

[2] **Differential Equations** by Edward, Penny, Calvis.

[3] **Differential Equation** by Harry Hochstardt.

DEPARTMENT OF MATHEMATICS, OSMANIA UNIVERSITY

(Choice Based Credit System)

(w.e.f. the academic year 2018-2019)

M. Sc. APPLIED MATHEMATICS

SEMESTER – I

Subjects	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	AM 101	**Abstract Algebra**	6	5	1	100	5
Core	AM 102	**Mathematical Analysis**	6	5	1	100	5
Core	AM 103	**Ordinary and Partial Differential Equations**	6	5	1	100	5
Core	AM 104	**Mechanics**	6	5	1	100	5
Core	AM 105	**Integral Transforms**	5	4	1	100	4
		Seminar	2			25	1
			31				25

T* - Tutorial Class for problems solving session.

SEMESTER – II

Subjects	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core	AM 201	**Galois Theory**	6	5	1	100	5
Core	AM 202	**Lebesgue Measure & Integration**	6	5	1	100	5
Core	AM 203	**Complex Analysis**	6	5	1	100	5
Core	AM 204	**Fluid Mechanics**	6	5	1	100	5
Core	AM 205	**Theory of Ordinary Differential Equations**	5	4	1	100	4
		Seminar	2			25	1
			31				25

T* - Tutorial Class for problems solving session.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M/MCS 101 **Semester - I**

Paper - I: **Abstract Algebra**

Unit-I
Automorphisms - Conjugacy and G - sets - Normal series Solvable groups - Nilpotent groups. (Pages 104 to 128 of [1])

Unit-II
Structure theorems of groups: Direct product - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow's theorems - Groups of orders p^2, pq . (Pages 138 to 155)

Unit-III
Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and prime ideals - Nilpotent and nil ideals - Zorn's lemma (Pages 179 to 211).

Unit-IV
Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD - Rings of Fractions.(Pages 212 to 228)

Text Book:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

References:

[1] Topics in Algebra by I.N. Herstein.

[2] Elements of Modern Algebra by Gibert& Gilbert.

[3] Abstract Algebra by Jeffrey Bergen.

[4] Basic Abstract Algebra by Robert B Ash.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M/MCS 102 **Semester - I**

Paper - II: **Mathematical Analysis**

Unit-I
Metric spaces - Compact sets - Perfect sets - Connected sets.

Unit-II
Limits of functions - Continuous functions - Continuity and compactness, Continuity and connectedness - Discontinuities - Monotone functions.

Unit-III
Riemann - Steiltjes integral - Definition and Existence of the Integral - Properties of the integral - Integration of vector valued functions - Rectifiable curves.

Unit-IV
Sequences and series of functions: Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation - Approximation of a continuous function by a sequence of polynomials.

Text Book:

Principles of Mathematical Analysis, (3rd Edition) (Chapters 2, 4, 6) By Walter Rudin, Mc Graw - Hill International Edition.

References:

[1] The Real Numbers by John Stillwel.

[2] Real Analysis by Barry Simon

[3] Mathematical Analysis Vol - I by D J H Garling.

[4] Measure and Integral by Richard L.Wheeden and Antoni Zygmund.

DEPARTMENT OF MATHEMATICS
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M.Sc. Applied Mathematics

AM/M 103 **Semester - I**

Paper - III: **Ordinary and Partial Differential Equations**

Unit-I

Existence and Uniqueness of solution of $\frac{dy}{dx} = f(x, y)$ and problems there on. The method of successive approximations - Picard's theorem - Non - Linear PDE of order one - Charpit's method - Cauchy's method of Characteristics for solving non - linear partial differential equations - Linear Partial Differential Equations with constant coefficients.

Unit-II

Partial Differential Equations of order two with variable coefficients - Canonical form - Classification of second order Partial Differential Equations - separation of variables method of solving the one - dimensional Heat equation, Wave equation and Laplace equation - Sturm - Liouville's boundary value problem.

Unit-III

Power Series solution of O.D.E. – Ordinary and Singular points - Series solution about an ordinary point - Series solution about Singular point - Frobenius Method.

Lagendre Polynomials: Lengendre's equation and its solution - Lengendre Polynomial and its properties - Generating function - Orthogonal properties - Recurrance relations - Laplace's definite integrals for $P_n(x)$ - Rodrigue's formula.

Unit-IV

Bessels Functions: Bessel's equation and its solution - Bessel function of the first kind and its properties - Recurrence Relations - Generating function - Orthogonality properties.

Hermite Polynomials: Hermite's equation and its solution - Hermite polynomial and its properties - Generating function - Alternative expressions (Rodrigue's formula) - Orthogonality properties - Recurrence Relations.

Text Books:

[1] **Ordinary and Partial Differential Equations**, By M.D. Raisingania, S. Chand Company Ltd., New Delhi.

[2] **Text book of Ordinary Differential Equation**, By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.

[3] **Elements of Partial Differential Equations**, By Ian Sneddon, Mc.Graw - Hill International Edition.

Reference:

[1] Worldwide Differential equations by Robert McOwen .

[2] Differential Equations with Linear Algebra by Boelkins, Goldberg, Potter.

[3] Differential Equations By Paul Dawkins.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM 104 **Semester - I**

Paper - IV: **Mechanics**

Unit-I

Newton's Law of Motion: Historical Introduction, **Rectilinear Motion:** Uniform Acceleration Under a Constant Force, Forces that Depend on Position: The Concepts of Kinetic and Potential Energy, **Dynamics of systems of Particles:** Introduction - Centre of Mass and Linear Momentum of a system - Angular momentum and Kinetic Energy of a system, Mechanics of Rigid bodies - Planar motion: - Centre of mass of Rigid body - some theorem of Static equilibrium of a Rigid body - Equilibrium in a uniform gravitational field.

Unit-II

Rotation of a Rigid body about a fixed axis, **Moment of Inertia:** calculation of moment of Inertia Perpendicular and Parallel axis theorem - Physical pendulum - A general theorem concerning Angular momentum - Laminar Motion of a Rigid body - Body rolling down an inclined plane (with and without slipping).

Unit-III

Motion of Rigid bodies in three dimension - Angular momentum of Rigid body products of Inertia, Principles axes - Determination of principles axes - Rotational Kinetic Energy of Rigid body - Momentum of Inertia of a Rigid body about an arbitrary axis - The momental ellipsoid - Euler's equation of motion of a Rigid body

Unit-IV

Lagrange Mechanics: - Generalized Coordinates - Generalized forces - Lagrange's Equations and their applications - Generalized momentum - Ignorable coordinates - Hamilton's variational principle - Hamilton function - Hamilton's Equations - Problems - Theorems.

Text Book:

Analytical Mechanics by G.R.Fowles, CBS Publishing, 1986

Reference:

[1] textbfAnalytical Mechanics by Farano,Marmi.

[2] textbfAnalytical Mechanics by L N Hand, J D Finch.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM 105 **Semester - I**

Paper - V: **INTEGRAL TRANSFORMS**

Unit-I

Fourier Transforms: Introduction - Classes of functions - Fourier Series and Fourier Integral Formula - Fourier Transforms - Fourier sine and cosine Transforms - Linearity property - Change of Scale property - Shifting property - The Modulation theorem - Evaluation of integrals by means of inversion theorems - Fourier Transform of some particular functions - Convolution or Faltung of two integrable functions - Convolution or Falting or Faltung Theorem for FT – Parseval's relations - Fourier Transform of the derivative of a function - Fourier Transform of some more useful functions - Fourier Transforms of Rational Functions - Other important examples concerning derivative of FT - The solution of Integral Equations of Convolution Type - Fourier Transform of Functions of several variables - Application of Fourier Transform to Boundary Value Problems.

Unit II

Laplace Transforms: Introduction - Definitions - Sufficient conditions for existence of Laplace Transform - Linearity property of Laplace Transform - Laplace transforms of some elementary functions - First shift theorem - Second shift theorem - The change of scale property - Examples - Laplace Transform of derivatives of a function - Laplace Transform of Integral of a function - Laplace Transform of t_nf(t)- Laplace Transform of f(t)/t - Laplace Transform of a periodic function - The Initial-Value Theorem and the Final-Value Theorem of Laplace Transform - Examples - Laplace Transform of some special functions - The Convolution of two functions - Applications.

Unit III

Inverse Laplace Transforms & **Applications:** Introduction - Calculation of Laplace inversion of some elementary functions - Method of expansion into partial fractions of the ratio of two - The general evaluation technique of inverse Laplace transform - Application of Laplace Transforms. **Finite Laplace Transforms:** Introduction - Definition of Finite Laplace Transform - Finite Laplace Transform of elementary functions - Operational Properties - The Initial Value and the Final Value Theorem - Applications.

Unit-IV

The Mellin Transform: Introduction - Definition of Mellin Transform - Mellin Transform of derivative of a function - Mellin Transform of Integral of a function - Mellin Inversion theorem - Convolution theorem of Mellin Transform - Illustrative solved Examples - Solution of Integral equations - Application to Summation of Series - The Generalised Mellin Transform - Convolution of generalised Mellin Transform - Finite Mellin Transform. **The Z-Transform:** Introduction - Transform: Definition - Some Operational Properties of Z-Transform - Application of Z-Transforms.

Text Book:

[1] An Introduction to Integral Transforms by Baidyanath Patra, CRC Press, Taylor Francis Group.

References:

[1] Integral Transforms by A.R.Vasishta and R.K.Guptha.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M 201 **Semester - II**

Paper - I: **Galois Theory**

Unit-I
Algebraic extensions of fields: Irreducible polynomials and Eisenstein criterion - Adjunction of roots - Algebraic extensions - Algebraically closed fields (Pages 281 to 299).

Unit-II
Normal and separable extensions: Splitting fields - Normal extensions - Multiple roots - Finite fields - Separable extensions (Pages 300 to 321).

Unit-III
Galois theory: Automorphism groups and fixed fields - Fundamental theorem of Galois theory - Fundamental theorem of Algebra (Pages 322 to 339).

Unit-IV
Applications of Galois theory to classical problems: Roots of unity and cyclotomic polynomials - Cyclic extensions - Polynomials solvable by radicals - Ruler and Compass constructions. (Pages 340 - 364).

Text Book:

Basic Abstract Algebra S.K. Jain, P.B. Bhattacharya, S.R. Nagpaul.

References:

[1] Topics in Algebra by I.N. Herstein.

[2] Elements of Modern Algebra by Gibert& Gilbert.

[3] Abstract Algebra by Jeffrey Bergen.

[4] Basic Abstract Algebra by Robert B Ash.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M 202 **Semester - II**

Paper - II: **Lebesgue Measure & Integration**

Unit-I
Algebra of sets - Borel sets - Outer measure - Measurable sets and Lebesgue measure - A non - measurable set - Measurable functions - Littlewood three principles.

Unit-II
The Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a non - negative function - The general Lebesgue integral.

Unit-III
Convergence in measure - Differentiation of a monotone functions - Functions of bounded variation.

Unit-IV
Differentiation of an integral - Absolute continuity - The Lp - spaces - The Minkowski and Holder's inequalities - Convergence and completeness.

Text Book:

Real Analysis (3rd Edition)(Chapters 3, 4, 5) by H. L. Royden Pearson Education (Low Price Edition).

References:

[1] Lebesgue measure and Integration by G.de Barra.

[2] Measure and Integral by Richard L.Wheeden, Anotoni Zygmund.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M/MCS 203 **Semester - II**

Paper - III: **Complex Analysis**

Unit-I

Regions in the Complex Plane - Functions of a Complex Variable - Mappings - Mappings by the Exponential Function - Limits - Limits Involving the Point at Infinity - Continuity - Derivatives - Cauchy – Riemann Equations - Sufficient Conditions for Differentiability - Analytic Functions - Harmonic Functions - Uniquely Determined Analytic Functions - Reflection Principle - The Exponential Function - The Logarithmic Function - Some Identities Involving Logarithms - Complex Exponents - Trigonometric Functions - Hyperbolic Functions

Unit-II

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals - Some Examples - Examples with Branch Cuts - Upper Bounds for Moduli of Contour Integrals – Anti derivatives - Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus Principle.

Unit-III

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series - Continuity of Sums of Power Series - Integration and Differentiation of Power Series - Uniqueness of Series Representations - Isolated Singular Points - Residues - Cauchy's Residue Theorem - Residue at Infinity - The Three Types of Isolated Singular Points - Residues at Poles - Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near Isolated Singular Points.

Unit-IV

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma - Indented Paths - Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem - Linear Transformations - The Transformation $w = 1/z$ - Mappings by $1/z$ - Linear Fractional Transformations - An Implicit Form - Mappings of the Upper Half Plane.

Text Book:

Complex Variables with applications by James Ward Brown, Ruel V Churchill.

References:

[1] Complex Analysis by Dennis G.Zill.

[2] Complex Variables by Stevan G. Krantz.

[3] Complex Variables with Applications by S.Ponnusamy, Herb Silverman.

[4] Complex Analysis by Joseph Bak, Donald J. Newman.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM 204 **Semester - II**

Paper - IV: **Fluid Mechanics**

Unit-I

General Orthogonal Curvilinear Coordinates: Definition **Kinematics of fluids in motion:** Real fluids and ideal fluids - velocity of a fluid at a point - Lagrangian and Eulerian methods - stream lines, path lines and streak lines - steady and unsteady flows - The velocity potential - the vorticity vector - Local and particle rates of change - Acceleration of fluid - The Equation of Continuity (Vector and Cartesian form) - conditions at a rigid boundary.

Unit-II

Equations of Motion of Fluid: Euler's equations of motion (Vector and Cartesian form) - Lagrange's equations of Motion - Equation in one dimensional flow problems: Bernoulli's Theorem - Kelvins circulation theorem. **Motion in two dimension:** velocity potential, Stream function - physical meaning of stream function.

Unit-III

Some Two Dimensional Flows: The complex potential - Irrotational motion - Stream function - Source, Sinks and Doublets and their Images - General theory of Irrotational - Milne Thomson Circle Theorem - Applications of circle theorem. The Magnus effect - The Therorem of Blasius.

Unit-IV

Irrotational Motion in Two Dimensions: Two - dimensional Irrotational motion produced by motion of circular cylinder, two coaxial cylinders. Equations of motion of a circular cylinder - Ellliptic coordinate - Motion of an Elliptic cylinder.

Text Books:

[1] **Textbook of Fluid Dynamics** by FRANK CHORLTON, CBS - Publishers, New Delhi,India.

[2] **A Treatise on Hydro - Mechanics (Part - II)** by W.H.BESANT and A.S.RAMSEY, CBS - Publishers, New Delhi, India

References:

[1] Fluid Dynamics by M.D.RAISINGHANIA S.Chand & Company, New Delhi.

[2] Introduction to Fluid Mechanics by Edward J. Shanghnessy

[3] Flow Visualization by Merzkirch.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Applied Mathematics

AM/M 205 **Semester - II**

Paper - V: **Theory of Ordinary Differential Equations**

Unit-I

Linear differential equations of higher order: Introduction - Higher order equations - A Modelling problem – Linear Independence - Equations with constant coefficients Equations with variable coefficients - Wronskian - Variation of parameters - Some Standard methods.

Unit-II

Existence and uniqueness of solutions: Introduction - Preliminaries - Successive approximations - Picard's theorem - Continuation and dependence on intial conditions - existence of solutions in the large - existence and uniqueness of solutions of systems - fixed point method.

Unit-III

Analysis and methods of non - linear differential equations: Introduction - Existence theorem – Extremal solutions - Upper and Lower solutions - Monotone iterative method and method of quasi linearization - Bihari's inequality, Application of Bihari's inequality

Unit-IV

Oscillation theory for linear Differential Equation of Second order: The adjoint equation - Self adjoint linear differential equation of second order - Abel's formula - the number of zeros in a finite interval - The sturm separation theorem - the sturm comparison theorem – the sturmpicone the Bocher Osgood theorem - A special pair of solution - Oscillation on half axis.

Text Book:

[2] **Text book of Ordinary Differential Equation**, By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.

References:

[1] **Text Book of Ordinary Differential Equations** by Earl A Coddington.

[2] Differential Equations by Edward, Penny, Calvis.

[3] Differential Equation by Harry Hochstardt.

DEPARTMENT OF MATHEMATICS, OSMANIA UNIVERSITY

(Choice Based Credit System)

(w.e.f. the academic year 2018-2019)

M.Sc. Mathematics with Computer Science

SEMESTER – I

Subject	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core 1	MCS 101	**Abstract Algebra**	6	5	1	100	5
Core 2	MCS 102	**Mathematical Analysis**	6	5	1	100	5
Core 3	MCS 103	**Discrete Mathematics**	6	5	1	100	5
Core 4	MCS 104	**Python Programming**	4	4		100	4
Core 5	MCS 105	**RDBMS**	4	4		100	4
Lab 1	Lab for Core 4	**Python Lab**	3			25	1
Lab 2	Lab for Core 5	**RDBMS Lab**	3			25	1
			32				25

T* - Tutorial Class for problems solving session.

SEMESTER – II

Subject	Code	Paper	Hours/ Week	Theory	T*	Max. Marks	Credits
Core 1	MCS 201	**Linear Algebra**	6	5	1	100	5
Core 2	MCS 202	**Ordinary and Partial Differential Equations**	6	5	1	100	5
Core 3	MCS 203	**Complex Analysis**	6	5	1	100	5
Core 4	MCS 204	**Design & Analysis of Algorithms**	4	4		100	4
Core 5	MCS 205	**Computer Organization**	4	4		100	4
Lab 3	Lab for Core 4	**Design & Analysis of Algorithms Lab**	3			25	1
Lab 4	Lab for Core 5	**Computer Organization Lab**	3			25	1
			32				25

T* - Tutorial Class for problems solving session.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS/M/AM 101 **Semester - I**

Paper - I: **Abstract Algebra**

Unit-I
Automorphisms - Conjugacy and G - sets - Normal series Solvable groups - Nilpotent groups. (Pages 104 to 128 of [1])

Unit-II
Structure theorems of groups: Direct product - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow's theorems - Groups of orders p^2, pq . (Pages 138 to 155)

Unit-III
Ideals and homomorphisms - Sum and direct sum of ideals, Maximal and prime ideals - Nilpotent and nil ideals - Zorn's lemma (Pages 179 to 211).

Unit-IV
Unique factorization domains - Principal ideal domains - Euclidean domains - Polynomial rings over UFD - Rings of Fractions.(Pages 212 to 228)

Text Book:

Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul.

References:

[1] Topics in Algebra by I.N. Herstein.

[2] Elements of Modern Algebra by Gibert& Gilbert.

[3] Abstract Algebra by Jeffrey Bergen.

[4] Basic Abstract Algebra by Robert B Ash.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS/M/AM 102 **Semester - I**

Paper - II: **Mathematical Analysis**

Unit-I
Metric spaces - Compact sets - Perfect sets - Connected sets.

Unit-II
Limits of functions - Continuous functions - Continuity and compactness, Continuity and connectedness - Discontinuities - Monotone functions.

Unit-III
Riemann - Steiltjes integral - Definition and Existence of the Integral - Properties of the integral - Integration of vector valued functions - Rectifiable curves.

Unit-IV
Sequences and series of functions: Uniform convergence - Uniform convergence and continuity - Uniform convergence and integration - Uniform convergence and differentiation - Approximation of a continuous function by a sequence of polynomials.

Text Book:

[1] **Principles of Mathematical Analysis**, (3rd Edition) (Chapters 2, 4, 6) By Walter Rudin, Mc Graw - Hill Internation Edition.

References:

[1] The Real Numbers by John Stillwel.

[2] Real Analysis by Barry Simon

[3] Mathematical Analysis Vol - I by D J H Garling.

[4] Measure and Integral by Richard L.Wheeden and Antoni Zygmund.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 103 **Semester - I**

Paper - III: **Discrete Mathematics**

Unit-I

Mathematical Logic: propositional logic, propositional equivalences, predicates & quantifiers, rule of inference,direct proofs, proof by contraposition, proof by contradiction. **Boolean Algebra:** Boolean functions and its representation, logic gates, minimizations of circuits by using Boolean identities and K - map.

Unit-II

Basic Structures: Sets representations, set operations, functions, sequences and summations. Division algorithm, modular arithmetic, solving congruences, applications of congruences. **Recursion:** Proofs by mathematical induction, recursive definitions, structural induction, generalized induction, recursive algorithms .

Unit-III

Counting: Basic counting principle, inclucombinations, Binomial coefficient and identities, generalized permutations and combinations, Binomial coefficient and identities, generalized permutations and combinations. Recurrence Relations: introduction, solving linear recurrence relations, generating functions, principle of inclusion - exclusion, applications of inclusion - exclusion. Relations: relations and their properties, representing relations, closures of relatpartial orderings.ions, equivalence relation

Unit-IV

Graphs: Graphs definitions, graph terminology, types of graphs, representing graphs, graph isomorphism, connectivity of graphs, Euler and Hamilton paths and circuits, Dijkstra's algorithm to find shortest path, planar graphs – Euler's formula and its applications, graph coloring and its applications Trees: Trees definitions – properties of trees, applications of trees – BST, Haffman Coding, tree traversals: pre - order, in - order, post - order, prefix, infix, postfix notations, spanning tress – DFS, BFS, Prim's, Kruskal's algorithms.

Text Book:

[1]**Discrete Mathematics and its Applications (7e)** by Kenneth H. Rosen.

References:

[1] Discrete and Combinatorial Mathematics by Ralph P. Grimaldi

[2] Discrete Mathematics for Computer Scientists by Stein, Drysdale, Bogart.

[3] Mathematical Analysis Vol - I by D J H Garling.

[4] Discrete Mathematics for Computer Scientists and Mathematicians by Joe L. Mott, Abraham Kandel, Theoder P. Baker.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 104 **Semester - I**

Paper - IV: **Python Programming**

Unit-I

Introduction to computer systems, computer languages, language translators, feature of python, writing and executing python programs, comments, keywords, identifiers, built - in data types, variables, literals, sequences, sets, operators (assignment, arithmetic, unary, Boolean, relational, logical, bitwise, membership, identity), operator precedence and associativity, type conversion, expression evaluation, simple input - output statements.

Unit-II

Control **Statements:** if, if - else, if - elif - else, while, for, else suite, break, continue, pass, return. **Strings:** creating, indexing, slicing, manipulating, operations, testing methods. **Functions:** defining, calling, returning single and multiple values, pass by object reference, different types of arguments, recursive functions, and anonymous functions. Modules: importing, using, creating own modules, exploring math, random, time modules.Lists, **Tuples and Dictionaries:** creating, indexing, slicing, manipulating, operations, methods.

Unit-III

Features of OOPs, classes, objects, constructor, self - variable, types variables, name spaces, types of methods, inner classes, inheritance, super method, types of inheritance, polymorphism, operator overloading, method overloading, method overriding, abstract methods, abstract classes, interfaces.

Unit-IV

Exceptions: types of errors, important exception classes, types of exceptions, exception handling (try, except, else, finally), assert statement, user defined exceptions. **Files:** types of files, file opening modes, operations on files (open, close, read, write, seek, tell, random access), file attributes, working with directories. **Regular Expressions:** Introduction, sequence characters, quantifiers, special characters, examples. **GUI:** Introduction, canvas, frame, widgets, layout managers, examples using widgets. Execute basic SQL commands using Pythons database connectivity.

Text Book:

[1] **Core Python Programming** (2017) Edition by R. Nageswara Rao.

References:

[1] Mark Lutz, Learning Python

[2] Wesley Chun, Core Python Programming

[3] Kenneth A. Lambert, Fundamentals of Python

[4] T. R. Padmanabhan, Programming with Python

[5] Zed A Shaw, Learn More Python 3 the Hard way

[6] Charles Dierach, Introduction to Computer Science using Python

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 104 **Semester - I**

Paper - IV: **Python Lab**

1. Write a program to get your details and display it by using simple I/O statements.
2. Write a program using arithmetic, relational, logical and bitwise operators.
3. Write a program to find the largest three integers using if - else and if - elif - else.
4. Write a program to print the prime numbers up to given number n (for).
5. Writea program to print the Fibonacci sequence up to given number n (while).
6. Write a program to demonstrate the use of break, continue, pass statements.
7. Write recursive and non - recursive functions for the following:
   a. To find GCD of two integers.
   b. To find the factorial of positive integer
   c. To print Fibonacci sequence up to given number n
8. Write a program to demonstrate use of anonymous functions.
9. Write a program to demonstrate different operations on strings.
10. Write a program to demonstrate different operations on Lists.
11. Write a program to demonstrate different operations on Tuples.
12. Write a program to demonstrate different operations on Dictionaries.
13. Write a program to demonstrate use of modules and creating your own modules.
14. Write a program to implement the constructor overloading and method overloading.
15. Write a program to implement the multiple inheritance.
16. Write a program to implement the operator overloading.
17. Write a program to implement the dynamic polymorphism.
18. Write a program to demonstrate use of abstract class and interface.
19. Write a program to demonstrate the exception handling.
20. Write a program to demonstrate the regular expressions.
21. Write a program to create file, write the content and display the contents of the file.
22. Write a program to analyze the contents of two text files using set operations.
23. Write a GUI program that converts Celsius temperatures to Fahrenheit temperatures.
24. Write a GUI program that displays your details when a button is clicked.

Note: Explain installation of python and creating, ruining the python programs in different ways.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 105 **Semester - I**

Paper - V: **RDBMS**

Unit-I

Introduction: Database System Applications, Purpose of database systems, View of Data, Database Languages, Relational Databases, Database Design, Database Architecture, Database Users and Administrators, Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, The Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus.

Unit-II

Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, SQL Additional Basic Operations, Set Operations, Null Values,SQL Aggregate Functions, Nested Sub - queries, Modification of the Database. The Entity - Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity - Relationship Diagrams, Reduction to Relational Schemas, Entity - Relationship Design Issues, Extended E - R Features.

Unit-III

Features of Good Relational Designs – Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, 2NF, 3NF, BCNF, 4NF, 5NF. SQL, views, Integrity constraints, Functions and Procedures, Triggers. File Organization, Organization of Records in Files, Data - Dictionary Storage, Indexing and Hashing, Basic Concepts, Ordered Indices, B+ - Tree Index, Files, B+ - Tree Extensions, Static Hashing, Dynamic Hashing, Bitmaps Indices.

Unit-IV

Transaction Concept,a Simple Transaction Model,Transaction Atomicity and Durability, Transaction Isolation, Serializabitlity,Transaction Isolation and Atomicity,TransactionIsolation Levels, Implementation of Isolation Levels. Concurrency Control, Lock based Protocols, Deadlock Handling, Multiple Granularity, Time - stamp based protocols, Validation based protocol, Multiversion Schemes. Recovery System, Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management.

Text Book:

[1] **Database System Concepts** by Abraham Silberschatz, Henry F. Korth, S. Sudarshan

References:

[1] Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems

[2] Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems

[3] Jeffrey A. Hoffer, V. Ramesh, HeikkiTopi, Modern Database Management

[4] Thomas M. Connolly, Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation, and Management

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 105 **Semester - I**

Paper - IV: **RDBMS Lab**

I. Create the tables using the university scheme and write the following queries in SQL

1. Find the titles of courses in the Comp. Sci. department that have 3 credits.
2. Find the names of all instructors in the Computer Science department who have salary greater than $70,000.
3. Retrieve the names of all instructors, along with their department names and department building name.
4. For all instructors in the university who have taught some course, find their names and the course ID of all courses they taught using where clause.
5. For all instructors in the university who have taught some course, find their names and the course ID of all courses they taught using natural join.
6. Find the names of all departments whose building name includes the substring 'Watson'.
7. Find the names of instructors with salary amounts between $90,000 and 100,000$.
8. Same above query using between.
9. Find all courses taught in the Spring 2010 semester.
10. Find all courses taught either in Fall 2009 or in Spring 2010, or both.
11. Find the all courses taught in the Fall 2009 as well as in Spring 2010.
12. Find all courses taught in the Fall 2009 semester but not in the Spring 2010 semester.
13. Find the average salary of instructors in the Computer Science department.
14. Find the total number of instructors who teach a course in the Spring 2010 semester."
15. Find the number of tuples in the course relation.
16. Find the average salary in each department.
17. Find the number of instructors in each department who teach a course in the Spring 2010 semester
18. Find the average salary of instructors in those departments where the average salary is more than $42,000.
19. For each course section offered in 2009, find the average total credits (tot cred) of all students enrolled in the section, if the section had at least 2 students.
20. Find all the courses taught in the Fall 2009 semester but not in the Spring 2010 sem.
21. Find the total number of (distinct) students who have taken course sections taught by the instructor with ID 110011"
22. Find the names of all instructors that have a salary value greater than that of each instructor in the Biology department.
23. Find the departments that have the highest average salary
24. Find all students who have not taken a course using natural left outer join.
25. Find all students who have not taken a course using natural right outer join.
26. Create a view that lists all course sections offered by the Physics department in the Fall 2009 semester with the building and room number of each section.
27. Find all Physics courses offered in the Fall 2009 semester in the Watson building in above view.
28. Increase the salary of each instructor in the Comp. Sci. department by 10%.
29. Delete all courses that have never been offered (i.e., do not occur in section relation).

30. Insert every student whose tot_cred attribute is greater than 100 as an instructor in the same Department, with a salary of $10,000.

II. Given relation schemas are Sailors(sid : integer, sname : string, rating : integer, age : real) Boats(bid : integer, bname : string, color : string) Reserves(sid : integer , bid : integer, day : date)

1. Find the names and ages of all sailors.
2. Find all sailors with a rating above 7.
3. Find the names of sailors who have reserved boat 103.
4. Find the sids of sailors who have reserved a red boat.
5. Find the names of sailors who have reserved a red boat.
6. Find the colors of boats reserved by Lubber.
7. Find the names of sailors who have reserved at least one boat.
8. Find the names of sailors who have reserved at least two boats.
9. Compute increments for the ratings of persons who have sailed two different boats on the same day.
10. Find the ages of sailors whose name begins and ends with B and has at least three characters.
11. Find the names of sailors who have reserved a red or a green boat.
12. Find the names of sailors who have reserved a red and a green boat.
13. Find the sids of all sailors who have reserved red boats but not green boats.
14. Find all sids of sailors who have a rating of 10 or have reserved boat 104.
15. Find the names of sailors who have not reserved a red boat.
16. Find sailors whose rating is better than some sailor called Horatio.
17. Find sailors whose rating is better than every sailor called Horatio.
18. Find the names of sailors who have reserved all boats.
19. Find the names of sailors who have reserved at least two boats.
20. Find the names of sailors who have reserved all boats called Interlake.
21. Find sailors who have reserved all red boats.
22. Find the sailor name, boat id, and reservation date for each reservation.
23. Find the sids of sailors with age over 20 who have not reserved a red boat.
24. Find the average age of all sailors.
25. Find the average age of sailors with a rating of 10.
26. Find the name and age of the oldest sailor.
27. Count the number of different sailor names.
28. Find the names of sailors who are older than the oldest sailor with a rating of 10.
29. Find the sailors with the highest rating.
30. Find the age of the youngest sailor for each rating level.
31. Find age of the youngest sailor who is eligible to vote for each rating level with at least 2 such sailors.
32. Find the average age of sailors for each rating level that has at least two sailors.
33. For each red boat, find the number of reservations for this boat.
34. Find the average age of sailors who are of voting age (i.e., at least 18 years old) for each rating level that has at least two sailors.
35. Delete the records of sailors who have rating 8 (deleting some rows in a table).

III. Write a program to explain views in SQL.

IV. Write a program to explain functions in SQL.

V. Write a program to explain procedures in SQL.

VI. Write a program to explain triggers in SQL.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 201 **Semester-II**

Paper - I: **Linear Algebra**

Unit-I

Elementary Canonical forms Introduction, Characterestic Values, Annihilating Polynomials, Invariant Subspaces, Simultaneous Triangulation and Simultaneous Diagonalization (Ch6, Sec 6.1 - 6.5).

Unit-II

Direct sum Decomposition, Invariant Direct sums, The Primary Decomposition Theorem (Ch6, Sec6.6 - 6.8).
The Rational and Jordan Forms: Cyclic Subspaces and Annihilators(Ch7, Sec 7.1)

Unit-III

Cyclic Decompositions and the Rational Form, The Jordan Form, Computation of Invariant Factors, Semi Simple Operators (Ch7, Sec 7.2 - 7.5)

Unit-IV

Bilinear Forms: Bilinear Forms, Symmetric Bilinear Forms, Skew - Symmetric Bilinear Forms, Groups Preserving Bilinear Forms (Ch10, Sec 10.1 - 10.4)

Text Book:

[1] **Linear Algebra** by Kenneth Hoffman and Ray Kunze (2e) PHI

References:

[1] Advanced Linear Algebra by Steven Roman (3e)

[2] Linear Algebra by David C Lay

[3] Linear Algebra by Kuldeep Singh

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc.Mathematics with Computer Science

MCS 202 **Semester -II**

Paper - II: **Ordinary and Partial Differential Equations**

Unit-I

Existence and Uniqueness of solution of $\frac{dy}{dx} = f(x, y)$ and problems there on. The method of successive approximations - Picard's theorem - Non - Linear PDE of order one - Charpit's method - Cauchy's method of Characteristics for solving non - linear partial differential equations - Linear Partial Differential Equations with constant coefficients.

Unit-II

Partial Differential Equations of order two with variable coefficients - Canonical form - Classification of second order Partial Differential Equations - separation of variables method of solving the one - dimensional Heat equation, Wave equation and Laplace equation - Sturm - Liouville's boundary value problem.

Unit-III

Power Series solution of O.D.E. – Ordinary and Singular points - Series solution about an ordinary point - Series solution about Singular point - Frobenius Method.

Lagendre Polynomials: Lengendre's equation and its solution - Lengendre Polynomial and its properties - Generating function - Orthogonal properties - Recurrance relations - Laplace's definite integrals for $P_n(x)$ - Rodrigue's formula.

Unit-IV

Bessels Functions: Bessel's equation and its solution - Bessel function of the first kind and its properties - Recurrence Relations - Generating function - Orthogonality properties.

Hermite Polynomials: Hermite's equation and its solution - Hermite polynomial and its properties - Generating function - Alternative expressions (Rodrigue's formula) - Orthogonality properties - Recurrence Relations.

Text Books:

[1] **Ordinary and Partial Differential Equations** By M.D. Raisingania, S. Chand Company Ltd., New Delhi.

[2] **Text book of Ordinary Differential Equation** By S.G.Deo, V. Lakshmi Kantham, V. Raghavendra, Tata Mc.Graw Hill Pub. Company Ltd.

[3] **Elements of Partial Differential Equations** By Ian Sneddon, Mc.Graw - Hill International Edition.

Reference:

[1] Worldwide Differential equations by Robert McOwen.

[2] Differential Equations with Linear Algebra by Boelkins, Goldberg, Potter.

[3] Differential Equations By Paul Dawkins.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc.Mathematics with Computer Science

MCS/M/AM 203 **Semester -II**

Paper - III: **Complex Analysis**

Unit-I

Regions in the Complex Plane - Functions of a Complex Variable - Mappings - Mappings by the Exponential Function - Limits - Limits Involving the Point at Infinity - Continuity - Derivatives - Cauchy – Riemann Equations - Sufficient Conditions for Differentiability - Analytic Functions - Harmonic Functions - Uniquely Determined Analytic Functions - Reflection Principle - The Exponential Function - The Logarithmic Function - Some Identities Involving Logarithms - Complex Exponents - Trigonometric Functions - Hyperbolic Functions

Unit-II

Derivatives of Functions $w(t)$ - Definite Integrals of Functions $w(t)$ - Contours - Contour Integrals - Some Examples - Examples with Branch Cuts - Upper Bounds for Moduli of Contour Integrals – Anti derivatives - Cauchy – Goursat Theorem - Simply Connected Domains - Multiply Connected Domains - Cauchy Integral Formula - An Extension of the Cauchy Integral Formula - Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum Modulus Principle.

Unit-III

Convergence of Sequences - Convergence of Series - Taylor Series - Laurent Series - Absolute and Uniform Convergence of Power Series - Continuity of Sums of Power Series - Integration and Differentiation of Power Series - Uniqueness of Series Representations - Isolated Singular Points - Residues - Cauchy's Residue Theorem - Residue at Infinity - The Three Types of Isolated Singular Points - Residues at Poles - Examples - Zeros of Analytic Functions - Zeros and Poles - Behavior of Functions Near Isolated Singular Points.

Unit-IV

Evaluation of Improper Integrals - Improper Integrals from Fourier Analysis - Jordan's Lemma - Indented Paths - Definite Integrals Involving Sines and Cosines - Argument Principle - Rouche's Theorem - Linear Transformations - The Transformation $w = 1/z$ - Mappings by $1/z$ - Linear Fractional Transformations - An Implicit Form - Mappings of the Upper Half Plane.

Text Book:

[1] **Complex Variables with applications** by James Ward Brown, Ruel V Churchill.

References:

[1] Complex Analysis by Dennis G.Zill.

[2] Complex Variables by Stevan G. Krantz.

[3] Complex Variables with Applications by S.Ponnusamy, Herb Silverman.

[4] Complex Analysis by Joseph Bak, Donald J. Newman.

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 204 **Semester -II**

Paper - IV: **Design and Analysis of Algorithms**

Unit-I

Introduction: Definition of an algorithms, algorithm specification, performance analysis – space complexity, time complexity, amortized complexity (briefly), asymptotic notations, performance measurement. Elementary data structures: stacks, queues, tress, binary search trees, heaps, heap sort, graph representations. Divide - and - Conquer: general method, binary search, finding maximum and minimum, merge sort, quick sort, strassen's matrix multiplication.

Unit-II

The Greedy Method: general method, knapsack problem, job sequencing with deadlines, minimum - cost spanning trees – prims algorithm, kruskals algorithm, optimal storage on tapes, optimal merge patterns – Huffman codes, single source shortest paths.Dynamic Programming: general method, multistage graphs, all - pairs shortest paths, single - source shortest paths, optimal binary search trees, 0/1 knapsack, traveling salesperson problem.

Unit-III

Basic Traversal and Search Techniques: BFS, DFS, spanning trees, bi - connected components. Backtracking: general method, 8 - quens problem, sum of subsets, graph coloring, Hamiltonian cycles, knapsack problem.

Unit-IV

Branch - and - Bound: general method, 0/1 knapsack problem, travelling salesperson problem.NP - Hard and NP - Complete Problems: introduction, non - deterministic algorithms, classes NP - hard and NP - complete, cook's theorem, NP - hard graph problems, NP - hard scheduling problems, and simplified NP - hard problems.

Text Book:

[1] **Fundamentals of Computer Algorithms** by E. Horowitz, S. Sahni.

References:

[1] Richard Neapolitan, Foundations of Algorithms

[2] Thomas H. Cormen, Introduction to Algorithms

[3] Donald E Knuth, The Art of Programming Volumes 1, 2, 3, 4

[4] AnanyLevitin, Introduction to the Design and Analysis of Algorithms

[5] 5. A.V. Aho, J.V. Hopcroft, J.D. Ullmann, The Design and Analysis of Computer Algorithms

DEPARTMENT OF MATHEMATICS
OSMANIA UNIVERSITY

Paper - IV: **Design and Analysis of Algorithms – Lab**

1. Write a program recursive and non - recursive function for the following:
   a) Factorial of an integer b) GCD of two integers c) Fibonacci Sequence
2. Write a program for sorting the given list using Heap Sort.
3. Write a program to find the given number in a list using Binary Search.
4. Write a program for sorting the given list using Merge Sort.
5. Write a program for sorting the given list using Quick Sort.
6. Write a program to find product of two matrices using strassen's matrix multiplication.
7. Write a program to demonstrate the knapsack problem.
8. Write a program to demonstrate the job sequencing with deadlines.
9. Write a program to demonstrate the single source shortest paths problem.
10. Write a program to demonstrate the all - pairs shortest paths problem.
11. Write a program to demonstrate the travelling salesperson problem.
12. Write a program to demonstrate the BSF technique on graphs.
13. Write a program to demonstrate the DFS technique on graphs.
14. Write a program to demonstrate the graph coloring problem.
15. Write a program to find the Hamiltonian circuit for a weighted graph.
16. Write a program to find the minimum spanning tree using Prim's Algorithm.
17. Write a program to find the minimum spanning tree using Kruskal's Algorithm

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OSMANIA UNIVERSITY

M.Sc. Mathematics with Computer Science

MCS 205 **Semester -II**

Paper - V: **Computer Organization**

Unit-I
Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map Simplification, Combinational Circuits, Flip - Flops, Sequential Circuits. Digital Components: Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit. Data Representation: Data Types, Complements, Fixed Point Representations, Floating Point Representation, Binary Codes, and Error Detection Codes.

Unit-II
Register Transfer and Microoperations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Microoperations, Logic Microoperations, and Shift Microoperations. Basic Computer Organization and Design: Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input - Output and Interrupt, Design of Accumulator Logic. Programming the Basic Computer: Machine Language, Assembly Language, The Assembler Program Loops, Programming Arithmetic and Logic Operations, Subroutines, Input - Output Programming.

Unit-III
Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer. Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipelines, Instruction Pipelines and RISC Pipelines, Vector Processing. Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms, and Floating Point Arithmetic Operations, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

Unit-IV
Input - Output Organization: Peripheral Devices, Input - Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input - Output Processor, Serial Communication. Memory Organization: Memory Hierarchy, Main Memory, RAM and ROM, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Text Book:

[1] **Computer System Architecture (3e)** by M. Morris Mano

References:

[1] Andrew S. Tanenbaum, Structured Computer Organization

[2] William Stallings, Computer Organization and Architecture

[3] ZviKohavi, Niraj K. Jha, Switching and Finite Automata Theory

[4] Sajjan G. Shiva, Computer Organization, Design and Architecture

[5] David A. Patterson, John L. Hennessy, Computer Organization Design

[6] Sivarama P. Dandamudi, Fundamentals of Computer Organization and Design

[7] David Money Harris, Sarah L. Harris, Digital Design and Computer Architecture

[8] Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization and Embedded Systems

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Paper - IV: **Computer Organization – Lab**

1. Implementation of various logic gates using NAND gate.
2. Implementation of the half adder and full adder.
3. Implementation of the sub - tractor.
4. Demonstrate of the RS flip - flop, D flip - flop, T flip - flop and JK flip - flop.
5. Implementation of the shift registers,
6. Implementation of the decoders and encoders
7. Implementation of the multiplexers and de - multiplexers
8. Design of counters.
9. Implementation of the addition algorithm
10. Implementation of the subtraction algorithm
11. Implementation of the multiplication algorithm
12. Implementation of the booths multiplication algorithm
13. Implementation of the division algorithm
14. Implementation of the simple ALU.
15. Simulation of direct memory access technique
16. Simulation of associative memory technique

Note: Using any simulator perform the following functions