FACULTY OF EDUCATION
SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES
Outcome based Curriculum for
Post graduate Degree Courses in Master of Science
Department of Mathematics

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Vision of the Departments :

To centre stage Mathematical knowledge in the curriculum; instill analytical and logical thinking among students and promote Mathematical thought as an important area of human thought.

Mission of the Departments:

- To encourage students to conduct student projects to develop their analytical and logical thinking.
- To conduct faculty training programmes through invited talks or workshops.
- To establish industry links to develop mathematical models and help the industry.
- To conduct outreach programmes for the socially marginalized students.

Programme Educational Objectives (PEO's):

PEO1. To equip students with knowledge, abilities and insight in mathematics and related fields.

PEO2. To enable them to work as a mathematical professional.

PEO3. To equip students with the ability to translate and synthesize their understanding towards nature, human and development.

PEO4. To develop the ability to utilize the mathematical problem solving methods such as analysis, modeling, and programming and mathematical software applications in addressing the practical and heuristic issues.

PEO5. To enable students to recognize the need for and the ability to engage in life-long learning

POs of the Programme :

The M.Sc. Mathematics programme's main objectives are
POs1: To inculcate and develop mathematical aptitude and the ability to think abstractly in the student.
POs2: To develop computational abilities and programming skills.
POs3: To develop in the student the ability to read, follow and appreciate mathematical text.
POs4: Train students to communicate mathematical ideas in a lucid and effective manner.
POs5: To train students to apply their theoretical knowledge to solve problems.
POs6: To encourage the use of relevant software such as MATLAB and MATHEMATICA.

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PROGRAM SPECIFIC OUTCOMES (PSOs) OF THE PROGRAMME:

On successful completion of the M.Sc. Mathematics programme a student will
PSO1: Have a strong foundation in core areas of Mathematics, both pure and applied.
PSO2: Be able to apply mathematical skills and logical reasoning for problem solving.
PSO3: Communicate mathematical ideas effectively, in writing as well as orally.
PSO4: Have sound knowledge of mathematical modeling, programming and computational techniques as required for employment in industry.

Programme PO's and PSO's Mapping:

			PO 1	PO2	PO3	PO4	PO5	PO6		
S. No	Program	Courses Category							PSO 1	PSO 2
1		ADVANCED ABSTRACT ALGEBRA	*		*	*	*		*	*
2		Real Analysis	*		*	*	*		*	*
3		TOPOLOGY			*	*	*			
4		COMPLEX ANALYSIS	*		*	*	*		*	*
5		ADVANCED DISCRETE MATHEMATICS	*	*	*	*	*		*	
6	MSC (Mathmeatics)	LEBESQUE MEASURE & INTEGRATION	*		*	*	*			
7		Functional Analysis	*		*	*	*			
8		Advanced Special Function	*		*	*	*			
9		Theory of Linear Operators	*		*	*	*			
10		Integral Transforms - I	*		*	*	*			
11		Spherical Trigonometry And Astronomy	*		*	*	*			

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Semester wise PO's and SPO's Mapping:

Semester	Name of the Courses/POs(Basic, Core Electives, Projects, Internships etc.)	PO 1	PO2	PO3	PO4	PO5	PO6	PSO 1	PSO 2
Semester - I	ADVANCED ABSTRACT ALGEBRA I	*		*	*	*		*	*
	Real Analysis	*		*	*	*		*	*
	TOPOLOGY I	*		*	*	*			
	COMPLEX ANALYSIS I	*		*	*	*		*	*
	ADVANCED DISCRETE MATHEMATICS -I	*	*	*	*	*		*	
Semester- - II	ADVANCED ABSTACT ALGEBRA II	*		*	*	*		*	
	LEBESQUE MEASURE & INTEGRATION	*		*	*	*			
	TOPOLOGY II	*		*	*	*			
	COMPLEX ANALYSIS II	*		*	*	*		*	*
	ADVANCED DISCRETE MATHEMATICS II	*		*	*	*		*	
Semester- III	Functional Analysis - I	*		*	*	*			
	Advanced Special Function -I	*		*	*	*			
	Theory of Linear Operators - I	*		*	*	*			
	Integral Transforms - I	*		*	*	*			
	Spherical Trigonometry And Astronomy - I	*		*	*	*			
	INTERNSHIP	*		*	*	*			
Semester- IV	Functional Analysis - II	*		*	*	*			
	Advanced Special Function -II	*		*	*	*			
	Theory of Linear Operators - II	*		*	*	*			
	Integral Transforms - II	*		*	*	*			
	Spherical Trigonometry And Astronomy - II	*		*	*	*			

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Structure of Programme: To fulfill the need of development of all the POs/ GAs, as per above mapping, the following semester wise programme structure are as under.

***Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (Lab)/week	1 Credit

Structure of Post graduate Master of Science (Mathematics) program:

S.No	Sem.No	Course Code	Course Name	Total Marks
	First			
1.		MAT-101	ADVANCED ABSTRACT ALGEBRA I	100
2.		MAT-102	Real Analysis	100
3.		MAT-103	TOPOLOGY I	100
4.		MAT-104	COMPLEX ANALYSIS I	100
5.		MAT-105	ADVANCED DISCRETE MATHEMATICS -I	100
	second			
6.		MAT-201	ADVANCED ABSTACT ALGEBRA II	100
7.		MAT-202	LEBESQUE MEASURE & INTEGRATION	100
8.		MAT-203	TOPOLOGY II	100
9.		MAT-204	COMPLEX ANALYSIS II	100
10.		MAT-205	ADVANCED DISCRETE MATHEMATICS II	100
	Third			
11.		MAT301	Functional Analysis - I	100
12.		MAT302	Advanced Special Function -I	100
13.		MAT303	Theory of Linear Operators - I	100
14.		MAT304	Integral Transforms - I	100
15.		MAT305	Spherical Trigonometry And Astronomy - I	100
16.		MAT306	INTERNSHIP	100
	Fourth			
17.		MAT401	Functional Analysis - II	100
18.		MAT402	Advanced Special Function -II	100
19.		MAT403	Theory of Linear Operators - II	100
20.		MAT404	Integral Transforms - II	100
21.		MAT405	Spherical Trigonometry And Astronomy - II	100

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Scheme of Examination Master of Science (Mathematics)Academic Year 2019-20

I Semester

<table>
<tr><th rowspan="3">SUBJECT CODE</th><th rowspan="3">COMPULSORY/ OPTIONAL</th><th rowspan="3">SUBJECT NAME</th><th colspan="6">THEORY</th><th colspan="2">PRACTICAL</th><th colspan="2">TOTAL</th></tr>
<tr><th colspan="2">PAPER</th><th colspan="2">CCE / INTERNAL</th><th colspan="2">TOTAL MARKS</th><th rowspan="2">MAX</th><th rowspan="2">MIN</th><th rowspan="2">MAX</th><th rowspan="2">MIN</th></tr>
<tr><th>MAX</th><th>MIN</th><th>MAX</th><th>MIN</th><th>MAX</th><th>MIN</th></tr>
<tr><td>MAT-101</td><td>COMPULSORY</td><td>ADVANCED ABSTACT ALGEBRA I</td><td>70</td><td>25</td><td>30</td><td>11</td><td>100</td><td>36</td><td>0</td><td>0</td><td>100</td><td>36</td></tr>
<tr><td>MAT-102</td><td>COMPULSORY</td><td>Real Analysis</td><td>70</td><td>25</td><td>30</td><td>11</td><td>100</td><td>36</td><td>0</td><td>0</td><td>100</td><td>36</td></tr>
<tr><td>MAT-103</td><td>COMPULSORY</td><td>TOPOLOGY I</td><td>70</td><td>25</td><td>30</td><td>11</td><td>100</td><td>36</td><td>0</td><td>0</td><td>100</td><td>36</td></tr>
<tr><td>MAT-104</td><td>COMPULSORY</td><td>COMPLEX ANALYSIS I</td><td>70</td><td>25</td><td>30</td><td>11</td><td>100</td><td>36</td><td>0</td><td>0</td><td>100</td><td>36</td></tr>
<tr><td>MAT-105</td><td>COMPULSORY</td><td>ADVANCED DISCRETE MATHEMATICS I</td><td>70</td><td>25</td><td>30</td><td>11</td><td>100</td><td>36</td><td>0</td><td>0</td><td>100</td><td>36</td></tr>
<tr><td colspan="3">TOTAL</td><td>350</td><td></td><td>150</td><td></td><td>500</td><td></td><td></td><td></td><td>500</td><td></td></tr>
</table>

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Semester-II

SUBJECT CODE	COMPULSORY/ OPTIONAL	SUBJECT NAME	THEORY						PRACTICAL		TOTAL	
			PAPER		CCE / INTERNAL		TOTAL MARKS		MAX	MIN	MAX	MIN
			MAX	MIN	MAX	MIN	MAX	MIN				
MAT-201	COMPULSORY	ADVANCED ABSTACT ALGEBRA II	70	25	30	11	100	36	0	0	100	36
MAT-202	COMPULSORY	LEBESQUE MEASURE & INTEGRATION	70	25	30	11	100	36	0	0	100	36
MAT-203	COMPULSORY	TOPOLOGY II	70	25	30	11	100	36	0	0	100	36
MAT-204	COMPULSORY	COMPLEX ANALYSIS II	70	25	30	11	100	36	0	0	100	36
MAT-205	COMPULSORY	ADVANCED DISCRETE MATHEMATICS II	70	25	30	11	100	36	0	0	100	36
TOTAL			350		150		500				500	

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Semester-III

SUBJECT CODE	COMPULSORY/ OPTIONAL	SUBJECT NAME	THEORY						PRACTICAL		TOTAL	
			PAPER		CCE / INTERNAL		TOTAL MARKS		MAX	MIN	MAX	MIN
			MAX	MIN	MAX	MIN	MAX	MIN				
MAT301	COMPULSORY	Functional Analysis - I	70	25	30	11	100	36	0	0	100	36
MAT302	COMPULSORY	Advanced Special Function -I	70	25	30	11	100	36	0	0	100	36
MAT303	COMPULSORY	Theory of Linear Operators - I	70	25	30	11	100	36	0	0	100	36
MAT304	COMPULSORY	Integral Transforms - I	70	25	30	11	100	36	0	0	100	36
MAT305	COMPULSORY	Spherical Trigonometry And Astronomy - I	70	25	30	11	100	36	0	0	100	36
MAT306	COMPULSORY	INTERNSHIP	0	0	0	0	0	0	100	36	100	36
TOTAL			350		150		500		100		600	

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Semester- IV

SUBJECT CODE	COMPULSORY/ OPTIONAL	SUBJECT NAME	THEORY						PRACTICAL		TOTAL	
			PAPER		CCE / INTERNAL		TOTAL MARKS		MAX	MIN	MAX	MIN
			MAX	MIN	MAX	MIN	MAX	MIN				
MAT401	COMPULSORY	Functional Analysis - II	70	25	30	11	100	36	0	0	100	36
MAT402	COMPULSORY	Advanced Special Function -II	70	25	30	11	100	36	0	0	100	36
MAT403	COMPULSORY	Theory of Linear Operators - II	70	25	30	11	100	36	0	0	100	36
MAT404	COMPULSORY	Integral Transforms - II	70	25	30	11	100	36	0	0	100	36
MAT405	COMPULSORY	Spherical Trigonometry And Astronomy - II	70	25	30	11	100	36	0	0	100	36
TOTAL			350		150		500				500	

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Course Content:

M.Sc. Mathematics Semester - I

MAT- 101 Advanced Abstract Algebra –I

MAT- 101	**Advanced Abstract Algebra –I**	**4L:0T:0P**	**30 Hrs**	**4 Hrs/Week**

Course Objective : The course aims to introduce the learner to the concepts of normal series, composition series and Zessenhaus lemma. A study of solvable groups, nilpotent group and fitting and Frattini subgroup will be conducted and the students will be introduced to free group, presentation of a group and properties of a free group.

Course Learning Outcomes:

After doing this course student will be able to

CO1. prove Jordan Holder theorem and also to prove

CO3. To Explain Fundamental theorem of Galois theory Solution of polynomial equations by radicals.

CO4. determine distinct presentations of a group.

Unit - I **Total -10 Hours**

Normal & Subnormal series of groups, Composition series, Jordan- Holder series.

Unit- II **Total -6 Hours**

Solvable & Nilpotent groups.

Unit- III **Total -6 Hours**

Extension filed Roots of polynomials, Algebraic and transcendental extensions. Splitting fields. Separable and inseparable extension.

Unit- IV **Total -6 Hours**

Perfect filed , Finite fields, primitrive elements, Algebraically closed field.

Unit – V **Total – 10 Hours**

Auto orphism of extension. Galois extension. Fundamental theorem of Galois theory Solution of polynomial equations by radicals, Insolubility of general equation of degree 5 by radicals.

Text Book :-

(1) I.N. Herstein, Topics in Algebra, Wiley Eastern, New Delhi.
(2) V. Sahai & V. Bisht, Algebra, Narosa Publishing House.

Reference.

(1) P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University Press.
(2) N. Jacobson, Basic Algebra, Vol, II & VIII, Hindustan Publishing Company
(3) S. Lang, Algebra, Addison- Wesley.
(4) I.S. Luther & I.B.S. Passi Algebra Vol-1,2,3, Narosa company.
(5) Dr.H.K Pathak Advanced Abstract Algebra

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods
- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords:
Jordan- Holder series, Normal & Subnormal series of groups, Solvable & Nilpotent groups. Algebraic and transcendental extensions, Algebraically closed field, Finite fields, Fundamental theorem of Galois theory, Insolubility of general equation of degree 5 by radicals.

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MAT – 102 Real Analysis

MAT – 102	Real Analysis	4L:0T:0P	30 Hrs	4 Hrs/Week

Course Objectives:
To understand the integration of bounded functions on a closed and bounded interval and its extension to the cases where either the interval of integration is infinite. The sequence and series of real valued functions, Weierstrass M- Mtest, Abel's and Dirichlet's tests for uniform convergence, Jacobians, extremum problem.

Course Learning Outcomes: The course will enable the students to:
CO1. Learn about some of the classes and properties of Riemann integrable functions, and the applications of the Fundamental theorems of integration.
CO2. Learn about Cauchy criterion for uniform convergence and Weierstrass M-test for uniform convergence.
CO3. Know about the constraints for the inter-changeability of differentiability and integrability with infinite sum.
CO4. Approximate transcendental functions in terms of power series as well as, differentiation and integration of power series.

Unit -1 **Total – 06 Hours**
Definition and existence of Riemann- stieltjes integral and its Properties, Integration and Differentiation, The fundamental theorem of Calculus.

Unit – II **Total – 06 Hours**
Integration of vector- valued function, Rectifiable curves. Rearrangement of terms of a series, Riemann's theorem.

Unit – III **Total – 10 Hours**
Sequence and series of functions, pointwise and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M- Mtest, Abel's and Dirichlet's tests for uniform convergence, Uniform convergence and continuity, uniform convergence and Riemann-Stieltjes integration, uniform convergence and differentiation, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.

Unit –IV **Total – 10 Hours**
Function of several variables, liner transformations, Derivatives in an open subset of R^n, chain rule, Partial derivative, Interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem,

Unit –V **Total – 07 Hours**

Implicit function theorem, Jacobians, extremum problem with constraints, Lagrange's multiplier methods Differentiation of integrads, Partitions of unity, Differential from, Stoke's Theorem.

Text Books:

1- Water Rudin, Principles of Mathematical Analysis, McGraw Hill

Reference :

1- T.M. Apostal, Mathematical Analysis Narosa.
2- H.L. Rayden, Real Analysis, Macmillan (Indian Edition)
3- Dr. H.K Pathak Real Analysis

Teaching Learning Process

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- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Riemann- stieltjes integral, The fundamental theorem of Calculus. Cauchy criterion for uniform convergence, Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems, Derivatives in an open subset of R^n, chain rule, Taylor's theorem, Inverse function theorem, Implicit function theorem, Jacobians, Lagrange's multiplier methods, Stoke's Theorem.

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MAT – 103 Topology -I

MAT – 103	Topology -I	4L:0T:0P	30 Hrs	4 Hrs/Week

Course Objective
To introduce basic concepts of point set topology, basis and sub basis for a topology and Subspaces and relative topology. Closed sets. Closure, Contiuous Functions and homeomorphism. product and box topologies and introduce notions of connectedness, path connectedness, local connectedness, local path connectedness, convergence, nets, countability axioms and compactness of spaces

Course Learning Outcomes

After studying this course the student will be able to
CO1. determine interior, closure, boundary, limit points of subsets and basis and subbasis of topological spaces.
CO2. check whether a collection of subsets is a basis for a given topological spaces or not, and determine the topology generated by a given basis.
CO3. determine the connectedness and path connectedness of the product of an arbitrary family of spaces.
CO4. learn about First and Second countable spaces, separable and Lindelöf spaces.
CO5. learn Schroeder- Bernstein theorem, and prove Cantor's theorem.

Course Contents

Unit -I **Total – 10 Hours**
Countable and uncountable sets, Ininiie sets any me Axiom of choice, Cardinal numbeis and its arithmetic. Schroeder- Bernstein theorem, Cantor's theorem and thee continuum hypothesis. Zorn's lemma. Weil- ordering theorem.

Unit -II **Total – 10 Hours**
Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods, interior and boundary. Accumulation points and derived sets. Bases and sub-bases. Subspaces and relative topology.

Unit -III **Total – 07 Hours**
Alternate methods of defining a topology in terms of kuratowski Closure Operator and Neighbourhood Systems. Contiuous Functions and homeomorphism.

Unit -IV **Total – 06 Hours**
First and Second Countable spaces. Lindeiof's theorems. Separable spaces. Second Countability and Separability.

Unit -V **Total – 06 Hours**

Path-connecedness, connected spaces, Connectedness on Real line. Components, Locally connected spaces.

Text Books: J.R.Munkres, Topology- Afirst course, Prentice- Hall of India.

References:

G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill
2, K.D. Joshi: Introduction to general topology, Wiley Eastern.
Dr. H.K Pathak Introduction to general topology

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Schroeder- Bernstein theorem, Cantor's theorem, Zorn's lemma. Weil- ordering theorem. Definition and examples of topological spaces. Closed sets. Closure. Dense subsets. Neighbourhoods, . Bases and sub-bases. defining a topology in terms of kuratowski Closure Operator and Neighbourhood Systems. Contiuous Functions and homeomorphism. Lindeiof's theorems. Separable spaces. Second Countability and Separability. Path-connecedness, connected spaces, Components, Locally connected spaces.

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MAT – 104 Complex Analysis -I

MAT - 104	**Complex Analysis -I**	**4L:0T:0P**	**30 Hrs**	**4 Hrs/Week**

Course Objective
The course aims to familiarize the learner with complex function theory, Morera's theorem, Cauchy's inequality, The fundamental theorem of algebra and Cauchy's theorems, Meromophic Functions , Evaluation of integrals. Cauchy's residue theorem. and Schwarz' lemma.

Course Learning Outcomes: After studying this course the student will be able to

CO1. understand Cauchy's theorems and integral formulas on open subsets of the plane.
CO2. understand the concept The fundamental theorem of algebra,
CO3. understand how to count the number of zeros of analytic function giving rise to open mapping theorem and Goursat theorem as a converse of Cauchy's theorem.
CO4. know about the kind of singularities of meromorphic functions which helps in residue theory and Rouche's theorem
CO5. Bilinear transformation, their properties and classification .

Unit -I **Total – 06 Hours**
Complex integration, Cauchy- Goursat theorem, Cauchy integral formula, Higher order derivatives

Unit –II **Total – 07 Hours**

Morera's theorem, Cauchy's inequality, Lowville's theorem, The fundamental theorem of algebra, Taylor's Theorem.

Unit- III **Total – 10 Hours**
The maximum modulus principle, Schwartz lemma, Laurent series Isolatrd singularities. Meromophic Functions. The argument principle, Rouche's theorem Inverse function theorem.

Unit – IV **Total – 10 Hours**
Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to argz z,z^a.

Unit – V **Total – 07 Hours**
Bilinear transformation, their properties and classification, Definition and examples of conformal mapping .

Text Book:

1. J.B. Convey. Functions of one complex variable, Spring verlag

References:

1. S.Ponnuswamy, Foundation of complex analysis, Narosa Publishing House.
2. L.V. Ahlfors. Complex analysis McGraw Hill
3. Dr .H.K. Pathak Complex analysis

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Cauchy- Goursat theorem, Cauchy integral formula, Morera's theorem, Cauchy's inequality, The fundamental theorem of algebra, Taylor's Theorem. Schwartz lemma, Laurent series, Meromophic Functions. The argument principle, Rouche's theorem Inverse function theorem. Residues. Cauchy's residue theorem. Bilinear transformation, conformal mapping .

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MAT – 105 Advanced Discrete Mathematics-I

MAT - 105	**Advanced Discrete Mathematics-I**	**4L:0T:0P**	**30 Hrs**	**4 Hrs/Week**

Course Objectives:
The course aims at introducing the concepts of ordered sets, lattices, sublattices and homomorphisms between lattices. It also includes introduction to modular and distributive lattices along with complemented lattices and Boolean algebra. Then some important applications of Boolean algebra are discussed in switching circuits. The second part of this course deals with introduction to graph theory, paths and circuits, Eulerian circuits, and finally some applications of graphs to shortest path algorithms. Using AND,OR,& NOT gates

Course Learning outcomes: After the course, the student will be able to:
CO1. Understand the notion of ordered sets and maps between ordered sets.
CO2. Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.
CO3. Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.
CO4. Learn about basics of graph theory, including Eulerian graphs, Kuratowski's two graphs,
CO5. Learn about the applications of graph theory in the study of shortest path algorithms.
CO6. Application of Boolean Algebra to switching theory (Using AND,OR,& NOT gates)

Unit – I **Total – 10 Hours**

Semigroup and monids, Subsemigroups Submonids, Homomorphism of semigroups and monoids, Congruence relation and Quotient semigroups, Direct products, Basic Homomorphism Theorm.

Unit – II **Total – 07 Hours**

Lattices-Lattices as partially ordered sets, their properties, Lattices as Algebraic systems, sublattices, Bounded lattices, Distributive Lattices, Complemented lattices.

Unit – III **Total – 10 Hours**

Boolean Algebra-Boolean Algebras as lattices, various Boolean identities. joint irreducible elements, minterms, maxterms, minterm Boolean forms, canonical forms, minimization of Boolean functions. Application of Boolean Algebra to switching theory (Using AND,OR,& NOT gates) the Karnaugh method.

Unit – IV **Total – 10 Hours**

Graph Theory- Defination and types of graphs.Paths & circuits. Connected graphs. Euler graphs, weighted graphs (undirected) Dijkstra's Algorithm. Trees, Properies of trees Rooted & Binary trees, spanning trees, minimal spanning tree.

Unit – V **Total – 07 Hours**

Complete Bipartite graphs, Cut-sets, properties of cut sers, Fundamental Cut-sets &circuits, Connectivity and Separability, Planar graphs, Kuratowski's two graphs, Euler's formula for planar graphs.

Text Books :-

1. J.P Tremblay manohar. Discrete Mathematical structures,

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Semigroup and monids, Subsemigroups Submonids, Basic Homomorphism Theorm. Lattices , sublattices , Bounded lattices, Distributive Lattices, Complemented lattices. Boolean Algebra, canonical forms, Boolean functions. Using AND,OR,& NOT gates, graphs.Paths & circuits. Connected graphs. Euler graphs, weighted graphs (undirected) Dijkstra's Algorithm. Trees, Properies of trees Rooted & Binary trees, spanning trees,

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M.Sc. Mathematics Semester - II

MAT201 Advanced Abstract Algebra —II

MAT201	**Advanced Abstract Algebra —II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objectives: The main objective is to familiarize Introduction to Modules, Module homomorphism, isomorphism, Semisimple modules. Schur's lemma. Noether-Laskar theorem. Index of Nilpotency, Invariants of a nilpotent transformation. The primary decomposition theorm.

Course Learning Outcomes: After studying this course the student will be able to
CO1. Finitely generated modules, cyclic modules.
CO2. Find Hilbert basis theorem. Wedderburn-Artin theorem.
CO3. Noether-Laskar theorem. Fundamental structure theorem of modules over a principal ideal domain and its applications to finitely generated : abelian groups.
CO4 To Explain Similarity of linear transformation, Invariant spaces, Reduction to triangular forms. Nilpotent transformations.

Unit- I **Total – 10 Hours**
Introduction to Modules. Examples, submodules quotient modules. Module homomorphism,isomorshism. Finitely generated modules, cyclic modules.

Unit – II **Total –06 Hours**
Simple modules, Semisimple modules, Free modules, Schur's lemma.

Unit – III **Total – 07 Hours**
Noetherian & Artinian modules and rings, Hilbert basis theorem. Wedderburn-Artin theorem.

Unit – IV **Total – 10 Hours**
Uniform modules, Primary modules, Noether-Laskar theorem. Fundamental structure theorem of modules over a principal ideal domain and its applications to finitely generated : abelian groups.

Unit – V **Total – 10 Hours**
Similarity of linear transformation, Invariant spaces, Reduction to triangular forms. Nilpotent transformations. Index of Nilpotency, Invariants of a nilpotent transformation. The primary decomposition theorm.

Reference Books:

P.B. Bhattacharya, S.K.Jain, S.R. Nagpaul, Basic Abstract Algebra, Cambridge University Press, (Indeian Edition)

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Modules. Examples, submodules quotient modules. Module homomorphism, isomorphism . Semi simple modules, Schur's lemma. Hilbert basis theorem. Wedderburn-Artin theorem. Noetherian & Artinian modules and rings, Nilpotent transformations. linear transformation, decomposition theorem.

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MAT202 Lebesgue Measure & Integration

MAT202	**Lebesgue Measure & Integration**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objectives: The main objective is to familiarize with the Lebesgue outer measure, Measurable sets, Measurable functions, Integration, Convergence of sequences of functions and their integrals, Functions of bounded variation, Lp-spaces.

Course Learning Outcomes: After studying this course the student will be able to
CO1. understand the requirement and the concept of the Lebesgue integral (a generalization of the Reimann integration) along its properties.
CO2. know about the concepts of functions of bounded variations and the absolute continuity of functions with their relations.
CO3. extend the concept of outer measure in an abstract space and integration with respect to a measure.
CO4. learn and apply Holder and Minkowski inequalities in L p-spaces and understand completeness of L p-spaces and convergence in measures.

Unit — I **Total – 10 Hours**
Lebesgue outer measure. Measurable sets. Regularity. Measurable functions. Borel and Lebesgue measurability. Non-measurable sets.

Unit – II **Total – 06 Hours**
Integration of Non-negative functions. The General integral. Integration of Series, Reimann and Lebesgue Integrals.

Unit – III **Total – 07 Hours**
The Four derivatives. Functions of Bounded variation. Lebesgue Differentiation Theorem, Differentiation and Integration.

Unit – IV **Total – 06 Hours**
The LP-spaces, Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of LP.

Unit – V **Total – 10 Hours**
Dual of space when $1 < p <$ convergence in Measure,Uniform. Convergence and almost uniform convergence.

Reference Books:

G. de Barra. Measure Theory and Integration, Wiley Eastern (Indian Edition)
Walter Rudin, Principles of Mathematical Analysis,McGraw-Hill, International student edition, H.L. Royden, Real Analysis, Macmillan, Indian Edition.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Lebesgue outer measure. Measurable sets. Borel and Lebesgue measurability. Integration of Series, Reimann and Lebesgue Integrals. Functions of Bounded variation. Lebesgue Differentiation Theorem, Differentiation and Integration. The LP-spaces, Convex functions, Jensen's inequality. Holder and Minkowski inequalities. Completeness of LP. Dual of space when $1 < p <$ convergence in Measure,Uniform. Convergence and almost uniform convergence.

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MAT203 Topology-II

MAT203	**Topology-II**	**4L:0T:0P**	**30 Hrs**	**4 Hrs/Week**

Course Objective
The main objective is to familiarize with the Urysohn's lemma, Sequentially and countably compact compact sets. Tychonoff s theorem , Embedding lemma and Tychonoff embedding Ultra-filters and Compactness. The fundamental group and covering spaces-Homotopy of paths.

Course Learning Outcomes
After studying this course the student will be able to
CO1. determine Basic properties of compactness. Compactness and finite intersection property.
CO2.learn and Tychonoff product topology in terms of standard sub-base and its characterizations
CO3. To Explain Topology and convergence of nets Hausdorffness and nets. Compactness and nets.
CO4. Learn and apply The fundamental group of the circle and the fundamental theorem of algebra.

Unit — I **Total – 06 Hours**
Separation axioms TO,T1,T2,T3,T4 : their Characterizations and basic properties. Urysohn's lemma. Tietze extension theorem.

Unit – II **Total – 10 Hours**
Compactness. Continuous functions and compact sets. Basic properties of compactness. Compactness and finite intersection property. Sequentially and countably compact compact sets. Local compactness and one point compactification. Stone-vech compactification. Compactness in metric spaces. Equivalence of compactness, countable compactness and one point compactification. Stone-vech compactification. Compactness in metric spaces. Equivalence of compactness, countable compactness and sequential compactness in metric spaces. Connected spaces. Connectedness on the line. Components. Locally connected spaces.

Unit – III **Total – 10 Hours**
Tychonoff product topology in terms of standard sub-base and its characterizations. Projection maps. Separation axioms and product spaces. Connectedness and product spaces. Compactness and product spaces (Tychonoff s theorem) Countability and product spaces.

Unit – IV **Total – 10 Hours**
Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem. Net and filters. Topology and convergence of nets Hausdorffness and nets. Compactness and nets. Filters and their convergence. Canonical way of converting nets to filters and vice-versa.Ultra-filters and Compactness.

Unit – V **Total – 07 Hours**

The fundamental group and covering spaces-Homotopy of paths. The fundamental group. Covering spaces. The fundamental group of the circle and the fundamental theorem of algebra.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Separation axioms TO,T1,T2,T3,T4 : their Characterizations and basic properties. Basic properties of compactness. Compactness, Compactness in metric spaces. Connected spaces. Connectedness on the line. Compactness and product spaces (Tychonoff s theorem) Countability and product spaces. Embedding and metrization. Embedding lemma and Tychonoff embedding. Topology and convergence of nets Hausdorffness and nets. covering spaces-Homotopy of paths. The fundamental group of the circle and the fundamental theorem of algebra.

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MAT204 Complex Analysis –II

MAT204	**Complex Analysis –II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objectives: The course aims to familiarize the Power series method of analytic continuation. , analytic functions theory, the concept of index and Weierstrass factorization theorem, Schwartz reflection principle. . Hadamard's three circles theorem. . Bloch's theorem

Course Learning Outcomes: After studying this course the student will be able to
CO1. Learn and Apply Riemann Zeta function .To Explain Gamma and its properties
CO2. understand Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve
CO3. understand the concept Harmonic function on a disc.
CO4. understand Exponent of convergence. Borels theorem. Hadamard's factorization theorem.

Unit — I **Total – 07 Hours**
Weierstrass factorization theorem. Gamma and its properties. Riemann Zeta function. Riemann's functional equation

Unit – II **Total – 07 Hours**
Runge's Theorem. Mittag-Leffler's theorem. Analytic continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.

Unit – III **Total – 06 Hours**
Schwartz reflection principle. Monodromy theorem and its consequences. Harmonic function on a disc.

Unit – IV **Total – 10 Hours**
Harnax inequality and theorem. Dirichlet problem. Green's function. Cannonical products. Jenson's formula. Hadamard's three circles theorem. Order of an entire function. Exponent of convergence. Borels theorem. Hadamard's factorization theorem.

Unit – V **Total – 10 Hours**
The range of an analytic function. Bloch's theorem. The little Picard theorem.Schottky's theorem. Montel Caratheodary and great Picard theorem. Univalent function. Bieberbach conjecture and the V, - theorem.

Reference Books:
J.B.Convey ,Functions of one complex variable, Springer-Verlag
S Ponnuswamy, Fundamentals of complex analysis, Narosa Publishing House.
L.V.Ahlfors, Complex Analysis, McGraw Hill

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Weierstrass factorization theorem. Gamma and its properties. Runge's Theorem. Mittag-Leffler's theorem. Power series method of analytic continuation. Schwartz reflection principle. Harmonic function on a disc. Green's function. . Hadamard's factorization theorem. Cannonical products. Jenson's formula. The range of an analytic function. Bloch's theorem. Univalent function.

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MAT205 Advanced Discrete Mathematics-II

MAT205	**Advanced Discrete Mathematics-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective
The course aims at introducing the concepts of dijkrtra's algorithm, washell's algorithm directed trees, Reduced Machines, Homomorphism. Moore and Mealy Machines. Rewriting Rules. Derivations, Pumphaj Lemma. Kleene's Theorem.

Course Learning Outcomes
After studying this course the student will be able to
CO1. understand weighted undirected graphs dijkrtra's algorithm, strong connectivity and washell's algorithm directed trees
CO2. Introductory coumputability theory-Finite State Machines and their Transition Table Diagrams.
CO3. understand the Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata
CO4. . Conversion of Infix Expressions to Polisn Notaaon

Unit — I **Total – 07 Hours**
Directed graphs, lndegree and outdegree of a ventex, weighted undirected graphs dijkrtra's algorithm, strong connectivity and washell's algorithm directed trees, search trees, tree traversals.

Unit – II **Total – 10 Hours**
Introductory coumputability theory-Finite State Machines and their Transition Table Diagrams. Equivlence of Finite State Machines. Reduced Machines, Homomorphism. Finite Automata. Acceptors.

Unit – III **Total – 06 Hours**
Non-deterministic Finite Automata and equivalence of its power to that of Deterministic Finite Automata. Moore and Mealy Machines.

Unit – IV **Total – 06 Hours**
Turing Machine and Partial Recursive Functions. Grammars and Languages-Phrase-Structure Grammars. Rewriting Rules. Derivations.

Unit – V **Total – 10 Hours**
Sentential Forms,. Language generated by grammer , Regular, Context-Free, and Context Sensitive Grammars and Languages. Regular sets. Regular Expressions and the Pumphaj Lemma. Kleene's Theorem. Notions of Syntax Analysis. Polish Notations. Conversion of Infix Expressions to Polish Notation.

Reference Books:

J.R Trerp.blay & R. Manohar, Discrete Mathomcs eal Sir uiJurus with, Applications to Computer Science, MeGxov- A

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Directed graphs, lndegree and outdegree of a ventex, weighted undirected graphs dijkrtra's algorithm, washell's algorithm directed trees, search trees, Reduced Machines, Homomorphism. Finite Automata. Acceptors. Turing Machine and Partial Recursive Functions. Functions. Grammars and Languages-Phrase-Structure Grammars. Polish Notations. Conversion of Infix Expressions to Polish Notation. Regular Expressions and the Pumphaj Lemma. Kleene's Theorem.

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M.Sc. Mathematics Semester - III

MAT301 FUNCTIONAL ANALYSIS -I

MAT301	**FUNCTIONAL ANALYSIS -I**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective
To familiarize with the basic tools of Functional Analysis involving normed spaces, Riesz Lemma ,Banach spaces and Properties of Normed linear spaces and operators , Quotient space, their properties dependent on the dimension and the bounded linear operators from one space to another.

Course Learning Outcomes:
After studying this course the student will be able to
CO1. verify the requirements of a norm, completeness with respect to a norm, relation between compactness and dimension of a space, check boundedness of a linear operator and relate to continuity.
CO2. To Explain Finite dimensional Non linear Spaces & Sub spaces Equivalent norms,
CO3. Learn Bounded Linear operators & continuous operators Non - Linear spaces operators.

CO4. To Explain bounded Linear functional Dual spaces with examples.

Unit- I **Total – 10 Hours**

Normed linear spaces. Banach spaces and examples. Properties of Normed linear spaces Basic properties of finite dimensional normed linear spaces.

Unit- II **Total – 10 Hours**

Finite dimensional Non linear Spaces & Sub spaces Equivalent norms, Riesz Lemma, and compactness.

Unit- III **Total – 06 Hours**

Quotient space of normed linear spaces and its completeness

Unit- IV **Total – 07 Hours**

Bounded Linear operators & continuous operators Non - Linear spaces operators

Unit- V **Total – 06 Hours**

Linear functional, bounded Linear functional Dual spaces with examples.

Text Books :

(1) E. Kreyszig, Introductory Functional Analysis with application, John Wiley & Sons New York.

(2) G.F. Simmons, Introduction to Topology & Modren Analysis Mc Graw Hill, New York

Reference :

[1] B. Choudary and Sudarshan Nanda. Functional Analysis with application Wiley Eastern Ltd.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Normed linear spaces. Banach spaces, finite dimensional normed linear spaces. Riesz Lemma, and compactness. Quotient space of normed linear spaces and its completeness, Bounded Linear operators & continuous operators Non - Linear spaces operators. Linear functional, bounded Linear functional Dual spaces.

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MAT302 Advanced Special Function -I

MAT302	**Advanced Special Function -I**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective

The course aims at introducing the concepts of Gamma and Beta Function, Legender's duplication formula ,Hyper geometric differential equation and its solutions, Relations between function of z and 1-z. confluent hyper geometric function

Course Learning Outcomes: After studying this course the student will be able to

CO1. Find the Gamma Function A series for г'(z) /г(z), Difference equation г(z+1)= zг(z), value of гz / г(1-z)

CO2.Learn and Apply Hypergeometric funtion and function $_2f_1$ (a,b;c;z).A simple integral form valuation of $_2F_1$ (a,b;c;z).

CO3. To Explain confluent hyper geometric function and its properties.

CO4. Learn Elementary series manipulations, Simple transformation, Relations between function of z and 1-z.

Unit- I **Total – 10 Hours**

Gamma and Beta Function: The Euler or Macheroni Constant Y, Gamma Function A series for г'(z) /г(z), Difference equation г(z+1)= zг(z), value of гz / г(1-z), Factorial funtion, Legender's duplication formula,Gauss multiplication theorm.

Unit- II **Total – 10 Hours**

Hypergeometric funtion and function $_2f_1$ (a,b;c;z). A simple integral form valuation of $_2F_1$ (a,b;c;z). Contiguous funtion relations, Hyper geometric differential equation and its solutions, F (a,b;c;z) as funtion of its parameters.

Unit- III **Total – 06 Hours**

Generalized Hypergeometric function.

Unit- IV **Total – 07 Hours**

Elementary series manipulations, Simple transformation, Relations between function of z and 1-z.

Unit- V **Total – 07 Hours**

confluent hyper geometric function and its properties.

Books Recommended :-

1. Rainville, E.D., Special Functions, the Macmillan Co., New York 1971.
2. Srivatava, H.M., Gupta K.C. and Goyal, S.P. :, The H- Functions of one and two variables with applications, South Asian Publication, New Delhi.
3. Saran N., Sharma S.D. and Trivedi – Special Function with application. Pragati Pragati Prakashan 1986.
4. The Saxena V.P.- I-Function, Anamaya- New Delhi, 2008.

Reference Books:-

1. Lebdev, N.N., Sepcial Functions and Their Applications, Prentice Hall, Englewood Cliffs, New Jersey, USA 1995.
2. Whittaker, E.T. and Watson, G.N., A Course of Modren Analysis Combridge University Press, London, 1963

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Gamma and Beta Function. Gamma Function A series for $\Gamma'(z) / \Gamma(z)$, Difference equation $\Gamma(z+1)= z\Gamma(z)$, value of Γz / $\Gamma(1-z)$, Factorial funtion, Legender's duplication formula,Gauss multiplication theorm. Hypergeometric funtion and function ${}_2f_1$ (a,b;c;z). Hyper geometric differential equation and its solutions, confluent hyper geometric function. Generalized Hypergeometric function. Relations between function of z and 1-z.

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MAT303 Theory of Linear Operators -I

MAT303	**Theory of Linear Operators -I**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective

The course aims at introducing the concepts of Spectral theory in normed linear spaces, Spectral mapping theorem for polynomials. Elementary theory of Banach algebras.

Course Learning Outcomes: After studying this course the student will be able to

CO1 To explain Properties of resolvent and spectrum.

CO2.To explain Spectral theory in normed linear spaces

CO3. Learn and Apply Spectral radius of a bounded linear operator on a complex banach space.

CO4. To explain General properties if compact linear operators.

Course Contents

UNIT -I **Total – 08 Hours**

Spectral theory in normed linear spaces, resolvent set and spectrum

UNIT -II **Total – 07 Hours**

Spectral properties of bounded linear operators.

UNIT -III **Total – 09 Hours**

Properties of resolvent and spectrum. Spectral mapping theorem for polyonmials.

UNIT -IV **Total – 10 Hours**

Spectral radius of a bounded linear operator on a complex banach space. Elementary theory of Banach algebras.

UNIT -V **Total – 06 Hours**

General properties if compact linear operators.

Recommended Books :-

1- E. Kreyszig Introductory Functional analysis with applications. Jhon wiley & Sons, New

Reference Book:

1. P.R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N. Y. 1957
2. N. Dundford and J.T. Schwartz, linear operator-3 part, Interscience/ Wiley, New York 1958-71.
3. G. Bachman and L. Narci, Funtuional analysis, Academic press New York. 1966.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: resolvent set and spectrum. Spectral properties of bounded linear operators. Spectral mapping theorem for polyonmials. Spectral radius of a bounded linear operator on a complex banach space. compact linear operators.

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MAT304 Integral Transforms –I

MAT304	**Integral Transforms –I**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective: The course aims at introducing the concepts of Laplace Transforms,

Laplace equations, Laplace wave equation 'ft, Heat conduction equation

Course Learning Outcomes : After studying this course the student will be able to
CO1. To Explain and Apply Laplace Transforms

CO2.To Explain and Verify Laplace's wave equation 'ft

CO3.To Explain Laplace's equations, and Application of Laplace Transforms.

CO4.To Explain Heat conduction equation.

UNIT- I **Total – 06 Hours**

Laplace Transforms

UNIT- II **Total – 07 Hours**

Laplace's equations,

UNIT- III **Total – 08 Hours**

Laplace's wave equation 'ft

UNIT -IV **Total – 10 Hours**

Application of Laplace Transforms

UNIT -V **Total – 07 Hours**

Heat conduction equation.

Recommended Books :-

- Integral Transforms by (Goyal & Gupta.
- Integral Transforms by Sneddon

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Laplace Transforms, Laplace's equations, Laplace's wave equation 'ft, Heat conduction equation.

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MAT305 Spherical Trigonometry and Astronomy-I

MAT-305	**Spherical Trigonometry and Astronomy-I**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective : The course aims at introducing the concepts of Fundamental of Spherical Trigonometry, solution and properties of right angled triangle, Spherical triangle & Examples.

Course Learning Outcomes: After studying this course the student will be able to
CO1. To Explain and learn Fundamental of Spherical Trigonometry

CO2.To Explain Properties of Right angle triangle and solution

CO3. To Explain Relation between Sides & angles of a Spherical triangle.

CO4. To Explain Application of Spherical triangle & Examples.

Course Contents
UNIT-I **Total – 06 Hours**

Fundamental of Spherical Trigonometry

UNIT-II **Total – 08 Hours**

solution of right angled triangle

UNIT-III **Total – 07 Hours**

Properties of Right angle triangle

UNIT-IV **Total – 10 Hours**

Relation between Sides & angles of a Spherical triangle

UNIT-V **Total – 08 Hours**

Application of Spherical triangle & Examples.

Recommended Books :-

- Spherical Astronomy - Smarat
- spherical Astronomy – Bell
- spherical Astronomy- G.S Malik

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Solution and properties of right angled triangle, Fundamental of Spherical Trigonometry, Relation between Sides & angles of a Spherical triangle. Application of Spherical triangle & Examples.

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M.Sc. Mathematics Semester - IV

MAT401 Functional Analysis-II

MAT- 401	**Functional Analysis-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective

To familiarize with the basic tools of Functional Analysis involving normed spaces, Hahn-Banach spaces and Hilbert spaces, their properties dependent on the dimension and Riesz representation theorem. Uniform boundedness theorem **.**

Course Learning Outcomes

After studying this course the student will be able to

CO1. distinguish between Hahn- Banach spaces and Hilbert spaces, decompose a Hilbert space in terms of Orthonormal Sets

CO2. classify operators intoself-adjoint , Normal and Unitary operators.

CO3.find Projection Mapping , Projection theorem structure of Hilbert spaces

CO4. To Explain Bessel's inequality. Complete orthonormal sets and Parseval's ldentity,

UNIT-I **Total – 08 Hours**

Uniform boundedness theorem and some of its consequences, Open mapping and closed graph theorems.

UNIT-II **Total – 10 Hours**

Hahn-Banach theorem for real linear spaces, Hahn-Banach theorem for complexlinear spaces and normed linear spaces.

UNIT-III **Total–10**

HoursReflexive spaces. Hilbert spaces, Orthonormal Sets, Bessel's inequality. Complete orthonormal sets and Parseval's ldentity,

UNIT-IV **Total – 07 Hours**

Projection Mapping , Projection theorem structure of Hilbert spaces. Riesz representation theorem.

UNIT-V **Total – 06 Hours**

Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces. Self-adjoint operators, Positive operators, Projection, Normal and Unitary operators.

Suggested Readings: .

E. Kreyszig, Introductory Functional Analysis with applications, John Wiley & Sons New York.

G.F. Simmons, Introduction to Topology & Modern Analysis Mc Graw Hill, NewYork

B. Choudhary and Sudarshan Nanda. Functional Analysis with applications, Wiley Eastern Ltd

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods
- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Uniform boundedness theorem, Hahn-Banach theorem for real linear spaces, . Hilbert spaces, Parseval's ldentity, Riesz representation theorem. Projection Mapping , Adjoint of an operator on a Hilbert space. Self-adjoint operators, Positive operators,

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MAT-402 ADVANCED SPECIAL FUNCTION-II

MAT- 402	**ADVANCED SPECIAL FUNCTION-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective
The course aims at introducing the concepts of Bessel's differential equation, Additional generating functions, Rodrigue’s formula ,The Laguerre Polynomials Ln(X),Generating functions, Laplace's first integral form.

Course Learning Outcomes: After studying this course the student will be able to
CO1. To Explain Bessel's integral with index half and an odd integer

CO2.To explain Generating function for Legendre polynomials Rodrigues formula

CO3 To Explain Special properties of PnX), Some more generating functions

CO4.To Explain Expansion of polynomials, more generating functions.

Unit-I **Total – 08 Hours**

Bessel function and Legendre polynomials :

Definition of Jn (z), Bessel's differential equation, Generating function, Bessel's integral

with index half and an odd integer,

Unit-II **Total – 10 Hours**

Generating function for Legendre polynomials Rodrigues formula,Bateman's generating function, Additional generating functions, Hypergeometric forms of Pn (X).

Unit-III **Total – 07 Hours**

Special properties of PnX), Some more generating functions, Laplace's first integral form, Othergonality.

Unit- IV **Total – 10 Hours**

Definition of Hermite polynomials Hn (x), Pure recurrence relations, Differential recurrence relations, Rodrigue’s formula, Other generating functions, Othogonality, Expansion of polynomials, more generating functions.

Unit V **Total – 07 Hours**

Laguerre Polynomials :

The Laguerre Polynomials Ln(X),Generating functions, Pure recurrence relations, Differential recurrence relation, Rodrigo's formula, Orthogonal, Expansion of polynomials, Special properties, Other generating functions.

BOOKS RECOMMENDED ;

1- Rainville, E.D, ; Special Functions, The Macmillan co., New york 1971,

2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and

Two Variables with applications, South Asian Publication, New Delhi.

3- Saran, N., Sharma S.D. and Trivedi, - Special Functions with application,

Pragati prakashan, 1986.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods
- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Bessel's differential equation, , Hypergeometric forms of Pn (X). Generating function for Legendre polynomials Rodrigues formula, Laplace's first integral form, Othergonality. Hermite polynomials Hn (x), Rodrigue’s formula, Expansion of polynomials.

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MAT403 Theory of Linear Operators-II

MAT- 403	**Theory of Linear Operators-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective :The course aims at introducing the concepts of Fredhoml alternative for integral equation. compact linear operators on normed spaces. Positive operators Monotone sequence theorem . Square roots of a positive operator.

Course Learning Outcomes: After studying this course the student will be able to
CO1. To Explain Positive operators Monotone sequence theorem for bounded self – adjoint operators on a complex Hilbert space.

CO2.To explain Behaviours of Compact linear operators with respect to solvability of operators equation.

CO3 To Explain projection operators. with applications.

Course Contents

UNIT-I **Total – 08 Hours**

Spectral properties of compact linear operators on normed spaces.

UNIT-II **Total – 06 Hours**

Behaviours of Compact linear operators with respect to solvability of operators equation.

UNIT-III **Total – 10 Hours**

Fredholm type theorems.fredholm alternative theorem. Fredhoml alternative for integral equation. spectral properties of bounded self – adjoint linear operator on complete Hilbert space.

UNIT-IV **Total – 08 Hours**

Positive operators Monotone sequence theorem for bounded self – adjoint operators on a complex Hilbert space.

UNIT-V **Total – 08 Hours**

Square roots of a positive operator. projection operators. with applications,

Suggested Readings:

1. E. Kreyszig Introductory functional analysis with applications, Jhon wiley & Sons, New York, 1978.
2. P. R. Halmos Introduction to Hilbert space and the theory of Spectral Multiplicity, Second edition, Chelsea publishing co. N.Y. 1957.

3. N. Dundford and J.T. Schwartz, linear operator -3 part, Interscience / Wiley, New York 1958-71.

4. G. Bachman and L. Narci, Functional analysis, Academic press New York, 1966.

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: compact linear operators on normed spaces. fredholm alternative theorem. spectral properties of bounded self – adjoint linear operator on complete Hilbert space. Positive operators Monotone sequence theorem for bounded self – adjoint operators on a complex Hilbert space. Square roots of a positive operator. projection operators.

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MAT404 Integral Transforms-II

MAT- 404	**Integral Transforms-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective :The course aims at introducing the concepts of Laplace Transform. Electric Circuits. Inversion Formula, Convolution & Parseval's identity, Fourier cosine and sine transform.

Course Learning Outcomes: After studying this course the student will be able to
CO1. To Explain Application of Laplace Transform to Boundary Value Problems.

CO2. To Explain The complex Fourier Transform and Properties of Fourier

CO3. To Explain Inversion Operational and combined properties Fourier transform.

UNIT-I **Total – 02 Hours**

Application of Laplace Transform to Boundary Value Problems.

UNIT-II **Total – 02 Hours**

Electric Circuits. Application to Beams.

UNIT-III **Total – 2 Hours**

The complex Fourier Transform, Inversion Formula, Fourier cosine and sine transform.

UNIT-IV **Total – 06 Hours**

Properties of Fourier. Transforms, Convolution & Parseval's identity.

UNIT-V **Total – 10 Hours**

Fourier Transform of the derivatives, Finite Fourier Sine & Cosine Transform, Inversion Operational and combined properties Fourier transform.

Suggested Readings:

[1] Integral Transforms by Goyal& Gupta.
[2] Integral Transforms by Sneddon

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Application to Beams. Application of Laplace Transform to Boundary Value Problems. , Fourier and finite Fourier cosine and sine transform. Properties of Fourier. Transforms, Convolution & Parseval's identity. Electric Circuits. Inversion Operational.

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MAT405 Spherical Trigonometry and Astronomy-II

MAT-405	**Spherical Trigonometry and Astronomy-II**	**4L:0T:0P**	**40 Hrs.**	**4 Hrs/Week**

Course Objective :

The course aims at introducing the concepts of Spherical Astronomy, Celestial sphere, Atmospheric Retraction, Time planetary phenomena. Transit instrument

Course Learning Outcomes:
After studying this course the student will be able to
CO1.To Explain Celestial sphere and Transit instrument.

CO2. To Explain Spherical Astronomy - Various system of references and related topics.

CO3 To Explain Atmospheric Retraction. and Time planetary phenomena

UNIT-I **Total – 10 Hours**

Spherical Astronomy - Various system of references and related topics.

UNIT-II **Total – 07 Hours**

Celestial sphere,

UNIT-III **Total – 08 Hours**

Transit instrument.

UNIT-IV **Total – 08 Hours**

Atmospheric Retraction.

UNIT-V **Total – 10 Hours**

Time planetary phenomena

Suggested Readings:

1. A text book of spherical trigonometry : Gorakh Prasad. 2- A text book of spherical Astronomy : Gorakh Prasad.
2. Spherical Astronomy – Smarat
3. spherical Astronomy – Bell

Teaching Learning Process

- Each topic to be explained with examples.
- Students to be involved in discussions and encouraged to ask questions.
- Students to be given homework/assignments.
- Students to be encouraged to give short presentations.
- Illustrate the concepts through CAS.

Assessment Methods

- Presentations and participation in discussions.
- Assignments and class tests.
- Mid-term examinations.
- End-term examinations.

Keywords: Atmospheric Retraction.Spherical Astronomy, Celestial sphere, Transit instrument. Time planetary phenomena.