SATAVAHANA UNIVERSITY
DEPARTMENT OF MATHEMATICS

M.Sc. (MATHEMATICS)
Course structure, Syllabus, Scheme of instruction and Examination
Choice Based Credit System
(With effect from the academic year 2019-2020)

Semester –I:

Paper	Code of the paper	Title of the Paper	Credits	Number of periods per week (each period is of 1 hour duration)			Maximum marks		
				L	T	Total	Univ. Exam	I.A.	Total
I	MS1CP1	Abstract Algebra	5	5	2	7	100	25	125
II	MS1CP2	Mathematical Analysis-I	5	5	2	7	100	25	125
III	MS1CP3	Ordinary differential equations and Special functions	5	5	2	7	100	25	125
IV	MS1CP4	Discrete Mathematics	5	5	2	7	100	25	125
V	MS1CP5	Elementary Number theory	5	5	2	7	100	25	125
		TOTAL	25	25	10	35	500	125	625

Semester –II:

Paper	Code of the paper	Title of the Paper	Credits	Number of periods per week (each period is of 1 hour duration)			Maximum marks		
				L	T	Total	Univ. Exam	I.A.	Total
I	MS2CP1	Galois Theory	5	5	2	7	100	25	125
II	MS2CP2	Mathematical Analysis-II	5	5	2	7	100	25	125
III	MS2CP3	Partial differential equations and Boundary value problems	5	5	2	7	100	25	125
IV	MS2CP4	Metric spaces	5	5	2	7	100	25	125
V	MS2CP5	Integral equations and Calculus of variations	5	5	2	7	100	25	125
		TOTAL	25	25	10	35	500	125	625

Semester –III:

Paper	Code of the paper	Title of the Paper	Credits	Number of periods per week (each period is of 1 hour duration)			Maximum marks		
				L	T	Total	Univ. Exam	I.A.	Total
I	MS3CP1	Complex analysis	5	5	2	7	100	25	125
II	MS3CP2	Integral transforms	5	5	2	7	100	25	125
III	MS3CP3	Topology	5	5	2	7	100	25	125
IV Any one of the paper	MS30P4(A)	Operations research	5	5	2	7	100	25	125
	MS30P4(B)	Fluid Mechanics							
	MS30P4(C)	Boolean algebra							
V Any one of the paper	MS30P5(A)	Theory of ordinary differential equations	5	5	2	7	100	25	125
	MS30P5(B)	Analytic mechanics							
	MS30P(C)	Fixed-point theory							
TOTAL			25	25	10	35	500	125	625

Semester –IV:

Paper	Code of the paper	Title of the Paper	Credits	Number of periods per week (each period is of 1 hour duration)			Maximum marks		
				L	T	Total	Univ. Exam	I.A.	Total
I	MS4CP1	Advanced Complex Analysis	5	5	2	7	100	25	125
II	MS4CP2	Lebesgue Measure and Integration	5	5	2	7	100	25	125
III	MS4CP3	Functional Analysis	5	5	2	7	100	25	125
IV any one of the paper	MS40P4(A)	Graph Theory	5	5	2	7	100	25	125
	MS40P4(B)	Elementary Operator theory							
	MS40P4(C)	Fundamentals of Statistics							
V any one of the paper	MS40P5(A)	Numerical Analysis	5	5	2	7	100	25	125
	MS40P5(B)	Algebraic Number theory							
	MS40P5(C)	Differential Geometry							
TOTAL			25	25	10	35	500	125	625

L: Lecture; T: Tutorial; I.A.: Internal assessment. For each paper of the tutorial, the strength of class is divided into two batches. Tutorial class for problem solving session.

The pattern of 1st Internal Assessment of each paper of Semester-I/II/III/ IV:

DEPARTMENT OF MATHEMATICS
M.Sc. (Mathematics)
1st Internal Assessment Examination
Paper I/ II/ III/ IV/ V

Time: 2 Hours Max Marks: 25.

Answer any FIVE the questions. Each question carry 5 marks.

1. A question from unit-I
2. A question from unit-I
3. A question from unit-I
4. A question from unit-I
5. A question from unit-II
6. A question from unit-II
7. A question from unit-II
8. A question from unit-II

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The pattern of 2nd Internal Assessment of each paper of Semester-I/II/III/ IV:

DEPARTMENT OF MATHEMATICS
M.Sc. (Mathematics)
2nd Internal Assessment Examination
Paper I/ II/ III/ IV/ V

Time: 2 Hours Max Marks: 25.

Answer any FIVE the questions. Each question carry 5 marks.

1. A question from unit-III
2. A question from unit-III
3. A question from unit-III
4. A question from unit-III
5. A question from unit-IV
6. A question from unit-IV
7. A question from unit-IV
8. A question from unit-IV

The pattern of University examination of each paper of Semester I/II/III/IV

DEPARTMENT OF MATHEMATICS
M.Sc. (Mathematics)

Papers I/ II/ III/ IV/ V

Time: 3 Hours Max Marks: 100

Answer all questions.
All questions carry equal Marks.

1. Answer all questions (each question carry 5 marks)
a) A short question From Unit-I
b) A short question From Unit-II
c) A short question From Unit-III
d) A short question From Unit-IV

2. Answer any two of the following (each question carry 10 marks)
a) Long Question from Unit-I
b) Long Question from Unit-I.
c) Long Question from Unit-I.
d) Long Question from Unit-I.

3. Answer any two of the following (each question carry 10 marks)
a) Long Question from Unit-II
b) Long Question from Unit-II
c) Long Question from Unit-II
d) Long Question from Unit-II

4. Answer any two of the following (each question carry 10 marks)
a) Long Question from Unit-III.
b) Long Question from Unit-III..
c) Long Question from Unit-III.
d) Long Question from Unit-III.

4. Answer any two of the following (each question carry 10 marks)
a) Long Question from Unit-IV.
b) Long Question from Unit-IV.
c) Long Question from Unit-IV.
d) Long Question from Unit-IV.

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-I: **Abstract Algebra**	Paper code
I		**MS1CP1**

Unit-I

Automorphisms - Conjugacy and G - sets - Normal series Solvable groups - Nilpotent groups. (Pages 104 to128 of Text book)

Unit-II

Structure theorems of groups: Direct product - Finitely generated abelian groups - Invariants of a finite abelian group - Sylow's theorems - Groups of orders p2, 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: 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
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-II: **Mathematical Analysis-I**	Paper code
I		**MS1CP2**

Unit I:

Power series –radius of convergence – some theorems – properties of functions expressible as power series –Abel's theorem (first form and second form) – Taylor's theorem

Fourier series-trigonometrical series –Fourier coefficients – some theorems – Main theorem – Fourier series of odd and even functions – Half-range series – interval other than $[-\pi, \pi]$

Unit-II:

Functions of several variables – Implicit functions – Explicit functions – Limit point – Limit of a function- algebra of limits – repeated limits –continuity - partial derivates - Mean value theorem – sufficient condition for continuity - Differentiability – Sufficient condition for differentiability

Unit III:

Change in the order of partial derivatives – sufficient condition for equality of f_{xy} and f_{yx} – differentials of higher order –Function of functions –Chain rule – change of variables – Taylor's theorem (two variables) – extreme values of function of two variables – extreme values of function of n variables.

Unit IV:
Improper integrals – integration of unbounded function with finite limits of integration – Comparison test for convergence at a - General test of convergence – infinite range of integration – comparison test for convergence at ∞ - General test for convergence at ∞ -Absolute convergence – integral as a product of function (convergence at ∞).

Text book: Mathematical Analysis – S.C.Malik and Savita Arora.
Reference books:

1. Elements of Real Analysis, R.G. Bartle
2. The Theory of Functions of a Real Variable
3. A first course in Real Analyis, M.H. Protter and C.B. Moray
4. Real and Abstract Analysis, Hewitt and Stromberg .K
5. A Course in Calculus and Real Analysis, S.R. Ghopade and B.V. Limaye
6. Analysis-I & II, Terence Tao

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-III: **Ordinary differential equations and Special functions**	Paper code
I		**MS1CP3**

Unit I:

Integration in series – introduction – some basic definitions – ordinary and singular points – power series solution in powers of $(x - x_o)$ –Frobenius method – series solution about regular singular point at ∞ - series solution of descending powers of independent variable.

UNIT II

Legendre's equation and its solution – Legendre's function of the first kind – Generating function for Legendre polynomials – Orthogonal properties of Legendre's polynomials – Recurrence relations – Beltrami's result – Rodrigues's formula – Legendre's series for a polynomial Expansion of function f(x) in a series of Legendre's polynomial – Even and odd function

(Chapter 9: Sec 9.1 to 9.3, 9.8 to 9.10, 9.13 to 9.19 of Text Book)

UNIT III

Bessel's equation and its solution – Bessel's function of the first kind of order n – List of important results of Gamma function and beta function – Bessels's function of the second kind of order n – Recurrence relations – Generating function for Bessels's function Jn(x) – Orthogonality of Bessels's function – Bessel-sereis or Fourier Bessel expansion of f(x).

(Chapter 11: Sec 11.1 to 11.5, 11.6A, 11.7, 11.7A, 11.7B, 11.8, 11.10, 11.11A of Text Book)

UNIT IV

Hermite's equation and its solution – Hermite polynomial of order n – Generating function for ermite polynomials – Alternative expressions for the Hermite polynomials – Hermite polynomials Hn(x) for some special values of n – Evaluation of values of H2n(0) and H2n+1(0)

– Orthogonality properties – recurrence relations (Chapter 12 of Text Book)

Text Book: Advanced Differential Equations- M.D. Raisinghania

References:

1. A text book of Ordinary differential equations – C.R. Mondal
2. Ordinary and Partial differential equations – Ravi P.Agarval, Donal O' Regan

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY
M.Sc. Mathematics

Semester	Paper-IV: **Discrete Mathematics**	Paper code
I		**MS1CP4**

UNIT I

Fundamentals of Logic : Fundamentals of logic-Logical inferences - Methods of proof of an implication – First order logic and other methods of proof - Rules of inference for propositions - Elementary Combinatorics: Rules of inference for quantified propositions. (Sec 1.5, 1.6, 1.7, 1.8 up to De Morgan Laws, 1.9 of Text Book 1)

UNIT II

Enumerating combinations and permutations with repetitions- Enumerating permutations with constrained repetitions- The principle of inclusion and exclusion.(Sec 2.1 to 2.5, 2.8 of Text Book 1)

UNIT III

Recurrence relations: Generating function of sequences – Calculating coefficients of generating functions- Recurrence relations-Solving recurrence relations by substitution and generating functions-the method of characteristic roots – solutions of inhomogeneous recurrence relations. (Sec 3.1 to 3.6 of Text Book 1)

UNIT IV;

Linear functional - real quadratic forms – orthogonal matrices – reduction of real quadratic form-classification of real quadratic forms.
Section 8.2 to 8.6 of text book 2)

Text book: 1) Discrete Mathematics for Computer Scientists and Mathematician by J.L.Mott, A.Kandel, and T.P. Bakel.

2)Linear Algebra and matrix theory by Jimmele Gilbert and Linda Gilbert,Elsevier.

Reference Books:

1. Discrete Mathematical structures by Roden.
2. Discrete Mathematics by Kolman.
3. A Text book of Discrete Mathematics by Tremblay and Manohar.
4. Elements of Discrete Mathematics by C.L.Liu, McGraw Hill Company

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics

Semester	Paper-V: **Elementary number theory**	Paper code
I		**MS1CP5**

Unit – I:

The Fundamental Theorem of Arithmetic: Divisibility, Greatest common divisor, Prime numbers, The Fundamental theorem of arithmetic, The Series of reciprocals of primes, The Euclidean algorithm, The GCD of more than two numbers, Arithmetical Functions: The Mobius Function, The Euler totient function, A relation connecting these functions, A product formula for Euler totient function.

Unit – II

Dirichlet Multiplication: Dirichlet product of arithmetical functions, Dirichlet inverse and the Mobius inverse formula, The Mangoldt function, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative functions, - Liouville's function, The Divisor functions, Generalized convolutions.

Unit – III

Congruences: Definition and basic Properties of congruences - Residue classes and Complete residue system, Linear congruence, Reduced residue systems and Euler-Fermat theorem, Polynomial congruences modulo p, Lagrange's theorem, Applications of Lagrange's theorem, Simultaneous linear congruences, Chinese remainder theorem and its applications, Polynomial congruences with prime power moduli.

Unit – IV

Quadratic Residues and the Quadratic Reciprocity Law: Quadratic residues, Legendre's symbol and its properties, Evaluation of $(-1 \mid p)$ and $(2 \mid p)$, Gauss' lemma - The quadratic reciprocity law, Application of reciprocity law, The Jacobi symbol.

Text book: book: Introduction to Analytic Number Theory, T.M. Apostol

References

An Introduction to the Theory of Numbers, Ivan Niven and H.S. Zuckerman

Elementary Number Theory, D.M. Burton

Elementary Number Theory with Applications, Thomas Koshy

Elementary Number Theory and its applications, Kenneth Rosen

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-I: **Galois Theory**	Paper code
II		**MS2CP1**

Unit – I

Algebraic Extensions of Fields: Irreducible Polynomials and Eisenstein Criterion, Adjunction of Roots, Algebraic Extensions, Algebraically closed fields.

Unit – II

Normal and Separable Extensions: Splitting Fields, Normal Extensions, Multiple roots, Finite fields, Separable extensions.

Unit – III

Galois Theory: Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra.

Unit – IV

Applications of Galois theory: Roots of unity and Cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Symmetric function, Ruler and compass constructions.

Text book: Basic Abstract Algebra, Battacharya, Jain, Nagpaul

References

1. Basic Algebra, N. Jacobson
2. Algebra, S. Lang
3. Contemporary Abstract Algebra, J.A. Gallian
4. Algebra, P.M. Cohen

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-II: **Mathematical Analysis-II**	Paper code
II		**MS2CP2**

Unit I:

Functions of bounded variation – properties of functions of bounded variation – variation function – Jordan theorem – variation function of continuous function – positive, negative and total variation of function – vector-valued functions –

Unit-II:

The Rieman-Stieltjes integral –condition of integrability – integral as a limit of sum –Some important theorems.

Unit III:

Uniform convergence of sequence and series of functions – point wise convergence – Uniform convergence of sequence of functions on an interval - tests for uniform convergence of sequence and series of functions – properties of uniformly convergent sequences and series – Uniform convergence and continuity – Dini's theorem on uniform convergence – Uniform convergence and integration – Uniform convergence and differentiation – Weierstrass approximation theorem

Unit – IV:

Multiple integrals – line integrals – double integrals – double integrals over a region – Green's theorem – change of variables – surface integrals – Stokes's theorem Volume of cylindrical solid by double integrals – volume integrals (triple integrals)- Gauss's theorem(or Divergence theorem.

Text book: Mathematical Analysis – S.C.Malik and Savita Arora

References:

1.Real analysis – Chaterjee

2. A course of mathematical Analysis – Shanti Narayan, P.K.Mittal

3. Methods of Real Analysis – Richard R. Goldberg.

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics

Semester	Paper-III: **Partial Differential equations and boundary value problems**	Paper code
II		**MS2CP3**

Unit I:

Formation of first order differential equations – solution of linear first order partial differential equations – Lagrange's method – integral surfaces passing through a given cure – surfaces orthogonal to a given system of surfaces –Compatibility of first order partial differential equations – classification of solutions of first order partial differential equations – solutions of non-linear partial differential equation of first order – Charpit's method – Jacobi's method

Unit II:

Second order partial differential equations – Origin – linear partial differential equations with constant coefficients – methods of solving linear partial differential equations with variable coefficients – classification of second order partial differential equation – canonical form

Unit III

Derivation of Laplace equation and Poisson equation – Boundary value problems – separation of vriable method – Laplace equation in cylindrical and sphereical coordinates – interior and exterior Dirichlet problem for a circle – Interior Dirichlet problem for a sphere – Interior Neumann problem for a circle .

Unit IV:

Solution of Diffusion by separation of variables method – Diffusion equation in cylindrical and sphereical coordinates – D'Alembert's solution of one dimensional wave equation – Seperation of variable method – two dimensional wavae equation and diffusion equation.

Text book: Partial differential equations for engineers and scientist – J.N.Sarma and Kehar Singh

References:

1. Elements of partial differential equations – Sneddon
2. Partial differential equations for engineers and scientists – Sharma

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics

Semester	Paper-IV: **Metric spaces**	Paper code
II		**MS2CP4**

Unit I:

Definition and Examples – metric space – inner product space – norm -Open Balls and Open Sets - Convergence - Convergent Sequences -

Limit and Cluster Points - Cauchy Sequences and Completeness - Bounded Sets - Dense Sets - Basis - Boundary of a Set –

Unit- II

Continuity - Continuous Functions - Equivalent Definitions of Continuity - Topological Property - Uniform Continuity - Limit of a Function - Open and closed maps

Unit III:

Compactness - Compact Spaces and their Properties - Continuous Functions on Compact Spaces

Characterization of Compact Metric Spaces - Arzela-Ascoli Theorem - Connectedness - Connected Spaces - Path Connected spaces

Unit-IV

Complete Metric Spaces - Examples of Complete Metric Spaces - Completion of a Metric Space - Baire Category Theorem - Banach's Contraction Principle . .

Text book : Topology of metric spaces – S.Kumaresan

References:

1. Metric Spaces – Pawar K Jain, Khalil Ahmed
2. A methods of real analysis – Richard R. Goldberg

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V: **Integral equations and calculus of variations**	Paper code
II		**MS2CP5**

Unit I:

Variational problems with fixed boundaries – The concept of variation and its properties – Euler's equation – Variational problems for functional of the form

$I[y_1(x),y_2(x),y_3(x),\ldots,y_n(x)]=\int F(x, y_1(x),y_2(x),....., y_n(x))dx$ -Functional dependent of higher order derivatives – Functional dependent on function of several independent variables – Variational problems in parametric form – Some applications to problems of mechanics.

Unit II:

Variational problem with moving boundaries – Functionals of the form $I[y(x)]=\int_{x_1}^{x_2} F(x, y(x).y'(x))dx$ - Variational problems with movable boundaries for a functional dependent on two functions – one-sided variations – reflection and refraction of extremals .

Unit – III

Volterra Integral Equations: Basic Concepts, Relation between Linear Differential Equations and Volterra Integral Equations, Resolvent Kernel of Volterra Integral Equation, Solution of Integral Equations by Resolvent Kernel, The Method of Successive Approximations.

Unit – IV

Convolutions-Type Equations, Solution of Integro-Differential Equations with the Aid of the Laplace Transformation, Volterra Integral Equations with limits (x,+∞), Volterra Integral Equations of First Kind, Euler Integrals, Abel's Integral Equations and Its Generalizations, Volterra Integral Equations of the First Kind of the Convolution Type.

Text books :

1) Calculus of Varaiations , A.S.Gupta

2) Problems and Exercises in Integral Equations, M.Krasnov, A. Kiselev, G. Makarenko

References

1. Integral Equations ,Shanti Swarup, Shiv Raj Singh
2. A First Course in integral equations, Abdul-Majid Wazwaz
3. Integral Equations and their applications, M.Rahman

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-I: **Complex Analysis**	Paper code
III		**MS3CP1**

Unit – I:

Regions in the complex Plane, Functions of Complex Variables, Mappings, Mappings by Exponential Function-Limits-Limits involving point at infinity-Continuity.

Unit – II

Derivatives, Cauchy-Riemann-Equations, Sufficient Conditions for Differentiability, Polar Coordinates, Analytic Functions, Harmonic Functions, Uniquely Determined Analytic Functions, Reflection Principle.

Unit – III

The Exponential Function, The Logarithmic Function, Branches and Derivatives of Logarithms, Some Identities Involving Logarithms, Complex Exponents, Trigonometric Functions, Hyperbolic Functions, Inverse Trigonometric and Hyperbolic Functions.

Unit – IV

Derivatives of Functions w(t), Definite Integrals of Functions w(t), Contours, Contour Integrals, Branch Cuts, Upper Bounds for Moduli of Contour Integrals, Antiderivatives, Cauchy- Goursat Theorem, Simply Connected Domains, Multi Connected Domains, Cauchy Integral Formula, An Extension of the Cauchy Integral Formula-Lioville's Theorem and fundamental theorem of Algebra, Maximum Modulus Priciple.

Text book: James Ward Brown, Ruel V. Churchil, Complex Variables and Applications.

References

1. Complex Analysis,Ahlfors
2. Foundations of Complex Analysis, S.Ponnuswamy
3. Complex Variables Theory and Applications ,Kasana
4. Functions of One Complex Variables, J.B.Convway

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-II: **Integral transforms**	Paper code
III		**MS3CP2**

Unit I:

Integral transforms – Laplace transform – existence of Laplace transform – First translation theorem – second translation theorem – change of scale property – Laplace transform of derivatives and integrals – Initial value theorem – final value theorem – Laplace transform of special functions – Inverse transform.

Unit II:

Convolution theorem – Application of Laplace transform to solution of ordinary differential and integral equations – application of Laplace transform to initial and boundary value problems

Unit III:

Introduction – Fourier transform – Sine and cosine transform – inverse Fourier transform (finite and infinite) – Application of Fourier transform to solution of ordinary and partial differential equations

Unit IV:

Hankel transform – Hankel transform of derivatives of a function – Application of Hankel transform in boundary value problems – The finite Hankel transform

Text book: Integral transform by A.R. Vasishta and R.K. Gupta

Refence books: 1. Operational mathematics by R.V. Churchill

1. Laplace transforms by Murray R.Spiegal
2. Fourier and Laplace transforms by R.J.Beerends and others

DEPARTMENT OF MATHEMATICS
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M.Sc. Mathematics

Semester	Paper-III: **Topology**	Paper code
III		**MS3CP3**

Unit – I

Topological Spaces: The definition and some examples, Elementary concepts, Open base and open subbase, Weak topologies, The function algebras C(X,R) and C(X,C).

Unit – II

Compactness: Compact Spaces, Product Spaces, Tychonoff 's theorem and local compact spaces, Compactness for metric spaces, Ascoli's theorem.

Unit – III

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

Unit – IV

Connectedness: Connected Spaces, The components of a space, Totally disconnected spaces, Locally connected spaces.

Text book: Topology and Modern Analysis, G.F. Simmons

References

Topology , J. Munkres

Counter Examples in Topology, L. Steen, J. Seebach

General Topology, J.L. Kelley

Topology, B.D. Gupta

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV(A): **Operations Research**	Paper code
III		**MS3OP4(A)**

UNIT I

Hyper planes – Hyper spheres – Convex sets and their properties –Mathematical formulation of a LPP - Graphical solution method- General LPP - Canonical and Standard form of a LPP. Basic solution – Degenerate solution – Basic feasible solution – Improved basic feasible solution - Optimum basic feasible solution – Fundamental properties of solutions-Reduction of a feasible solution to a basic feasible solution – Fundamental theorem of linear programming - Improved basic feasible solution - Existence of unbounded solution – Conditions of optimality – The Simplex algorithm.

UNIT II

Use of Artificial Variables – Two-Phase Method - Big M-Method – Degeneracy in linear programming - Duality – General Primal-Dual pair – Formulating a Dual problem – PrimalDual pair in matrix form - Duality theorems – Duality and Simplex method - Dual simplex method.

UNIT III

Transportation problem- Matrix form of T.P. – special case of LPP Transportation tableInitial Basic Feasible Solution – North West Corner Rule Matrix - Minima Method, Vogel approximation method of finding initial basic feasible solution – loops in a T.P. – Transportation Algorithm of finding optimal solution - Degeneracy in T.P. – Unbalanced T.P. UNIT IV

Assignment problems – Hungarian method of finding optimal assignment problems – Travelling Salesman Problem.

Integer programming – all & mixed integer programming problems- Gomory's All IPP method- Gemory's mixed integer programming – branch and bound method .

Text Book: Operations Research by Kanti Swarup. P.K.Gupta and Manmohan.

Reference Books:

1. Operations Research by Handy A.Taha. Printice Hall of India.

2. Linear programming methods and applications by Gass. S.I

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV(B): **Fluid Mechanics**	Paper code
III		**MS3OP4(B)**

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'sequations of Motion - Equation in one dimensional flow problems: Bernoulli's Theorem - Kelvins circulationtheorem. 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
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV(C): **Boolean algebra**	Paper code
III		**MS3OP4(C)**

Unit – I

Algebra of Sets: Introduction, Preliminary definitions, Definitions and properties of Boolean algebra, Disjunctive normal form, Conjunctive normal form, Representation of a Boolean algebra.

Unit – II

Boolean algebra: Introduction, Propositions and definitions of symbols, Truth tables.

Unit – III

Object logic and syntax logic, Material implication, Truth sets for propositions, Quantifiers, Valid arguments, indirect proofs, functionally complete sets of operations, Special problems.

Unit – IV

Switching Algebra: Introduction, Definition of the algebraic symbols, Simplifications of circuits, Non-series-parallel circuits, Design of circuits from given properties, Design of n-terminal circuits, Symmetric functions and their circuits.

Text book: Boolean Algebra and its applications, J.Eldon.Whitesitt

References

1. Boolean algebra, R.L. Goldstein
2. Logic and Boolean algebra, Bradford Henry Arnold
3. Boolean algebra and switching circuits, Elliott Mendelson
4. Boolean algebra, Prabhat Kr. Choudhary
5. Boolean algebra, A.K. Sharma

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V (A): **Theory of ordinary differential equations**	Paper code
III		**MS3OP5(A)**

Unit – I

Linear Equations with Constant Coefficients: Introduction, The second order homogenous equation, Initial Value Problems for Second order equations, Linear dependence and independence, A formula for the Wronskian , The non-homogeneous equation of order, The homogeneous equation of order n, The initial value problems for n-th order equations, Equations with real constants, The non-homogeneous equation of order n, A special method for solving non homogeneous equation, Algebra of constant operators.

Unit – II

Linear Equations with Variable Constants: Introduction, Initial value problems for the homogeneous equation, Solutions of the homogeneous equations, Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogeneous equation, Homogeneous equations with analytic coefficients.

Unit – III

Linear Equations with Regular Singular Points: Introduction, The Euler equation, Second order equations with regular singular points-an example, Second order equations with regular singular points- the general case, A convergence proof, The exceptional cases.

Unit – IV

Existence and Uniqueness of Solutions to First Order Equations: Introduction, Equations with variable separated, Exact equations, The method of successive approximations, The Lipchitz condition, Convergence of the Successive approximations, Non-local existence of solutions, Approximations to and uniqueness of solutions, Equations with complex-valued functions.

Text book: An introduction to ordinary differential equations, Earl A. Codington

References:

1. Ordinary Differential Equations and Stability Theory, S.G. Deo, V. Ragvendra, V. Laxmi Kantham
2. Ordinary Differential Equations, William. A. Adkins, Mark G. Davidson

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V(B): **Analytical Mechanics**	Paper code
III		**MS3OP5(B)**

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 – Center 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 theorems 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 – Moment of Inertia of Rigid body about an arbitrary axis – 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 vibrational principle- Hamilton's Equations- Problems- Theorems.

Text book: Analytical Mechanics, G.R. Fowles

References

1. Classical Mechanics, R. Douglas Gregory
2. Introduction to Classical Mechanics, Nikhil Ranjan Roy
3. Classical Mechanics an introduction, Dieter Strauch
4. An introduction to Classical Mechanics, R.G. Takwale & Puranik
5. Classical Mechanics, Martin W. McCall

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V(C): **Fixed-point theory**	Paper code
III		**MS3OP5(C)**

Unit – I

Metric Contraction Principles: Banach's Contraction Principle, Further extensions of Banach's Principle, The Caristi – Ekeland Principle, Equivalent of the Caristi-Ekeland Principle, Set – valued contractions, Generalized contractions.

Unit – II

Hyperconvex Spaces: Introduction, Hyperconvexity, Properties of hyperconvex spaces, A fixed point theorem, Intersections of hyperconvex spaces, Approximate fixed points, Isbell's hyperconvex hull.

Unit – III

Normal Structure in Metric Spaces: A fixed point theorem, Structure of the fixed point set, Uniform normal structure, Uniform relative normal structure.

Unit – IV

Quasi- normal structure Stability and normal structure, Ultrametric spaces, Fixed point set structure- separable case.

Text book: Metric Spaces and Fixed point theory, Mohamed A. Khamsi, William A. Kirk

References

1. Fixed Point Theory, Andrej Granes, James Dugundji

2. Fixed Point Theorems and Their Applications, Ioannis Farmakis, Martin Moskowitz

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-I: **Advanced complex analysis**	Paper code
IV		**MS4CP1**

Unit – I:

Series: Convergence of Sequence, 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, Multiplication and Division of Power Series.

Unit – II

Residues and Poles: Isolated singular Points, Residues, Cauchy's Residue Theorem, Residue at Infinity, The Three types of Isolated Singular Points, Residues at Poles, Zeros of Analytic Functions, Zeros and Poles, Behavior of Functions near Isolated Singular Points.

Unit – III

Evaluation of Improper Integrals, Improper integrals from Fourier Analysis, Jordan's Lemma, Indented Paths, An Indentation Around a Branch Cut, Definite Integrals Involving Sines and cosines , Argument Principle, Rouche's Theorem, Inverse Laplace Transforms.

Unit – IV

Linear Transformations, The Transformation w=1/z, Mappings 1/z, Linear Fractional Transformations, An Implicit form, Mappings of the Upper Half Plane, The Transformation w=sin z, Mappings by z^2 and Branches of z^(1/2), Square Roots of Polynomials, Riemann Surfaces, Surfaces for Related Functions.

Text book: Complex Variables and Applications, James Ward Brown, Ruel V. Churchill

Reference

Complex Analysis, Ahlfors

Foundations of Complex Analysis, S.Ponnuswamy

Complex Variables Theory and Applications ,Kasana

Functions of on Complex Variables, J.B.Convway

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-II: **Lebesgue measure and integration**	Paper code
IV		**MS4CP2**

Unit – I

Lebegue Measure: Lebesgue Outer Measure, The sigma algebra of Lebesgue Measurable Sets, Outer Inner Approximation of Lebesgue Measurable Sets, Countable Additivity, Continuity and Borel Cantelli Lemma.

Unit – II

Lebesgue Measurable Functions: Sums, Products and Compositions, Sequential Pointwise Limits and Simple Approximation, Littlewood's Three Priciples, Egoroff's theorem and Lusin's theorem.

Unit – III

Lebesgue Integration: The Riemann Integral, The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure, The Lebesgue Integral of a Measurable nonnegative Function, The General Lebesgue Integral, Countable Additive and Continuity of Integration.

Unit – IV

Differentiation and Integration: Continuity of Monotone Functions, Differentiability of Monotone Functions, Lebesgue's theorem, Functions of Bounded Variation, Jordan's theorem, Absolutely Continuous Functions, Integrating Derivatives.

Text book: Real Analysis, H.L. Royden, P.M. Fitzpatrick

References

1. The Elements of Integration and Lebesgue Measure, Robert G. Bartle
2. Measure Theory, P. R. Halmos
3. Real and Complex Analysis, Walter Rudin
4. Real Analysis, G.B. Folland

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-III: **Functional Analysis**	Paper code
IV		**MS4CP3**

Unit – I:

Some Standard inequalities in Metric Spaces, Normed Linear Spaces and Elementary Properties, Subspace, Closed Subspace, Finite Dimesional Normed Linear spaces and Subspaces, Quotient Spaces, Completion of Normed Spaces.

Unit – II

Inner Product Space, Hilbert Space, Cauchy-Bunyakovsky-Schwarz (CBZ) Inequality, Parallelogram Law, Orthogonality, Orthogonal Projection Theorem, Orthogonal Complements, Direct Sum, Orthogonal system, Complete Orthogonal System, Isomorphism between Separable Hilbert Spaces.

Unit – III

Linear Operator, Linear Operators in Normed Linear Spaces, Linear Functionals, The Space of Bounded Linear Operators, Uniform Boundedness Priniciple, Inverse Operators, Banach space with a basis, Hahn- Banach Theorem, Hanh-Banach Theorem for Complex Vector and Normed Linear Space, The General Form Linear Functionals in Certain Functional Spaces, The General Form Linear Functional spaces in Hilbert Spaces.

Unit – IV

Conjugate Spaces and Adjoint Operators, Conjugates (Duals) and Transposes (Adjoints), Closed Graph Theorem, Open Mapping Theorem, Bounded Inverse Theorem, Applications of the Open Mapping Theorem.

Text book: Rabindranath Sen, A First Course in Functional Analysis Theory and Applications

Reference books;

1. Introdution to Topology and Modern Analysis, G.F.Simmons
2. Introductory Functional Analysis with Applications, Kreyszig
3. Functional Analysis A First Course, M.Thamban Nair
4. Topics in Functional Analysis and Applications, S.Kesavan
5. Functional Analysis, B.V.Limaye

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV (A): **Graph theory**	Paper code
IV		**MS4OP4(A)**

UNIT I:

Relations and digraphs – special properties of binary relations – equivalence relations – ordering relations – lattices and enumerations – paths and closures – directed graphs and adjacency matrices

Unit-II

Graphs – basic concepts – isomorphism and sub graphs –trees and their properties – spanning trees – directed trees – binary trees – planar graphs

Unit III:

Euler's formula – Konisgsberg seven bridges problems – Multigraphs –Euler circuits – Hamiltonian graphs – chromatic numbers – the four-color problem.

Unit-IV:

Networks flows – Graphs as models of flow of commodities – flows –maximal flows and minimal cuts – the maxflow min-cut theorem – applications – matching and Hall's marriage theorem

Text book : Discrete mathematics for computer scientist and mathematicians by J.L. Mott, A.Kandle, P.Bakes

Reference books:

1. Graph Theory – Harary
2. Discrete mathematical structures with applications to computer science – J. P. Tremblay and R. Manohar.

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV(B): **Elementary operator theory**	Paper code
IV		**MS4OP4(B)**

Unit – I

Compact Linear Operators, Spectrum of a Compact Operator.

Unit – II

Fredholm Alternative, Approximation Solutions.

Unit – III

Adjoint Operators, Self-Adjoint Operators, Quadratic Form, Unitary Operators, Projection Operators.

Unit – IV

Positive Operators, Square Roots of a Positive Operator, Spectrum of Self- Adjoint Operators, Invariant Subspaces, Continuous Spectra and Point Spectra.

Text book: A First Course in Functional Analysis Theory and Applications, Rabindranath Sen

References

1. Introdution to Topology and Modern Analysis, G.F.Simmons
2. Introductory Functional Analysis with Applications, Kreyszig
3. Functional Analysis A First Course, M.Thamban Nair
4. Topics in Functional Analysis and Applications, S.Kesavan
5. Functional Analysis, B.V.Limaye

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-IV(C): **FUNDAMENTALS OF STATISTICS**	Paper code
IV		**MS4OP4(C)**

UNIT I:

Moments–Pearson's β and γ coefficients -Skewness and Kurtosis
Probability Definitions–Addition Theorem-Conditional probability - Multiplication Law of probability - Baye's Theorem - Random Variables - Probability mass function – Probability density function.
(Chapter 2, 3, 4.2, 5.1 to 5.5.5 of Text Book)

UNIT II
Mathematical Expectation – Expectation of a function of a random variable – Addition and Multiplication theorem of expectation - Expectation of linear Combination of random variables – Covariance – Variance of linear combination on of random variables – Moment generating function – Chebychev's inequality – Correlation –Karl Pearson's coefficient of Correlation-Linear regression.Angle between two regression lines.
(Chapter 6.1 to 6.6.1, 7.1, 7.1.2, 7.5,10.1 to 10.4.2, 11.1 to 11.2.3 of Text Book)

UNIT III
Discrete Distributions - Bernoulli distribution – Moments of Bernoulli distribution – Binomial distribution – Moments - Moment generating function of Binomial distribution – Additive property of Binomial distribution - Poisson distribution – Moments of Poisson distribution – Geometric distribution –Lack of memory property.
(Chapter 8.1 to 8.4.1, 8.4.4 to 8.4.7, 8.5, 8.5.2, 8.5.3, 8.5.5, 8.5.8, 8.7 to 8.7.3 of Text Book)

UNIT IV
Continuous Distributions -Normal Distribution – Characteristics of Normal Distribution and normal probability curve - Moments of Normal Distribution – Area property- Gamma Distribution - Moment generating function of Gamma Distribution – Exponential distribution-Moment generating function of Exponential distribution- Lack of memory property.
(Chapter 9.1, 9.2, 9.2.2 to 9.2.5, 9.2.7 to 9.2.11, 9.5, 9.5.1, 9.5.3, 9.8, 9.8.1 of Text Book)

Text Book:
Fundamentals of Mathematical Statistics by S.C. Gupta & V.K.Kapoor, 11th Edition

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V(A): **Numerical Analysis**	Paper code
IV		**MS4OP5(A)**

Unit I:

Solution of algebraic and transcendental equations : Muller's method – Graeffe's root-squaring method – Lin-Bairstow's method Quotient-difference method – solution of system of non-linear equations – Method of iteration – Newton-Raphson method.

Solution of linear equations – Gauss elimination method – Gauss-Seidel method

(sections 2.8 to 2.11, 2.12.1, 2.12.2 and 6.3.2,6.4)

Unit II:

Least squares curve-fitting procedures – Fitting of a straight line – multiple linear least squares – linearization of non-linear laws – curve fitting by polynomials – curve fitting by a sum of exponentials – linear weighted least squares approximation – non-linear weighted least squares approximation. (Sections 4.2.1 to 4.2.5, 4.3.1, 4.3.2)

Unit III:

Numerical solution of ordinary differential equations – Taylor's series method –Picard's method-

Euler's method – modified Euler's method – Runge-Kutta method – Predictor-Corrector methods – Adams-Moulton method, Milne's method.(Sections8.2,8.3,8.4.1,8.4.2,8.5.8.6.1,8.6.2)

Unit IV:

Numerical solution of partial differential equations – Laplace equation – finite difference approximation to derivatives – Solution of Laplace equation – Jacobi's method –Gauss-Seidel method – Solution of heat equation – solution of wave equation

(Sections 9.2 to 9.6 and 9.8)

Text book: Introductory method of Numerical Analysis by S.S.Sastry,5^{th} edition,PHI.

Reference books:

1. Elementary Numerical Analysis, K.Atkinson

2. Numerical Methods for Scientific and Engineering, M.K. Jain, S.R.K. Iyengar, R.K. Jain
3. Numerical Methods for Scientists and Engineers, K. Shankara Rao
4. The Numerical Analysis of Ordinary Differential Equations, J.C. Butcher
5. Numerical Analysis and Mathematics of Scientific Computing, David Kinciad & Ward Cheney.

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V(B): **Algebraic Number theory**	Paper code
IV		**MS4OP5(B)**

Unit – I

Divisibility: The uniqueness of factorization, A general problem, The Gaussian integers, Rational and Gaussian primes, Congruences, Determination of the Gaussian primes, Fermat's theorem for Gaussian primes.

Unit – II

Algebraic Integers and Integral Bases: Algebraic integers, The integers in a quadratic field, Integral bases, Examples of integral bases.

Unit – III

Arithmetic in Algebraic Number Fields: Units and primes, Units in a quadratic field, The uniqueness of factorization, Ideals in an algebraic number field.

Unit – IV

The Fundamental Theorem of Ideal Theory: Basic properties of ideals, The classical proof of the unique factorization theorem, the modern proof.

Text book; The Theory Of Algebraic Numbers, Harry Pollard

Reference books:

1. Algebraic Number Theory, Jarvis, Frazer
2. Algebraic Number Theory, Serge Lang

DEPARTMENT OF MATHEMATICS
SATAVAHANA UNIVERSITY

M.Sc. Mathematics

Semester	Paper-V(C): **Differential Geometry**	Paper code
IV		**MS4OP5(C)**

Unit – I:

Theory of Space Curves: Representation of space curves, Unique parametric representation of a space curve, Arc-length, Tangent and osculating plane, Principal normal and binormal, Curvature and torsion, Behaviour of a curve near one of its points, The curvature and torsion of a curve as a intersection of two surfaces.

Unit – II

Contact between curves and surfaces, Osculating circle and osculating sphere, Locus of centres of spherical curvature, Tangent surfaces, involutes and evolutes, Intrinsic equations of space curves, Fundamental existence theorem for space curve.

Unit – III

The First Fundamental Form and Local Intrinsic Properties of A Surface: Definition of a surface, Nature of points on a surface, Representation of a surface, Curves on surfaces, Tangent plane and surface normal, The general surfaces of revolution, Helicoids, Metric on a surface- The first fundamental form, Direction coefficients on a surface.

Unit – IV

The First Fundamental Form and Local Intrinsic Properties of A Surface: Families of curves, Orthogonal trajectories, Double family of curves, Isometric correspondence, Intrinsic.

Geodesics on a Surface: Geodesics and their differential equations, Canonical geodesic equations, Geodesics on surfaces of revolution, Normal property of geodesics.

Text book: Differential Geometry, D. Somasundaram

Reference books:

1. Lectures on Classical Differential Geometry, D.T. Struik
2. Elementary Topics in Differential Geometry, J.A. Thorpe

THE END