PROGRAMME: M.Sc.,(MATHEMATICS & APPLIED MATHEMATICS)
SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF MATHEMATICS

Mission of the Mathematics Department:

1. To emerge as a global centre of learning academic excellence and innovative research.
2. To pursue collaborative programs with highly reputed National and International institutions.

Vision of the Mathematics Department:

1. Imparting quality mathematical education and inculcating the spirit of research through innovative teaching and Research methodologies.
2. To achieve high standards of excellence in generating and propagating knowledge in mathematics
3. To provide an environment where students can learn, become competent users of mathematics and understand the use of mathematics in other disciplines.

Program Out Comes (PO) of PG in Mathematics & Applied Mathematics:

Students are expected to know or able to do by the time of graduation. At the end of the programme, the students will be to:

1. Apply Knowledge in Mathematics in all the fields of learning including higher research and its extensions.
2. Utilize Number Theory in the field of Cryptography that helps in hiding information and maintaining secrecy in military information, transmission, computer password and e-commerce.
3. Facilitate the study of groups in crystallography in chemistry and Lie symmetry groups in physics.
4. Ability to think, acquire knowledge and skills through logical reasoning and in culture the habit of self- learning throughout life.
5. Inculcate critical thinking to carry out scientific investigation objectively.
6. Equip the student with skills to analyse problems, formulate the hypothesis, evaluate and draw reasonable conclusions.
7. Imbibe effective, scientific / technical communications in both oral and write.
8. Demonstrate the high standards of ethical issues.
9. Investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry.
10. Illustrate solutions using numeric or graphical or programming methods.

11. Investigate and solve unfamiliar math problems and allow to think on unsolved mathematical problems.
12. Able to qualify Lectureship and fellowship exams approved by UGC like CSIR-NET, GATE and SET.

Program Specific Outcomes:

1. To develop problem – solving skills and apply them independently to problems in pure and applied mathematics.
2. To assimilate complex mathematical ideas and argument.
3. To develop abstract mathematical thinking.
4. To improve own learning and performance.

SRI VENKATESWARA UNIVERSITY::TIRUPATI
S.V.U.COLLEGE OF SCIENCES
DEPARTMENT OF MATHEMATICS

(Syllabus common for SV University College and affiliated colleges offered P.G. Courses in SVU Area)

(Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the Academic Years 2021-22 for I and II Semesters and 2022-23 for III and IV Semesters)

M.Sc. MATHEMATICS

SCHEME OF INSTRUCTION AND EXAMINATION

Semester-I

Sl. no	Components of study	Code	Title of the course	Hrs / week	No. of Credits	Uni. Exams (Hour	IA	Semester end exam	Total Marks
1.	**Core**	MA 101	**Algebra**	**6**	**4**	**3**	**20**	**80**	**100**
2.	**Core**	MA 102	**Real Analysis**	**6**	**4**	**3**	**20**	**80**	**100**
3.	**Compulsory Foundation**	MA 103	**A) Ordinary Differential Equations** **B) Linear Algebra**	**6** **6**	**4**	**3**	**20**	**80**	**100**
4.	**Elective foundation**	MA 104	**A) Numerical Methods** **B) Lattice theory**	**6** **6**	**4**	**3**	**20**	**80**	**100**
5.	**Theory**	MA 105	**Complex Analysis**	**6**	**4**	**3**	**20**	**80**	**100**
6.	**Theory**	MA 106	**Discrete Mathematics**	**6**	**4**	**3**	**20**	**80**	**100**
			TOTAL	**48**	**24**		**120**	**480**	**600**

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DEPARTMENT OF MATHEMATICS

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M.Sc. APPLIED MATHEMATICS

SCHEME OF INSTRUCTION AND EXAMINATION

Semester-I

Sl. no	Components of study	Code	Title of the course	Hrs / week	No. of Credits	Uni. Exams (Hour	IA	Semester end exam	Total Marks
1.	**Core**	AMA 101	**Methods of Applied Mathematics**	**6**	**4**	**3**	**20**	**80**	**100**
2.	**Core**	AMA 102	**Real Analysis**	**6**	**4**	**3**	**20**	**80**	**100**
3.	**Compulsory Foundation**	AMA 103	**A) Ordinary Differential Equations** **B) Viscous Flows**	**6** **6**	**4**	**3**	**20**	**80**	**100**
4.	**Elective foundation**	AMA 104	**A) Numerical Methods** **B) Boundary Value Problems**	**6** **6**	**4**	**3**	**20**	**80**	**100**
5.	**Theory**	AMA 105	**Complex Analysis**	**6**	**4**	**3**	**20**	**80**	**100**
6.	**Theory**	AMA 106	**Discrete Mathematics**	**6**	**4**	**3**	**20**	**80**	**100**
			TOTAL	**48**	**24**		**120**	**480**	**600**

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Instructions for evaluation:-

1. Each theory subject is evaluated for 100 Marks out of which 80 Marks through end examination and internal assessment would be for 20 Marks. The minimum marks for qualifying in theory subject shall be 40%.
2. End Examination Question Paper Pattern is as follows:

Section A&B	Questions	Units of the Syllabus	Marks
A	Questions 1 To 8 (four short answer Questions, TWO from each unit)	From UNIT-I to UNIT-IV	4x5=20
B	Questions 9.(a) & (b) or 10 .(a) &(b)	From UNIT-I	15
B	Questions 11. (a) &(b) or 12.(a) &(b)	From UNIT-II	15
B	Questions 13. (a) &(b) or 14.(a) &(b)	From UNIT-III	15
B	Questions 15(a) &(b) or 16(a) &(b)	From UNIT-IV	15
		Total:	80

Procedure to evaluate internal examinations:

Theory:

Internal Examinations –I &II	20 marks

The pattern for the internal examination: 20 marks will be divided into descriptive (two out of four questions each carries 4 marks and two questions each carries 6 marks for each question with internal choice & 60 minutes duration).

***Note 1: If the final marks are in fraction, it shall be rounded off to the next number**

- If the student is absent for the internal examination, no re-exam shall be conducted If the student failed to attend both the internal examinations, his/her aggregate marks shall be considered zero.

- **Note:** Final internal semester marks shall be awarded as average of two internal examinations.

Example:

Marks obtained in first internal: 20
Marks obtained in second internal: 20
Final internal semester Marks: (20+20) = 40/2=20

Practical/Lab:

*Continuous assessment/ Day to day work	End examination	Total
20 marks	80M (50T+30P)	100M

*****Continuous assessment format given below.

Note: For practical courses, there shall be a continuous evaluation during the semester for 20 sessional marks and end examination shall be for 50 T+30P marks. Day-to-day work in the laboratory shall be evaluated for 20 marks by the concerned laboratory teacher based on the regularity/record/viva. Both day to day evaluation and two internal should be finalized by 20 marks. The end examination shall be conducted by the concerned laboratory teacher and external examiner in the subject nominated by the university.

- Internal marks will be awarded by internal examiner only.

FIRST SEMESTER

MA 101 ALGEBRA

Algebra is one of the broad areas of Mathematics together with Number theory, Geometry and Analysis. Algebra is applicable to all mathematical domains.

Course objectives:

1. To introduce the basic structures of Algebra such as groups, rings, fields and Domains which are pillars of modern mathematics
2. To develop working knowledge on Sylow's theorems
3. Provide information on Ideals and homomorphism.
4. Discuss U.F.D, E.D and polynomial Rings.

UNIT –I:

Cyclic groups - Conjugacy and G-Sets, Permutation groups-Cyclic decomposition-Alternating Group A_n -Simplicity of A_n .
(Section 4 of Chapter 4 ,Sections 4 of Chapter 5, Sections 1, 2 and 3 of chapters 7,).

UNIT –II:

Structure Theory of Groups: Direct Products –Finitely generated abelian groups -Invariants of a finite abelian group –Sylow theorems –group of orders p2, pq.
(Section 1,2,3,4 and 5 of Chapter 8).

UNIT – III:

Ideals and Homomorphism's: Ideals – Homomorphisms –Sum and direct sum of ideals – Maximal and prime ideals – Nilpotent and nil ideals –Zorn's Lemma
(Chapter 10)

UNIT – IV:

Unique Factorization domains and Euclidean Domains: Unique factorization domains-Principal ideal domains-Euclidean domains, Polynomial rings over UFD.
(Chapter 11)

Scope and standard in the book **" Basic Abstract Algebra" by P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Cambridge University Press, Reprint 1997.**

References:

(1) Topics in Algebra, by I.N. Herstein
(2) Commutative algebra, by Zariski and Samuel Affiliated East-West Press.
(3) Abstract Algebra – Ronald. Solomon.
(4) A First course in 'ABSTRACT ALGEBRA' seventh edition by John B. Fraleigh, Pearson Education.

(5) Abstract algebra by David S. Summit, Richard .M.Forte, Wiley publication, 3rd edition.
(6) Introduction to rings and modules by C.Musli, Narosa Publications.
(7) A first course in abstract algebra by John B Fraleigh.
(8) Basic algebra by Jacobson.Nathan , Vol 1, Hindustan Publishing corporation 1991 .

Course outcomes: After completing this course the student will be able to

1. Identify the concept of action and conjugation.
2. Solve the problems on homomorphism, Permutations and cyclic groups
3. Analyze the maximal, prime, nilpotent and Nil ideals.
4. Explain the applications of Sylow's theorems
5. Understand U.F.D, E.D and Polynomial Rings

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2						M						
CO3									M			
CO4			S									
CO5												S

MA 102 Real Analysis

(Common with the paper AMA 102 of Branch 1(B) Applied Mathematics)

This course covers Riemann-Stieltjes Integral, Sequences and Series of Functions, Functions of Several Variables, Improper Integrals, Fourier series, Maxima and Minima.

Course Objectives:

1) Acquired knowledge on Riemann-Stieltjes Integration and Differentiation.
2) To apply Integration of Vector Valued Functions, Rectifiable Curves.
3) Discussion of main problem Sequences and Series of Function.
4) Uniform Convergence, Continuity Integration and Differentiation.

UNIT –I:
The Riemann –Stieltijes Integral : Definition and Existence of the integral properties of the integral, integration and Differentiation, Integration of vector valued function, Rectifiable curves.

UNIT – II:
Sequence and series of functions : Discussions of main problem, uniform convergence, uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation, Equicontinuous families of functions, The stone –Weistrass theorem .
Scope and standard as in Chapters 6, sections 7.1 to 7.26 of chapter 7 of Walter Rudin" Principles of Mathematical Analysis" 3rd edition 1976, Nc. Graw hill International student edition.

UNIT – III:
Improper Integrals: Introduction, Integration of unbounded functions with finite limit of Integration, comparison tests for convergence at a $\propto$, infinite Range of Integration.
Fourier series: Trigonometrically series, some preliminary theorems, the Main theorem intervals other than $-[-\Pi, \Pi]$

UNIT-IV:
Functions of Several Variables : Explicit and Implicit functions, Continuity, Partial derivations, differentiability, partial derivatives of higher order, differentials of higher order, function of functions, change of variables, Taylor's theorem, Extreme values, Maxima and Minima, functions of several variables.

Scope and standard as in chapters 11, 12 and 15 of **Mathematical Anlaysis by " S.C. Malik 1994" Wiley Eastern limited.**

Reference:
(1) Mathematical Analysis- A modern Approach to Advanced Calculus Narosa Book Distributors Pvt LTD- New Delhi
(2) Real Analysis - Golden Math Series By N.P. Bali.

(3) A course of Mathematical Analysis by Shanti Narayan -.K. Mittal , S-Chand & Company LTD-New Delhi

Course Outcomes:

1. Understand the concepts of Riemann Integration and Differentiation.
2. To learn the different types of Sequences and Series of Functions, Equicontinuous Families of Functions.
3. Understand Uniform Convergence and continuity.
4. Apply the Stone-Weierstrass theorem.
5. Analyze the concept of functions of several variables.
6. Study the applications of Integration and Differential forms.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S											
CO2		M										
CO3								M				
CO4										S		
CO5							M					
CO6									M			

MA 103 A: ORDINARY DIFFERENTIAL EQUATIONS

(Common with paper AMA 103 of Branch I (B) Applied Mathematics)

This course introduces fundamental knowledge in mathematics that is applicable in the engineering aspects.

Course objectives :

1. To study linear equations with regular singular points.
2. To provide knowledge on Legendre polynomials and properties of Bessel functions

3. To know the existence and uniqueness of solutions.
4. To Study surfaces and curves in 3-D space.

UNIT –I:
Oscillation Theory and boundary value problems: Qualitative properties of solutions –The Sturm comparison theorem-Eigen values, Eigen functions and the vibrating string.

UNIT – II:
Power series solutions: Series solutions of first order equations –Second order linear equations-Ordinary points-Regular singular points- Gauss's hyper geometric equation.

UNIT – III:
Some special functions of Mathematical Physics :Legender polynomials – properties of Legendre polynomials –Bessel functions –The gamma function- Properties of Bessel functions.

UNIT-IV:
The existence and uniqueness of solutions : The method of successive approximations-Picard's theorem-systems. The second order linear equations.

Scope and standard as in sections 22 to 24 of Chapter 4 (excluding Appendix A), Sections 26 to 30 of Chapter 5, Sections 32 to 35 of Chapter 6 (Excluding Appendices) and sections 55 to 57 of Chapter 11 of **" Differential Equations with Applications and Historical notes" by George F. Simmons, (1992) Tata McGraw Hill Publications**

References:

1. Advanced Differential Equations, M.D. Raisinghania , S. Chand Publications
2. Differential Equations" Ross, Shepley L Wieley India Pvt LTD.
3. Engineering Mathematics y Bali NP, SatyanarayanaBhavanari, kelkar, University Science Press, New Delhi 2012.
4. An introduction to O.D.E by Earl.A.Coddington , Prentice Hall of India Private Limited, New Delhi 1991.
5. Theory of ODE by Sam Sundaram, Narosa Publications

Course outcomes: From this course students will be able to

1. Recognize and classify O.D.Es.
2. Learn boundary value problems, Eigen values and Eigen functions
3. Apply knowledge on special functions of Mathematical Physics.
4. Understand the method of successive approximation and solve the second order linear questions.
5. Solve the problems related to Picard's theorem
6. Identify research problems where D.Es can be used .
7. Analyse engineering problems like series/ parallel circuits etc using 1^{st} and 2^{nd} order O.D.Es.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1												S
CO2									M			
CO3	S											
CO4				M								
CO5											M	
CO6					M							

MA 103 B: Linear Algebra

Course Objective:
1.To introduce the notions of abstract vector spaces and linear transformations and properties of inner product spaces.
2.To study important results like Rank-Nullity theorem, Diagonalization, Primary decomposition and bilinear forms

UNIT –I:
Linear Equations:
Systems of Linear Equations, Matrices and Elementary Row Operations, Row-Reduced Echelon Matrices.

UNIT –II:
Vector Spaces & linear transformations:
Vector Spaces, Subspaces, Bases andDimension, Ordered basis and coordinates. Linear transformations, Rank-NullityTheorem, The algebra of linear transformations, Isomorphism, Matrix representationof linear transformations, Linear Functionals, Annihilator, Double dual, Transpose of a linear transformation. Characteristic Values and Characteristic Vectors of linear transformations.

UNIT –III:
Direct-sum decompositions:
Direct-sum decompositions –Invariant Direct sums. The primary decomposition theorem –cyclic subspaces and annihilators –cyclic decomposition, Rational and Jordan forms

UNIT –IV:
Bilinear Forms:
Bilinear Forms –Symmetric Bilinear Forms –Skew-Symmetric Bilinear Forms –Groups Preserving Bilinear Forms.

Text books:
1. K. Hoffman, R. Kunze, Linear Algebra, Prentice Hall of India, (2015).
2. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, (2009).

References:
1. I. N. Herstein, Topics in Algebra, Wiley, (2006).
2. S. Axler, Linear Algebra Done Right, Springer, (2004).
3. S. Lang, Linear Algebra, Springer, (2004).
4. S. Kumaresan, Linear Algebra: A Geometric Approach, Prentice Hall India, (2009).
5. M. Artin, Algebra, Pearson Education India, (2010).

Course outcomes: After completing this course the student will be able to

1. Solve the system of linear equations
2 .Understand the concept of vecor space,basis and dimension.
3. Analyze the linear Transformation
4. Explain the direct sum decompositons
5. Understand the Bilinear forms.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2												S
CO3						M						
CO4			L									
CO5				M								

MA 104 A: NUMERICAL METHODS
(Common with paper AMA 104 of Branch I (B) Applied Mathematics)

Course objectives :

1. To provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems
2. To make the students familiarize with the ways of solving complicated mathematical problems numerically.

UNIT-I:
Solution of Algebraic and Transcendental Equations: Introduction - Bisection method – Method of False position - Newton Raphson –method solutions of non linear equations – Method of iteration.
[Above topics are from 2.1 to 2.7, 2.12 of Chapter-2 of the Text Book]

UNIT-II:
Interpolation : Introduction - - Finite Differences- Newton's formula for interpolation- Central difference interpolation formulae –Gauss central difference formulae- Stiriling's formula- Bessel's formula – Lagrange's interpolation formula- spline interpolation.
[Above topics are from 3.1, 3.3, 3.6 ,3.7, 3.7.3,3.9.1,3.10, 3.13 of Chapter-3 of the Text Book]

UNIT-III:
Linear system of equations: Direct methods – matrix inversion method -Gauss Elimination Method - Gauss -Jordan Method-solution of linear systems-iterative methods- eigen value problems .
[Above topics are from 6.3.1 to 6.3.4 , 6.3.7 and 6.4 of Chapter-6 of the Text Book]

UNIT-IV:
Numerical integration: Trapezoidal rule- Simpson's rules – numerical solution of ODEs by Picard – Euler - Modified Euler – Runge-Kutta methods.
[Above topics are from.4.1 to 5.4.3 of Chapter- 5 and 7.1 to 7.5 of Chapter- 7of the Text Book]

Text Book:
Scope and standard as in chapters 2,3,5,6 and 7 of "**Introductory methods for Numerical Analysis by S.S.Sastry fourth edition**".

Reference Book:
1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Information Technology and Numerical methods fot Atul Kahate
3. Theory and problems in Numerical Methods with programs in C and C++.
4. Numerical Methods and computing by Ward Cheney and David Kincaid
5. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International (p) Limited, Publishers, 5th Edition

Course Outcomes:

From this Course Students are able to

1. solve Algebraic and Transcendental polynomial equations.
2. Learn how to apply the Numerical method for various Mathematical operations and tasks.
3. Understand Interpolation,Differentiation,Integration,the solution of Differential Equations
4. Analyse and evaluate the accuracy of common Numerical methods.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2				S								
CO3		M										
CO4									M			

MA 104 B: LATTICE THEORY

Course Learning Objectives:
The course mainly designs with the aim of introducing the Lattice theory and Boolean algebra, the portion of lattice theory discuss modular, distributive lattice.

UNIT-I
Partly Ordered Sets: Set Theoretical Notations, Relations, Partly Ordered Sets, Diagrams, Special Subsets of a Partly Ordered Set, Length, Lower and Upper Bounds, The Minimum and Maximum Conditions, The Jordan–Dedekind Chain Condition, Dimension Functions.
(Sections 1 to 9 of Chapter 1)

UNIT-II
Lattices in General: Algebras, Lattices, The Lattice Theoretical Duality Principle, Semi Lattices, Lattices as Partly Ordered Sets, Diagrams of Lattices, Sub Lattices, Ideals, Bound Elements of a Lattice, Atoms and Dual Atoms, Complements, Relative Complements, Semi Complements, Irreducible and Prime Elements of a Lattice, The Homomorphism of a Lattice, Axiom Systems of Lattices. (Sections 10 to 21 of Chapter 2)

UNIT-III
Complete Lattices: Complete Lattices, Complete Sub Lattices of a Complete Lattice, Conditionally Complete Lattices, Compact Elements and Compactly Generated Lattices, Sub Algebra Lattice of an Algebra, Closure Operations, Galois Connections, Dedekind Cuts, Partly Ordered Sets as Topological Spaces.
(Sections 22 to 29 of Chapter 3)

UNIT-IV
Distributive and Modular Lattices: Distributive Lattices, Infinitely Distributive and Completely Distributive Lattices, Modular Lattices, Characterization of Modular and Distributive Lattices by their Sub lattices, Distributive Sub lattices of Modular Lattices, The Isomorphism Theorem of Modular Lattices, Covering Conditions, Meet Representation in Modular and Distributive Lattices.
(Sections 30 to 36 of Chapter 4)

PRESCRIBED BOOK:
Introduction to Lattice Theory, Gabor Szasz, Academic press.

REFERENCE BOOK:
Lattice Theory, G. Birkhoff, Amer, Math. Soc.
Course Learning Outcome(s): From this course students are able to
1.Understand Lattices as Algebraic structures.
2. Analyse lattice structures
3. compare the distributive and modular lattices

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S											
CO2						M						
CO3				M								

MA 105: COMPLEX ANALYSIS
(Common with paper AMA 105 of Branch I(B) Applied Mathematics)

Complex analysis, traditionally known as the theory of functions of a complex variable, is the branch of mathematical analysis that investigates functions of complex numbers.

Course Objectives :

1. To define analytic functions and derivative rules of complex functions.
2. To introduce Mobius transformations and explain its applications.
3. To evaluate definite integrals using Cauchy integral formula.
4. To understand power series and expansion of analytic function**.**

UNIT –I:

Differentiation: Analytic Functions: Derivative Rules for Differentiating Complex Functions-The Cauchy-Riemann Equations –Analytic Functions-Geometrical Interpretation of Arg $f^1(z)$ and $\left| f^1(z) \right|$ - Conformal Mapping –The Mapping w = $\frac{az+b}{cz+d}$ -Conformal Mapping of the Extended Plane.

UNIT – II:

Mobius Transformations: The Group Property of Mobius Transformations – The Circle – Preserving Property of Mobius Transformations-Fixed points of a Mobius Transformation-Invariance of Cross Ratio-Mapping of a circle onto a Circle –Symmetry Transformations.

UNIT – III:

Complex Integrals: Cauchy Integral Theorem: Rectifiable Curves-Complex Integrals-The Case of Smooth Curves-Cauchy's Integral Theorem-The Key Lemma proof of Cauchy's Integral Theorem-Application to the Evaluation of Definite Integrals Cauchy's Integral Theorem for a system of Contours. Cauchy's Integral Formula –Morera's Theorem – Cauchy's Inequalities.

UNIT-IV:

Power Series: The Cauchy-Hadamard Theorem – Taylor Series. The Uniqueness Theorem for Power series-Expansion of an Analytic Function in a power series –Liouvill'es Theorem. The Uniqueness Theorem for Analytic functions-A Points and Zeros-Weirstrass' Double Series Theorem-Substitution of One Power Series into Another- Division of Power series.

Scope and Standard as in Chapters 3,5,7,8 and 10 of **"Introductory Complex Analysis" by Richard A. Silverman Dover Publications, Inc. (1972). New York.**

References : 1 Complex Variables - . Schaum outline series, 2/E by Speigel
2. An Introductions to Complex Analysis, by C.L. Siegel :North Holland,

Course outcomes:

1. Identify curves and regions in the complex plane defined by simple expressions.
2. Describe basic properties of complex integration and having the ability to compute such integrals.
3. Decide when and where a given function is analytic and be able to find it series development.
4. Describe conformal mappings between various plane regions.
5. Apply the concepts of Complex Analysis in many branches of mathematics, including algebraic geometry, number theory, analytic combinatorics, applied mathematics; as well as in physics, including the branches of hydrodynamics, thermodynamic sand particularly quantum mechanics.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2						M						
CO3				S								
CO4									M			
CO5					S							

MA 106: DISCRETE MATHEMATICS
(Common with paper AMA 106 of Branch I(B) Applied Mathematics)

The aim of the discrete mathematics is the study of mathematical structure that are fundamentally discrete rather than continuous.

Course Objectives:

1. To study the mathematical structures that are countable or distinct and separable.
2. To learn sets, functions, logic,calculus and analysis.
3. To study the Algebraic systems such as Lattices ,Boolean Algebra and Boolean functions
4. To introduce basic concepts of graph theory

UNIT –I :

Normal Forms-Disjunctive-Conjunctive Principal Disjunctive, Principal Conjunctive Normal Forms –Ordering and Uniqueness of Normal Forms. The theory of Inference for the statement Calculus-Rules of inferences – Consistency of Premises-Automatic Theorem proving(Sections 1.3 and 1.4 of Chapter 1)

UNIT – II:

The predicate calculus-Inference Theory of the Predicate Calculus(Sections 1.5 and 1.6 of Chapter 1)

UNIT – III:

Lattices and Boolean Functions: Lattices as partially Ordered sets-Lattices as Algebraic Systems –Boolean Algebra-Boolean Functions- Minimization. (Sections 4.1 , 4.2,4.3 and 4.4 of Chapter 4)

UNIT-IV:

Finite – State Machines-Basic Concepts of Graph Theory –Basic Definitions-Paths-Reach ability, and Connectedness-Matrix Representation of Graphs-Trees (Section 4.6 of Chapter 4 and Section 5.1 of Chapter)

Scope and Standard as in the book **" Discrete Mathematical Structures With Applications To Computer Science" by Tremblay, J.P&Manohar, R-Published by McGraw-Hill International Edition -1987 Edition**

References : 1. Discrete Mathematics & Graph Theory by BhavanariSatyanarana& KunchamSyam Prasad, PHI Publications, New Delhi, Second Edition, 2014.
2. Mathematical Foundation of Computer Science, by Bhavanari Satyanarayana, T.V. Pradeep Kumar, SK. Mohiddin Shaw, BS Publications, Hyderabad.2016.

Course Outcomes:

1. Use standard notaions of propositional logic.
2. Understand the truth tables for expressions involving nagation, conjuction, and disjunction
3. Determine if a logical argument is valid or invalid.
4. Find concepts and notations from discrete mathematics are useful in studying Automata theory, Number theory and mathematical cryptography.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1							L					
CO2				M								
CO3						M						
CO4				S								

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M.Sc. APPLIED MATHEMATICS

SCHEME OF INSTRUCTION AND EXAMINATION

FIRST SEMESTER

AMA101: METHODS OF APPLIED MATHEMATICS

Course Objectives:

1. To familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.
2. To study Fourier series and Fourier Transforms.
3. To understand the applications of Sylow's Theorems.
4. To discuss the algebraic structures U.F.D, E.D and polynomial rings.
5. To investigate applications to problems in economics, management and related areas.
6. To develop the understanding of the theoretical concepts behind these methods.

UNIT I:

Fourier Transforms : Dirichlet conditions – Fourier integral formula –The (Complex) Fourier transform – Fourier sine and cosine transforms-Relationship of Fourier and Laplace transforms – Some useful results for direct applications-Linearity property of Fourier transforms –Change of scale property –Shifting property—Modulation theorem –Convolution or Falting-The convolution or Falting theorem for Fourier transforms –Parseval's identity for Fourier transforms Rayleigh's theorem of Plancherel's theorem – Relation between the Fourier transforms of the derivatives of a function –Multiple Fourier transforms-Applications of Fourier transforms to Boundary value problems. (Chapter 4)

UNIT-II

Finite Fourier Transforms: Fourier Series –The finite Fourier sine transform-The finite Fourier cosine transforms –Relation between the finite Fourier transforms of the derivations of a function –Multiple finite Fourier transforms –Applications of finite Fourier transforms to boundary value problems-Special case of boundary value problem (Chapter 5)

Scope and standard as in **" Integral Transforms" by Raisinghania, published by S. Chand & Co., New Delhi, 1995 Editon.**

ALGEBRA:

UNIT: III
Structure Theory of Groups : Conjugacy and G-Sets, Normal series, Sovable groups, Simplicity of A_n, Sylow theorems.
(Sections 4 of Chapter 5, Sections 1 and 2 of Chapter 6, Section 3 of Chapter 7 and Sections 4 of Chapter 8)

UNIT IV : UNIQUE FACTORIZATION AND EUCLIDEAN DOMAINS**:**
Unique factorization domains-Principal ideal domains-Euclidean domains-Polynomial rings over UFD(chapter 11)

Scope and standard as in **" Basic Abstract Algebra" by Bhattacharya , P.B. Jain, S.K. and Nagpul S.R, Cambridge University Press, 1997 Reprint**
References : 1. Topics in Algebra – I.N. Herstein

Course outcomes:

1. Understand basic concepts of complex analysis including the important integral theorems.
2. Determine the residues of a complex function and use the residue theorem to compute certain types of integrals.
3. Solve ordinary second order differential equations particulary in the physical sciences; solve physically relevant partial differential equations using standard methods like separation of variables, series expansion (Fourier-type series), and integral transforms.
4. Expand a function in a Fourier series and able to know under what conditions such an expansion is valid.
5..Aware of the connection between integral transforms (Fourier and Laplace) and be able to use the latter to solve mathematical problems relevant to the physical sciences.
6. Receive basic training in tensor calculus.

	PO											
CO/PO	1	2	3	4	5	6	7	8	9	10	11	12
CO1				M								
CO2												S
CO3						M						
CO4							M					
CO5					M							
CO6									M			

AMA 102 Real Analysis

(Common with the paper MA 102 of Branch 1(B) Mathematics)

This course covers Riemann-Stieltjes Integral, Sequences and Series of Functions, Functions of Several Variables, Improper Integrals, Fourier series, Maxima and Minima.

Course Objectives:

1) To acquire knowledge on Riemann-Stieltjes Integration and Differentiation.
2) To know Integration of Vector Valued Functions, Rectifiable Curves.
3) To discuss Sequences and Series of Function.
4) To learn Uniform Convergence, Continuity, Integration and Differentiation.

UNIT –I :
The Riemann –Stieltijes Integral : Definition and Existence of the integral properties of the integral, integration and Differentiation, Integration of vector valued function, Rectifiable curves.

UNIT – II:
Sequence and series of functions : Discussions of main problem, uniform convergence, uniform convergence and continuity, Uniform convergence and Integration, Uniform convergence and Differentiation, Equicontinuous families of functions, The stone –Weierstrass theorem .
Scope and standard as in Chapters 6, sections 7.1 to 7.26 of chapter 7 of Walter Rudin" Principles of Mathematical Analysis" 3rd edition 1976, Nc. Graw hill International student edition.

UNIT – III:
Improper Integrals: Introduction, Integration of unbounded functions with finite limit of Integration, comparison tests for convergence at $a\propto$, infinite Range of Integration.
Fourier series: Trigonometrically series, some preliminary theorems, the Main theorem intervals other than -$[-\Pi, \Pi]$

UNIT-IV:
Functions of Several Variables : Explicit and Implicit functions, Continuity, Partial derivations, differentiability, partial derivatives of higher order, differentials of higher order, function of functions, change of variables, Taylor's theorem, Extreme values, Maxima and Minima, functions of several variables.

Scope and standard as in chapters 11, 12 and 15 of **Mathematical Anlaysis by " S.C. Malik 1994" Wiley Eastern limited**

Reference :
(1) Mathematical Analysis- A modern Approach to Advanced Calculus Narosa Book

Distributors Pvt LTD- New Delhi

(2) Real Analysis - Golden Math Series By N.P. Bali.

(3) A course of Mathematical Analysis by Shanti Narayan -.K. Mittal , S-Chand & Company LTD-New Delhi

Course Outcomes:

1. Understand the concepts of Riemann Integration and Differentiation.

2. To learn the different types of Sequences and Series of Functions, Equicontinuous Families of Functions.

3. Understand Uniform Convergence and continuity.

4. Apply the Stone-Weierstrass theorem.

5. Analyze the concept of functions of several variables.

6. Study the applications of Integration and Differential forms.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S											
CO2		M										
CO3								M				
CO4										S		
CO5							M					
CO6									M			

MA 103 A: ORDINARY DIFFERENTIAL EQUATIONS

(Common with paper MA 103 of Branch I(B) Mathematics)

This course introduces fundamental knowledge in mathematics that is applicable in the engineering aspects.

Course objectives :

1. To study linear equations with regular singular points.
2. To provide knowledge on Legendre polynomials and properties of Bessel functions
3. To know the existence and uniqueness of solutions.
4. To Study surfaces and curves in 3-D space.

UNIT –I :
Oscillation Theory and boundary value problems: Qualitative properties of solutions –The Sturm comparison theorem-Eigen values, Eigen functions and the vibrating string.

UNIT – II:
Power series solutions: Series solutions of first order equations –Second order linear equations-Ordinary points-Regular singular points- Gauss's hyper geometric equation.

UNIT – III:
Some special functions of Mathematical Physics :Legender polynomials – properties of Legender polynomials –Bessel functions –The gamma function- Properties of Bessel functions.

UNIT-IV:
The existence and uniqueness of solutions: The method of successive approximations-Picard's theorem-systems. The second order linear equations.

Scope and standard as in sections 22 to 24 of Chapter 4 (excluding Appendix A), Sections 26 to 30 of Chapter 5, Sections 32 to 35 of Chapter 6 (Excluding Appendices) and sections 55 to 57 of Chapter 11 of **" Differential Equations with Applications and Historical notes" by George F. Simmons, (1992) Tata McGraw Hill Publications**

References:

1. Advanced Differential Equations, M.D. Raisinghania , S. Chand Publications
2. Differential Equations" Ross, Shepley L Wieley India Pvt LTD.
3. Engineering Mathematics y Bali NP, SatyanarayanaBhavanari, kelkar, University Science Press, New Delhi 2012.
4. An introduction to O.D.E by Earl.A.Coddington , Prentice Hall of India Private Limited, New Delhi 1991.
5. Theory of ODE by Sam Sundaram, Narosa Publications

Course outcomes: From this course students will be able to

1. Recognize and classify O.D.Es.
2. Learn boundary value problems, Eigen values and Eigen functions
3. Apply knowledge on special functions of Mathematical Physics.
4. Understand the method of successive approximation and solve the second order linear questions.
5. Solve the problems related to Picard's theorem
6. Identify research problems where D.Es can be used .
7. Analyse engineering problems like series/ parallel circuits etc using 1^{st} and 2^{nd} order O.D.Es.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1												S
CO2									M			
CO3	S											
CO4				M								
CO5											M	
CO6					M							

AMA 103 B: Viscous Flow

Course objectives:

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.

2. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.

3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.

UNIT – I:
General theory of stress and rate of strain –Nature of stresses –Transformation of stress components –Nature of Strain Transformation of rates of strain –Relation between stress and rate of strain.

UNIT – II:
Fundamental equations of the flow of viscous incompressible fluids –The equation of continuity -conservation of momentum –the energy equation – conservation of energy –the equations of state –perfect gases –the fundamental equations in cylindrical coordinate –equation of continuity –equations of motion –the energy equation.

UNIT –III:
Laminar flow of viscous incompressible fluids –similarity of flows –The Reynold's number – Viscosity from the point of view of the kinetic energy –Flow between parallel flat plates –couttee flow –plane Poiseuille flow –steady flow through a pipe –the Hagen Poiseuille flow –flow between two co-axial cylinders –Flow between two concentric Rotating cylinders –Applications of the parallel flow theory –The measure of viscosity –Hydro dynamics of bearing Lubrication – Steady flow around a sphere –the theory of very slow motion –unsteady motion os a flat plate

UNIT – IV:
The Laminar Boundary layer –properties of Navier-Stokes equations - Boundary layer concepts –The Boundary layer equations in two dimensional flow –The Boundary layer along a Flat plate –Blasius solution – Shearing stress and boundary layer thickness - Boundary layer as a surface with pressure Gradient –Momentum Integral theorems for the boundary layer –The Von Karman Integral relation.

Standard and treatment as in Articles 4.1 to 4.5 of chapter 4, Articles 5.1 to 5.6, Articles 8.1 to 8.8 of Chapter 8 and Articles9.1 to 9.5a of chapter 9 of **"FOUNDATIONS OF FLUID MECHANICS" by S.W.Yuvan, Prentice Hall of India Pvt.ltd. New Delhi,1969**.

Course outcomes: From this course students will be able to

1. Employ Bernoulli's equation for real flow and deduce expressions for orifice meter and Venturimeter.

2. Establish Hagen Poisueille's equation for laminar flow through pipe and parallel plates.

3. Formulate and solve problems in fluid mechanics.

4. Focus on the laminar flow regime.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	S											
CO2				M								
CO3						S						
CO4							M					

MA 104 A: NUMERICAL METHODS
(Common with paper AMA 104 of Branch I (B) Applied Mathematics)

Course objectives :

1. To provide suitable and effective methods called Numerical Methods, for obtaining approximate representative numerical results of the problems
2. To make the students familiarize with the ways of solving complicated mathematical problems numerically.

UNIT-I:
Solution of Algebraic and Transcendental Equations: Introduction - Bisection method – Method of False position - Newton Raphson –method solutions of non linear equations – Method of iteration.
[Above topics are from 2.1 to 2.7, 2.12 of Chapter-2 of the Text Book]

UNIT-II:

Interpolation : Introduction - - Finite Differences- Newton's formula for interpolation- Central difference interpolation formulae –Gauss central difference formulae- Stiriling's formula- Bessel's formula – Lagrange's interpolation formula- spline interpolation.
[Above topics are from 3.1, 3.3, 3.6 ,3.7, 3.7.3,3.9.1,3.10, 3.13 of Chapter-3 of the Text Book]

UNIT-III:
Linear system of equations: Direct methods – matrix inversion method -Gauss Elimination Method - Gauss -Jordan Method-solution of linear systems-iterative methods- eigen value problems .
[Above topics are from 6.3.1 to 6.3.4 , 6.3.7 and 6.4 of Chapter-6 of the Text Book]

UNIT-IV:
Numerical integration: Trapezoidal rule- Simpson's rules – numerical solution of ODEs by Picard – Euler - Modified Euler – Runge-Kutta methods.
[Above topics are from.4.1 to 5.4.3 of Chapter- 5 and 7.1 to 7.5 of Chapter- 7of the Text Book]

Text Book:
Scope and standard as in chapters 2,3,5,6 and 7 of "**Introductory methods for Numerical Analysis by S.S.Sastry fourth edition**".

Reference Book:
1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Information Technology and Numerical methods fot Atul Kahate
3. Theory and problems in Numerical Methods with programs in C and C++.
4. Numerical Methods and computing by Ward Cheney and David Kincaid
5. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain, New Age International (p) Limited, Publishers, 5th Edition

Course Outcomes:
From this Course Students are able to
1. solve Algebraic and Transcendental polynomial equations.
2.Learn how to apply the Numerical method for various Mathematical operations and tasks.
3. Understand Interpolation,Differentiation,Integration,the solution of Differential Equations
4.Analyse and evaluate the accuracy of common Numerical methods.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2				S								

CO3		M										
CO4									M			

AMA 104 B: BOUNDARY VALUE PROBLEMS

Course objectives:
To learn series solution of some wellknown differential equations, Legendre & Chebysheve polynomials, Fourier &Hankel transforms, linear programming problems and basics of probability.

UNIT-I:
Stability of linear and weakly non-linear systems, continuous dependence and stability properties of linear, non-linear and weakly non-linear systems. Two dimensional systems. (chapter III of text book-1)

UNIT-II:
Stability by Liapunov second method, Autonomous systems, quadratic forms, Krasovski'sMethod. Construction of Liapunov functions for linear systems with constant coefficients. Selection of total energy function as a Liapunov Function, Stability based on first approximation (Chapter V of text book-1)

UNIT-III:
Mathematical Models in Population Dynamics: Introduction, single species Models, Two species Lotka volterra Models, Multi species Models. (chapter VI of text book-1)

UNIT-IV:
Analysis and Methods of non-linear differential equations, Existence theorem, extremal solutions, upper and lower solutions. Existence via upper and lower solutions, Monotone iterative Method and Method of quasilinearlization, Bihari's inequality, Application of Bihari's integral inequality. Non-linear variation of parameters formula Alekseev's formula. (Chapter VI of text book-2)

Text Books:

1. M.Rama Mohan Rao, Ordinary Differential equations, Theory methods and applications, Affiliated East-West Press Pvt.Ltd., New Delhi. (1980).

2. V.Lakshmikantam, S.G.Deo and V.Raghavendra, Text book of ordinary differential equations (second edition) Tata Mc Graw Hill, New Delhi. (1997)

Course Outcomes:

After completing this course the students would be able to:

1. Use the knowledge of Legendre and Chebyshev polynomials.
2. Apply Fourier and Hankel transforms in engineering problems.
3. Solve boundary value problems.
4. Understand the probability theory.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1						S						
CO2		S										
CO3									M			
CO4				M								

AMA 105: COMPLEX ANALYSIS
(Common with paper MA 105 of Branch I(B) Mathematics)

Complex analysis, traditionally known as the theory of functions of a complex variable, is the branch of mathematical analysis that investigates functions of complex numbers.

Course Objectives:

1. To define analytic functions and derivative rules of complex functions.
2. To introduce Mobius transformations and explain its applications.
3. To evaluate definite integrals using Cauchy integral formula.
4. To understand power series and expansion of analytic function**.**

UNIT –I :

Differentiation: Analytic Functions : Derivative Rules for Differentiating Complex Functions- The Cauchy-Riemann Equations –Analytic Functions-Geometrical Interpretation of Arg $f^1(z)$ and $\left| f^1(z) \right|$ - Conformal Mapping –The Mapping w = $\frac{az+b}{cz+d}$ -Conformal Mapping of the Extended Plane.

UNIT – II:

Mobius Transformations: The Group Property of Mobius Transformations – The Circle – Preserving Property of Mobius Transformations-Fixed points of a Mobius Transformation-Invariance of Cross Ratio-Mapping of a circle onto a Circle –Symmetry Transformations.

UNIT – III:
Complex Integrals: Cauchy Integral Theorem: Rectifiable Curves-Complex Integrals-The Case of Smooth Curves-Cauchy's Integral Theorem-The Key Lemma proof of Cauchy's Integral Theorem-Application to the Evaluation of Definite Integrals Cauchy's Integral Theorem for a system of Contours. Cauchy's Integral Formula –Morera's Theorem – Cauchy's Inequalities.

UNIT-IV:
Power Series: The Cauchy-Hadamard Theorem – Taylor Series. The Uniqueness Theorem for Power series-Expansion of an Analytic Function in a power series –Liouvill'es Theorem. The Uniqueness Theorem for Analytic functions-A Points and Zeros-Weirstrass' Double Series Theorem-Substitution of One Power Series into Another- Division of Power series.

Scope and Standard as in Chapters 3,5,7,8 and 10 of **" Introductory Complex Analysis" by Richard A. Silverman Dover Publications, Inc. (1972). New York**

References: 1 Complex Variables - . Schaum outline series, 2/E by Speigel
2. An Introductions to Complex Analysis, by C.L. Siegel: North Holland.

Course outcomes:

1. Identify curves and regions in the complex plane defined by simple expressions.
2. Describe basic properties of complex integration and having the ability to compute such integrals.
3. Decide when and where a given function is analytic and be able to find it series development.
4. Describe conformal mappings between various plane regions.
5. Apply the concepts of Complex Analysis in many branches of mathematics, including algebraic geometry, number theory, analytic combinatorics, applied mathematics; as well as in physics, including the branches of hydrodynamics, thermodynamicsand particularly quantum mechanics.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	M											
CO2						M						

CO3				S								
CO4									M			
CO5					S							

AMA 106: DISCRETE MATHEMATICS
(Common with paper MA 106 of Branch I(B) Mathematics)

The aim of the discrete mathematics is the study of mathematical structure that are fundamentally discrete rather than continuous.

Course Objectives:

1. To study the mathematical structures that are countable or distinct and separable.
2. To learn sets, functions, logic,calculus and analysis.
3. To study the Algebraic systems such as Lattices ,Boolean Algebra and Boolean functions
4. To introduce basic concepts of graph theory

UNIT –I :
Normal Forms-Disjunctive-Conjunctive Principal Disjunctive, Principal Conjunctive Normal Forms –Ordering and Uniqueness of Normal Forms. The theory of Inference for the statement Calculus-Rules of inferences – Consistency of Premises-Automatic Theorem proving(Sections 1.3 and 1.4 of Chapter 1)

UNIT – II:
The predicate calculus-Inference Theory of the Predicate Calculus(Sections 1.5 and 1.6 of Chapter 1)

UNIT – III:
Lattices and Boolean Functions: Lattices as partially Ordered sets-Lattices as Algebraic Systems –Boolean Algebra-Boolean Functions- Minimization. (Sections 4.1 , 4.2,4.3 and 4.4 of Chapter 4)

UNIT-IV:
Finite – State Machines-Basic Concepts of Graph Theory –Basic Definitions-Paths-Reach ability, and Connectedness-Matrix Representation of Graphs-Trees (Section 4.6 of Chapter 4 and Section 5.1 of Chapter)

Scope and Standard as in the book " **Discrete Mathematical Structures With Applications To Computer Science" by Tremblay, J.P&Manohar, R-Published by McGraw-Hill International Edition -1987 Edition.**

References: 1. Discrete Mathematics & Graph Theory by Bhavanari Satyanarana& KunchamSyam Prasad, PHI Publications, New Delhi, Second Edition, 2014.
2. Mathematical Foundation of Computer Science, by Bhavanari Satyanarayana, T.V. Pradeep Kumar, SK. Mohiddin Shaw, BS Publications, Hyderabad.2016.

Course Outcomes:

1. Use standard notations of propositional logic.
2. Understand the truth tables for expressions involving nagation, conjuction, and disjunction
3. Determine if a logical argument is valid or invalid.
4. Find concepts and notations from discrete mathematics are useful in studying Automata theory,Number theory and mathematical cryptography.

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1							L					
CO2				M								
CO3						M						
CO4				S								