

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 the knowledge of Mathematics in all the fields of learning including higher research and its extensions.
2. Equip the student with skills to analyse problems, formulate the hypothesis, evaluate and draw reasonable conclusions.
3. Investigate and apply mathematical problems and solutions in a variety of contexts related to science, technology, business and industry.
4. Able to design and develop mathematical experiments to solve environment problems like global pollution, aerosol particles weather and virus in atmosphere.
5. 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. Facilitate the study of groups in crystallography in chemistry and Lie symmetry groups in physics.
6. To interpret the data like dosage of medicine, nutritious food to children and effectiveness of new drugs and survival rate of cancer patients under certain treatments etc.
7. Illustrate solutions using numeric or graphical or programming methods.
8. Imbibe high standards in life by understanding the values and ethics in their life..

9. Investigate and solve unfamiliar math problems and allow to think on unsolved mathematical problems.
10. Imbibe effective, scientific / technical communications in both oral and write.
11. Acquire knowledge in designing Mathematical models .Also generate funds through various research projects..
12. Ability to think, acquire knowledge and skills through logical reasoning and develop a habit of self- learning throughout life.

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)
RESTRUCTURE OF M.Sc., I(A) : MATHEMATICS (CBCS) as per NEP-2020

((Revised Scheme of Instruction and Examination, Syllabus etc., with effect from the
w.e.f the batch admitted in the academic year 2024-25)

M.Sc. MATHEMATICS

SCHEME OF INSTRUCTION AND EXAMINATION

SEMESTER-I

S.NO	COURSE	CODE MAT	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	CC	101	1.Algebra	4	4	70	30	100
2		102	2(A). Real Analysis 2(B). Lattice theory	4	3	50	25	75
3		103	3(A). Differential Equations 3(B). Integral Equations	4	3	50	25	75
4	P	104	Practical-I (related to CC 2&3)	6	2	35	15	50
5	SOC	105	1(A).Numerical Methods 1(B). MATLAB	4	3	50	25	75
6		106	2(A). Discrete Mathematics 2(B).C-Programming Language	4	3	50	25	75
7	P	107	Practical- II (related to SOC 1 &2)	6	2	35	15	50
			Total	36	22	340	160	500
8	Audit Course	109	Ancient Indian Mathematics	4	0	0	100	0

M.Sc., MATHEMATICS
SEMESTER-II

S.NO	COURSE	CODE MAT	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	CC	201	4. Galois Theory	4	4	70	30	100
2		202	5(A).Complex Analysis 5(B).Semi group theory	4	3	50	25	75
3		203	6(A). Topology 6(B). Linear Algebra	4	3	50	25	75
4	P	204	Practical-III (Related to CC 5&6)	6	2	35	15	50
5	SOC	205	3(A).Mathematical Statistics 3(B).Data Structures and Algorithms	4	3	50	25	75
6		206	4(A). Operations Research For Industry and Community Development (TORA) 4(B). Python	4	3	50	25	75
7	P	207	Practical -IV (related to SOC 3 &4)	6	2	35	15	50
8	OOTC-I	208	edX/Swayam/NPTEL/ MOOCS	-	2	-	-	100-
			Total	36	22	340	260	600
9	Audit Course	209	Vedic Mathematics	4	0	0	100	0

SRI VENKATESWARA UNIVERSITY: TIRUPATI

DEPARTMENT OF MATHEMATICS

RESTRUCTURE OF M.Sc., I(A) : MATHEMATICS (CBCS) as per NEP-2020

(w.e.f the batch admitted in the academic year 2024-25)

SEMESTER-III: MATHEMATICS

S.NO	COURSE	CODE	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
		MAT						
1	CC	301	7. Classical Mechanics	4	4	70	30	100
2		302	8(A). Advanced Complex Analysis	4	3	50	25	75
			8(B). Measure and Integration					
3		303	9(A).Differential Geometry	4	3	50	25	75
			9(B).Functional Analysis					
4	P	304	Practical-I (Related to CC 8 &9)	6	2	35	15	50
5	SOC	305	5(A)Number Theory	4	3	50	25	75
			5(B). Cryptography					
6		306	6(A).Graph Theory	4	3	50	25	75
			6(B). Fuzzy Sets and Fuzzy Logics					
7	P	307	Practical -II (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC-2	308	edX/Swayam/NPTEL/MOOCs	-	2	-	100	100
	OE (Open Elective)		Business Mathematics-I	4	4	70	30	100
Seminar/Tutorials/Remedial classes and Quiz as part of internal Assessment				4	-	-	-	-
			TOTAL	36	22	340	260	600

SEMESTER-IV: MATHEMATICS

S.NO	COURSE	CODE MAT	TITLE OF THE COURSE	H/W	C	SEE	IA	TOTAL MARKS
1	OOSDC	401	Open online skill Development Courses (SWAYAM/ NPTEL/any equivalent Courses) 401-A Algebraic Coding Theory 401-B Introductory Methods of Numerical Analysis	-	8	-	0	0
2	Project work	402	Algebra/ Graph Theory / Coding Theory/ Operation Research/ Mathematical Statistics/ Cryptography/ Number theory	-	12	-	300	300
Total					20		300	300

Instructions for evaluation:-

- Core 1, core 4 & core 7 are evaluated for 100 Marks out of which 70 Marks through end examination and internal assessment would be for 30 Marks mandatory with 4 credits.
- Core courses 2, 3, 5, 6, 8 & 9 and SOC 1, SOC 2, SOC 3, SOC 4, SOC 5 & SOC 6 are evaluated for 75 marks out of which 50 Marks through end examination and internal assessment would be for 25 Marks with 3 credits.
- Practicals for Core courses 2,3,5,6&8,9: SOC 1, SOC-2, SOC-3, SOC-4, SOC-5 & SOC-6 are for 50 marks out of which 35 Marks through end examination and internal assessment would be for 15 Marks with 2 credits.
- Totally 9 core courses are distributed in I, II and III semesters. Student must complete Open Online Transdisciplinary Courses during II and III Semesters each with 2 credits

- And student has to take Indian Knowledge system in I and II semesters respectively. They are Audit courses with zero credits. But mandatory with only a pass. A student has to secure 40 marks out of 100 marks.
- IV semester Students have to complete Open online Skill Development courses for 8 credits. Students have the option to select one or two or more courses to accumulate the designated 8 credits. Each course is designated to be at least 20 hours in duration to earn one credit. In IV semester Students have to take project work which carries 12 credits.
- The minimum marks for qualifying in theory subject shall be 40%.

1. End Examination Question Paper Pattern for Theory is as follows:

Section A&B	Questions	Units of the Syllabus	Marks for core 1	Marks for Core 2,3 and SOC 1 &2
A	Questions 1 To 8 (four short answer Questions, TWO from each unit)	Form UNIT-I to UNIT-IV	5x4M=20	5x2M=10
B	Questions 9.(a) or (b)	Form UNIT-I	12.5	10
B	Questions 10. (a) or (b)	From UNIT-II	12.5	10
B	Questions 11(a) or (b)	From UNIT-III	12.5	10
B	Questions 12(a) or (b)	From UNIT-IV	12.5	10
Total:			70	50

Procedure to evaluate internal examinations: Theory:

Internal Examinations –I &II	30 marks for core 1,4 &7
	25 marks for Core 2,3,,5,6;8,9 & and SOC 1,2,3,4,5,6.
Practicals	15 marks for Practicals -I and II

***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.

Practical/Lab:

*Continuous assessment/ Day to day work	End examination	Total
35 marks	35T+15P	50M

- Internal marks will be awarded by internal examiner only.

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(For admitted Batch 2024-26)**

**FIRST SEMESTER
MAT 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 understand Sylow's theorems.
2. Develop knowledge on Ideals and homomorphism.
3. Discuss U.F.D, E.D and polynomial Rings.
4. To introduce algebraic structure Module.

UNIT-I

Structure theorems of groups:- Conjugacy and G-Sets- Direct products-Finitely generated abelian groups-Invariants of a finite abelian group-Sylow Theorems. (Sections 1 to 4 of the Chapter 8)

UNIT-II

Ideals and Homomorphisms:- Ideals-Homomorphisms-Sums and direct sums of ideals-Maximal and prime ideals-Nilpotent and nil ideals-Zorn's lemma. (Chapter 10)

UNIT-III

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

UNIT IV

Modules and Vector Spaces: Definition and examples – Submodules and direct sums – R-homomorphisms and quotient modules-Completely reducible Modules- Free Modules (Sections 1 to 5 of Chapter 14)

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. Explain the applications of Sylow's theorems
2. Discuss homomorphism and ideals in Rings.
3. Understand U.F.D, E.D and Polynomial Rings
4. Develop concepts on modules

MAT 102:2 (A) - REAL ANALYSIS

(Common with the paper AMA 102: 2 (A) 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) Acquire knowledge on Riemann-Stieltjes Integration and Differentiation.
- 2) Discuss Uniform Convergence, Continuity Integration and Differentiation
- 3) Learn comparison Tests
- 4). Understand the concept of functions of several variables.

UNIT –I:

The Riemann –Stieltjes 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.

Scope and standard as in Chapters 6, sections 7.1 to 7.18 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 ∞ , infinite Range of Integration.

Fourier series: Trigonometrically series, some preliminary theorems.

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 Analysis 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 Stieltjes integration and Differentiation.
2. Understand Uniform Convergence and continuity.

3. Learn comparison tests at a infinity.
4. Analyze the concept of functions of several variables.

MAT 102:2(B) - LATTICE THEORY

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

Course Objectives:

1. To study the Partially Ordered Sets.
2. To discuss Lattices.
3. To analyze Complete Lattices.
4. To explain distributive and modular lattices.

UNIT-I

Partially Ordered Sets: Set Theoretical Notations, Relations, Partially Ordered Sets, Diagrams, Special Subsets of a Partially 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: 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)

Scope and Standard as in:

Introduction to Lattice Theory, Gabor Szasz, Academic press.

References:

Lattice Theory, G. Birkhoff, Amer, Math. Soc.

Course Learning Outcome(s): From this course students are able to

1. Identify Partially Ordered Sets.
2. Understand Lattices as Algebraic structures
3. Study complete Lattices.
4. Compare the distributive and modular lattices

MAT 103:3(A) - DIFFERENTIAL EQUATIONS

(Common with paper AMA 103:3(A) of Branch I (B) Applied Mathematics)

This course introduces fundamental knowledge in Differential Equations that is applicable in the engineering aspects. Also it is designed to strengthen the fundamental knowledge of P.D.Es which lead to understand the real world problems.

Course objectives:

1. To find solutions of power series and second order linear equations.
2. To provide knowledge on Special functions -Legendre polynomials and properties of Bessel functions.
3. To find integral surface passing through given surface using P.D.E
4. To explain methods to solve Linear P.D.Es with constant and Variable coefficients

UNIT –I:

Eigen values, Eigen functions –Series solutions of first order equations –Second order linear equations-Ordinary points-Regular singular points.

UNIT – II:

Legendre polynomials – properties of Legendre polynomials –Bessel functions –The gamma function- Properties of Bessel functions

UNIT –III:

Differential Equations in more than two variables: Methods of solutions of $dx/P = dy/Q = dz/R$. (Sections 3, of Chapter 1)

Partial Differential Equations of the First order: Partial Differential equations-Origins of first order partial differential equations-Cauchy's problems for first order equations-Linear equations of first order -Charpit's method. (Sections 1,2,3,4,5 and 10 of Chapter 2)

UNIT – IV:

Partial Differential Equations of the Second order: The Origin of second order equations –Linear partial differential with constant coefficients-Equations with variable coefficients. (Sections 1, 4 and 5 of Chapter 3).

Scope and standard as in

1. **“Differential Equations with Applications and Historical notes” by George F. Simmons, (1992) Tata McGraw Hill Publications for Units I & II.**

2. **“Elements of Partial Differential Equations” by IAN Sneddon for Units III & IV.**

References:

1. Advanced Differential Equations, M.D. Raisinghania , S. Chand Publications
2. Differential Equations” Ross, Shepley L Wiley 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
6. Ordinary and Partial Differential Equations by M.D. Raisinghania.
7. An elementary course to P.D.E by T.Amarnath, Second Edition, Narosa publishing house.

Course outcomes: From this course students will be able to

1. Find solutions of power series and second order linear equations.
2. Acquire knowledge on Special functions -Legendre polynomials and properties of Bessel functions.
3. Analyze the origin of first order PDEs and Integral surfaces passing through a given Curve
4. Identify linear and nonlinear PDE and solve nonlinear PDE by Charpit's method.

MAT 103:3(B) - INTEGRAL EQUATIONS
(Common with paper AMA 103:3(B) of Branch I (B) Applied Mathematics)

Course Objectives:

1. To convert Ordinary Differential equations into Integral Equations
2. To study the Kernels
3. To understand the Volterra Equations and Hilbert Transform
4. To obtain the solutions of Linear Integral equations

Unit – 1: PRELIMINARY CONCEPTS

Introduction; Some Problems which give Rise to Integral Equations; Conversion of Ordinary Differential Equations into Integral Equations; Classification Linear Integral Equations; Integral-differential Equations.

Unit – 2: FREDHOLM EQUATIONS

Analogies with Matrix Algebra; Degenerate Kernels; Hermitian and Symmetric Kernels; The Hilbert-Schmidt Theorem; Hermitization and Symmetricization of Kernels; Solution of Integral Equations with Green's Function Type Kernels; Miscellaneous.

(Chapter 2 of Text Book).

Unit – 3 : VOLTERRA INTEGRAL EQUATIONS:

Types of Volterra Equations, Resolvent Kernel of Volterra Equation ;Convolution Type Kernels; Some Miscellaneous Types of Volterra Integral Equations.

INTEGRAL EQUATIONS AND TRANSFORMATIONS:

Preliminary; Fourier Integral Equations; Laplace Integral Equations; Hilbert Transform; Finite Hilbert Transforms; Miscellaneous Integral Transforms.

Unit – 4: APPROXIMATE METHODS.

General; Non-linear Volterra Equations; Non-linear Fredholm Equations; Approximate Methods of Solution for Linear Integral Equations; Approximate Evaluation of Eigen values and Eigen functions.

Scope and standard as in Problems and Exercises in Integral Equations, MIR Oybkusgers, Moscow, 1971 by M. Krsnov, A. Kiselev and G. Makarendo.

References:

- 1) Integral Equations and their Applications, WIT press, 25 Bridge Street, Billerica, MA 01821, USA, by M. Rahman.
- 2) Introduction to Integral Equations with Applications, John Wiley & Sons, 1999, by Jerri, A.
- 3) Linear Integral Equation, Theory and Techniques, Academic Press, 2014 by Kanwal R. P.
- 4) A first course in Integral Equations, 2nd edition, World Scientific Publishing Co. 2015 by Wazwaz, A. M.

Course outcomes: From this course students will be able to

1. Apply and analyze the integral equations in ordinary differential equations.
2. Find Hermitian and Symmetric Kernels
3. Gain the knowledge about the types of Volterra equations.
4. Evaluate solutions of Linear Integral Equations.

MAT 104: PRACTICAL-I
(Common with paper AMA 104 of Branch I (B) Applied Mathematics)

(Related to CC : (2A) & CC : (3A)

Practicals for Real Analysis: CC 102:2A

1. Write a program to find the largest value in an array of elements.
2. Write a program using pointers to compute the sum of all elements stored in an array
3. Write a program to illustrate error handling in the file operators.
4. Write a program of function power that computes X raised to the power Y for integers X and Y and return double type value.
5. Write a program which would print the alphabet set a to z and A to Z in decimal and character form.
6. Write a program to evaluate the equation $\sum_{i=1}^n \left(\frac{1}{i} \right)$ using a cost

Practicals for Differential Equations: CC 103:3A

1. Evaluate the Eigen Values and Eigen functions for the equation.
2. Explain the Power series solution of the given Differential equation
3. Obtain the solution of the D.E using Recurrence formula
4. Discuss the Legendre polynomial of degree n.
5. Evaluate the D.E $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.
6. Determine the solution of Nonlinear PDE by Charpits Method.
7. Evaluate the solution of second order PDE.

(OR)

MAT 104: PRACTICAL-I
(Common with paper AMA 104 of Branch I (B) Applied Mathematics)

(Related to CC :2B & CC :3B)

Practicals for Lattice Theory: CC 102:2B

1. Demonstrate lattice homomorphism between two lattices with a given function.
2. Given a finite-dimensional vector space, list all its subspaces and show that they form a lattice.
3. Construct Galois connections between different posets and verify the defining properties.
4. Create a Hasse diagram for a finite poset and define the corresponding topology.
5. Verify the modular property in the lattice of subspaces of a three-dimensional vector space.
6. Identify distributive sub-lattices within the modular lattice of subspaces of $\mathbb{R}^3$

Practicals for Integral equations: CC 103: 3B

1. Convert an ODE to Integral equation
2. Write kernels in finite-sum form and solve related integral equations.
3. Determine if kernels are Hermitian or symmetric and study their integral equation solutions.
4. Verify Hilbert-Schmidt conditions and compute eigenvalues and eigenfunctions for kernels.
5. Construct and use Green's functions to solve integral equations.
6. Solve Volterra integral equations of various types using appropriate methods (resolvent kernels, Laplace transforms).
7. Apply Laplace transforms/ Hilbert transforms/ Fourier transforms to handle convolution-type integral equations.

SKILL ORIENTED COURSE (SOC-I)

MAT 105: SOC-1(A) - NUMERICAL METHODS

(Common with paper AMA 105: SOC-1(A) of Branch I (B) Applied Mathematics)

Course objectives:

1. To provide suitable Numerical Methods, for obtaining Roots of algebraic and Transcendental equations
2. To study of different methods of Interpolation.
3. To know the interpolation with unevenly spaced points.
4. To study the various methods of Numerical integration.

UNIT-I:

Solutions 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 formulae for interpolation- Newton's forward difference interpolation- Backward difference interpolation- Central interpolation formulae –Gauss's central difference formulae- Strirling's formula- Bessel's formula.

[Above topics are from 3.1, 3.3, 3.6, 3.7:3.7.1,3.7.2, 3.7.3 of Chapter-3 of the Text Book]

UNIT-III:

Interpolation with unevenly spaced points- Lagrange's Interpolation Formula -Divided Differences and their properties – Newton's general Interpolation Formula-Spline Interpolation [Above topics are from 3.9.1, 3.10.1, 3.13 of Chapter-3 of the Text Book]

UNIT-IV:

Numerical integration: Trapezoidal rule- Simpsons rules – numerical solution of ODEs by Picard – Euler - Modified Euler – Runge-Kutta methods.

[Above topics are from 5.4.1 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 1.“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. Understand Interpolation.
3. Study interpolation with unevenly spaced points
4. Analyze and evaluate the accuracy of area, volume by Numerical methods.

MAT 105: SOC- 1(B) - MATLAB
(Common with paper AMA 105: SOC- 1(B) of Branch I (B) Applied Mathematics)

Course Objectives:

1. Getting started with MATLAB
2. To create M-files.
3. To learn 2D and 3D Plotting Techniques.
4. To know how to write programs to solve Algebraic Equations

UNIT-I (Basics of MATLAB)

Getting Started with MATLAB- Different windows-Mathematical Operators and Mathematical functions-Creating matrices and arrays- Matrix algebra-Linear algebra concepts.

UNIT-II: (MATLAB Programming)

M-files-Script files- Function files-Relational operators-conditional statements.

UNIT-III

Graphics: Basic 2-D plots- 3-D plots

UNIT-IV:Algebraic Equations: solving linear system-Gaussian elimination-finding eigen values and eigen vectors.

Scope and Standard as in:

1.Getting Started with MATLAB – A Quick Introduction for Scientists and Engineers,

RudraPratap, Oxford University Press.

References:

- 1.. MATLAB Programming for Engineers. (4th ed.), Stephen J. Chapman, CI Engineering.
2. MATLAB: Demystified -Basic Concepts and Applications, K KSarma, Vikas Publishing House Pvt Lt.
3. Engineering Problem solving with MATLAB, D.M.Etter, Printice-Hall

Course Outcomes: From this course students will be able to

1. Understand the mathematical operations & functions.
2. Able to write a program to addition & multiplication matrices.
3. Understand the 2-D plotting and 3-D plotting techniques.
4. Able to Solve Algebraic equations.

SKILL ORIENTED COURSE (SOC-2)

MAT 106: SOC-2(A): DISCRETE MATHEMATICS (Common with paper AMA 106: SOC-2(A) 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 understand the connectives & tautology.
2. To study the mathematical structure that is countable or distinct and separable.
3. To learn sets functions, logic, calculus and analysis.
4. To study the Algebraic systems such as Lattices, Boolean Algebra and Boolean function.

UNIT –I:

Introduction – connectives – well formed formula Tautologies – Equivalence formulas – duality Tautological implications – Formula with distinct truth tables – Functionally complete sets of connectives.

(Sections 1.1 and 1.2 to 2.11 of Chapter 1)

UNIT – II:

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 (Sections 1.3 and 1.4 of Chapter 1)

UNIT – III:

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

UNIT-IV:

Lattices and Boolean Functions: Lattices as partially Ordered sets-Lattices as Algebraic Systems – Minimization.

(Sections 4.1 of Chapter 4)

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 & Kuncham Syam 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: From this course students will be able to

1. Use standard notations of propositional logic.
2. Understand the truth tables for expressions involving negation, conjunction, and disjunction
3. Determine if a logical argument is valid or invalid.
4. Understand Lattices as algebraic systems.

MAT 106 SOC-2(B) - C-Programming language
(Common with paper AMA 106 SOC-2(B) of Branch I (B) Applied Mathematics)

Course Objectives:

1. To learn basic concepts in C-language
2. To know the various operators in C-Language
3. To draw conclusion by using decision making, branching and looping
4. To learn more about arrays

UNIT-I:

Constants, Variables, and Data Types: Introduction-Character set-C Tokens-Key words and Identifiers-Constants-Variables-Data types – Declaration of variables-Declaration of storage class – Assigning Values to Variables- Defining Symbolic Constants – Declaring a Variables as Constant- Declaring a Variable as Volatile- Overflow and Underflow of Data.

UNIT-II:

Operators and Expressions : Introduction - Arithmetic operators –Relational operators –Logical operators –Assignment operators- Increment and decrement operators –Conditional operators- Bitwise Operators-Special Operators – Arithmetic Expressions- Evaluation of Expressions-Precedence of Arithmetic Operators – Some Computational Problems-Type Conversions in Expressions –Operator Precedence and Associativity- Mathematical Functions .

UNIT-III:

Decision making and Branching : Introduction – Decision making with if Statement-Simple if Statement-The if...Else Statement –Nesting of if... Else Statements-The Else if Ladder-The Switch Statement – The ?: Operator- The Go to Statement.

UNIT-IV:

Decision Making and Looping: - Introduction-The While Statement – The do Statement-The for Statement-Jumps in Loops-Concise Test Expressions.

Arrays

Introduction - One Dimensional Arrays – Declaration of One-Dimensional Arrays- Initialization of One Dimensional Arrays-Two Dimensional Arrays – Initializing Two –Dimensional Arrays-Multi-Dimensional Arrays- Dynamic Arrays-More about Arrays.

Scope and Standard as in sections 2.1 to 2.14 of Chapter 2, 3.1 to 3.16 of Chapter 3, 5.1 to 5.9 of Chapter 5, 6.1 to 6.6, of Chapter 6, 7.1 to 7.9 of Chapter 7, of “ Programming in ANSI C” by E. Balaguruswamy(Sixth edition) Mc. Graw Hill Edition, India.

References: 1. Programming in C by D. Ravichandran, New Age International, 1998.
2. C and Data Structures by Ashok N. Karthane, Pearson Education.

Course Outcomes: From this course students will be able

1. To use different data types and variables in C-language
2. To decide the various operators in C-Language while writing a program
3. To able to use decision making, branching and looping
- 4 .To create arrays and learn more about arrays

MAT 107: PRACTICAL-II
(Common with paper AMA 107 of Branch I (B) Applied Mathematics)

(Related to SOC 1:1A &SOC 2:2A)

Practicals for Numerical Methods: SOC 1:1A

(Practicals with C-Programming)

1. Bi-section method.
2. False position method.
3. Newton Raphson method.
4. Trapezoidal rule.
5. Simpson’s $3/8^{\text{th}}$ rule
6. Picard’s Method
7. Euler method
8. Modified Euler method
9. Range-Kutta Method

Practicals for DISCRETE MATHEMATICS: SOC 2: 2A

1. Generate truth tables automatically for complex formulas.

2. Convert logical expressions into their Disjunctive Normal Form (DNF) and Conjunctive Normal Form (CNF).
3. Construct truth tables for NAND, NOR, and XOR connectives.
4. Apply Karnaugh maps (K-maps) to minimize Boolean functions.
5. Draw Hasse diagrams and visually represent lattices. (Use graphing tools or software like Graphviz or Gephi).
6. Construct examples of modular lattices and distributive lattices and demonstrate their properties.

(OR)

MAT 107: PRACTICAL-II
(Common with paper AMA 107 of Branch I (B) Applied Mathematics)
(Related to SOC 1:1B & SOC 2:2B)

Practicals for MATLAB: SOC 1:1B

1. Create any M-file
2. Creating arrays and Matrices
3. Basic 2D-plots
4. Basic 3D-plots
5. Solving system of algebraic equations
6. To find Eigen values and Eigen vectors

Practicals for C-Programming language: SOC 2:2B

1. write a C- program of the given problems.
2. Write a C-program to evaluate the power series.
3. Write a C-program using single subscripted variables.
4. Write a C-program using a two dimensional array.
5. Write a C-program to compute and print a multiplication.
6. Write a C-program for standard deviation.

MAT 108: edX/Swayam/NPTEL/ MOOCS

(Common with paper AMA 108 of Branch I (B) Applied Mathematics)

MAT 109: Ancient Indian Mathematics
(Common with paper AMA 109 of Branch I (B) Applied Mathematics)

Course objectives :

1. To know about Ancient Indian Mathematicians.
2. To create awareness on Ancient Indian Mathematics
3. To inculcate interest on History of Mathematics
4. To understand the development of basic concepts

UNIT – I : Heralding the Golden Age: Aryabhata I and his Followers:

Introduction – The Mathematics in Aryabhatiya- I and its followers Aryabhatiya –Geometry – series –Algebra –Indeterminate equations.

Unit- II: Riding the Crest of a Wave: From Brahmagupta to Mahavira- I:

The Mathematics in the Brahmasphuta siddhanta –arithmetic of calculation –Triangles and Quadrilaterals

Unit-III : Riding the Crest of a Wave: From Brahmagupta to Mahavira-II:

Geometry of circles –intersecting circles -Shadow Problems –intermediate analysis works of Brahmasphuta siddhanta –solution of Quadratic equations –volume of sphere – Mahavira –Unit fractions.

Unit-IV: The 500 Year Climax: Bhaskaracharya and His Legacy:

The Contents of Lilavati – Arithmetic calculation –Method of inversion –Solution of Cubic and biquadratic equations.

Scope and standard as “**Indian Mathematics Engaging with the World from Ancient to Modern Times**” by George Gheverghese Joseph University of Manchester, UK National University of Singapore, Singapore McMaster University, Canada.

Reference Book:

1. “**History Of Ancient Indian Mathematics**” by Srinivasiengar .C.N ,The World press Calcutta.

Course outcomes: From this course students will be able to

1. Know about our Ancient Indian Mathematicians.
2. Get awareness on Ancient Indian Mathematics
3. Develop interest in research through History of Mathematics
4. Able to solve problems using basic concepts .

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**M.Sc., MATHEMATICS
SEMESTER-II**

MAT 201: GALOIS THEORY

Galois Theory plays an important role in the development of modern mathematics and it has large applications in computer science.

Course objectives:

1. Discuss extension fields and algebraic extensions.
2. To study the roots of polynomials and their symmetries in terms of Galois Groups
3. To introduce Galois Theory and understand applications of Galois theory.
4. To study applications and cyclotomic polynomials

UNIT –I:

Algebraic Extensions of Fields: Irreducible polynomials and Eisenstein's Criterion-Adjunction of roots- Algebraic extensions- Algebraically closed fields.

UNIT – II:

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

UNIT – III:

Galois Theory: Automorphic groups and fixed fields- Fundamental theorem of Galois Theory- Fundamental theorem of Algebra.

UNIT-IV:

Applications: Roots of unity and Cyclotomic polynomials- Polynomials solvable by radicals- Ruler and compass constructions.

Syllabus and Scope and Standard as in “**Basic Abstract Algebra**” by **P.. Bhattacharya, S.K. Jain and S.R. Nagpaul, Cambridge University Press, Reprint 1997**. Sections 15.1, 15.2, 15.3 and 15.4 of chapter 15, Sections 16.1, 16.2, 16.3, 16.4 and 16.5 of chapter 16, Sections 17.1, 17.2 and 17.3 of chapter 17 and Sections 18.1, 18.3 and 18.5 of Chapter 18.

Reference:

1. Topics in Algebra by I.N. Herstein.
2. Field and Galois Theory-Howie. J.M
3. Galois Theory II Edition-Steven.H. Weintraub
4. Fields and Galois Theory-J.S. Milne.
5. Galois theory by Joseph Rotman, Second Edition 1998 Springer Publisher.
6. Algebra by Artinn, 1991 PHI
7. Abstract Algebra by David S summit and Richard M Forte , Wiley publications, 3rd edition

Course outcomes:

1. Study the roots of polynomials specially quintic polynomials which is the cause to develop Galois theory.
2. Understand the concepts such as extension fields and splitting fields
3. Explain the normal and separable extensions
4. Solve the problems on cyclotomic polynomials.
5. Apply the knowledge on polynomials solvable by radicals
6. Learn applications of Galois theory to classical problems
7. Analyze ruler and compass constructions

MAT 202: 5(A) - COMPLEX ANALYSIS

(Common with paper AMA 202:5A - 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 $f^1(z)$ and $|f^1(z)|$ - Conformal Mapping –The Mapping $w = \frac{az+b}{cz+d}$.

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 –Liouville's Theorem. The Uniqueness Theorem for Analytic functions.

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 Spiegel
2. An Introduction 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 its 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, thermodynamics and particularly quantum mechanics.

MAT 202:5(B) - SEMIGROUP THEORY
(Common with paper AMA 202:5(B) of Branch I (B) Applied Mathematics)

Course Objectives:

1. Introduce basic definitions and examples of semi groups and semi Lattices.
2. Discuss free semi groups and lattices of equivalences.
3. Explain Rees's theorem & primitive Idempotents.
4. Analyze O-simple semi groups and free semi groups with Illustrations.

UNIT-I

Basic definitions – Homogenic Semigroups – Ordered sets- Semi lattices and lattices – Binary relations- Equivalences- Congruences.

UNIT-II

Free Semi groups Ideals and – Rees Congruences. Lattices of equivalences and congruences – Green's equivalences. The structure of D.Classes – regular semigroups.

UNIT-III

Simple and Q-Simple semi groups. Principle factors, Rees's Theorem, Primitive idempotents.

UNIT-IV

Congruences on completely O-Simple semi groups. The Lattice of Congruences on a completely O-Simple semi groups. Finite Congruences, free semi groups.

Text Book :

An Introduction to Semi group Theory by J.M. Howie (1976), Academic Press, (Content of the Syllabus : Chapters-I, II and III).

Course Out comes:

1. Understand semi groups with the properties.
2. Explain the structure of D.Classes – regular semigroups.
3. Obtain proofs of Rees's Theorem.
4. Know the congruences on completely O-Simple semi groups

MAT 203:6A - TOPOLOGY **(Common with paper AMA 203:6A of Branch I(B) Applied Mathematics)**

Topological concepts play important role in the development of modern mathematics and it has large applications in theoretical physics.

Course Objectives:

1. This course aims to teach the fundamentals of point set topology and constitute an awareness of need for the topology in Mathematics.
2. Introduce the basic definitions and standard examples of topological spaces.

3. Define and illustrate a variety of topological properties such as compactness, connectedness and separation axioms.
4. Explain the idea of topological equivalence and define homeomorphisms.

UNIT –I :

Metric spaces:-open sets-closed sets- convergence-completeness and Baire's theorem- Continuous mappings – Cauchy's Inequality and Minkowski's Inequality.

UNIT – II:

Topological Spaces, definition & examples-open bases and open sub bases- compact spaces

UNIT – III:

Product of spaces-Tychonoff's theorem -compactness for Metric spaces.

UNIT-IV:

Separation – T^1 space and Hausdorff spaces –completely regular spaces and Normal spaces – Urysohn's lemma- Tietze extension theorem-Urysohn's imbedding theorem.

Articles 9 to 14,16,17,18,21, 22, 23, 26-29 and 31 of Chapters II,III,IV,V,andVI of **Introduction to Topology and Modern Analysis**” by **G.F. Simmons of MC Graw Hill Publishing company, ltd.**

Reference:

1. 'Topology' by K.ChandraSekharaRao, Narosa Publications
2. "Topology" by J.P. Chauhan, J.N. Sharma, Krishna Publications
3. "General Topology" by M.G. Murdeshwar, new age International publications

Course Outcomes:

Upon completion of this course, the student will be able to:

1. Understand to construct topological spaces from metric spaces and using general properties of neighbourhoods, open sets, closed sets, basic and sub-basis.
2. Apply the properties of open sets, closed sets, interior points, accumulation points and derived sets in deriving the proofs of various theorems.
3. To understand the concepts of countable spaces and separable spaces.
4. They know what we mean by connectedness, compactness, and hausdorff property and their general characteristics.
5. Understand the Countability axioms, the separation axioms and normal spaces.
6. Understand the classical theorems such as the Uryshon lemma, the Tietze extension theorem.

MAT 203:6B - LINEAR ALGEBRA

Course Objectives:

1. To study System of Linear Equations.
2. To introduce the notions of abstract vector spaces and linear transformations.
3. To know the Direct-sum decomposition, cyclic decomposition, Rational and Jordan forms.
4. To study 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 and Dimension, Ordered basis and coordinates. Linear transformations, Rank-Nullity Theorem, The algebra of linear transformations, Isomorphism, Matrix representation of 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 vector space, basis, dimension and linear Transformation
3. Explain the direct sum decompositions
4. Understand the Bilinear forms.

MAT 204 : PRACTICAL-III
(Related CC: 5A &CC: 6A)
(Common with paper AMA 204 of Branch I (B) Applied Mathematics)

Practicals for Complex Analysis: CC: 5A

1. Apply the derivative rules to differentiate several complex functions.
2. Verify that a function is analytic in a given domain by the Cauchy-Riemann equations.
3. Evaluate integrals of different analytic functions over smooth curves (like circles or ellipses).
4. Evaluate specific integrals using Cauchy's Integral Formula.
5. Derive the Taylor series expansion for given functions .
6. Compute the cross ratio of four distinct points in the complex plane.
7. Verify the given transformation is Mobius transformation.

Practicals for Topology: CC:6A

1. Write a program to evaluate the roots of the equation.
2. Write a program to evaluate the power series
3. Write a program to determine the range of values and the average cost of a personal computer in the market.
4. Write a program to evaluate the series $\left(\frac{1}{1-x}\right)$.
5. Write a program to using single- subscribed variable to evaluate the expression

$$\text{total} = \sum_{i=1}^{10} (x_i^2).$$
6. Write a program to read a line of text containing a series of words from the terminal.

(OR)

MAT 204: PRACTICAL-III
(Related CC: 5B & 6B)
(Common with paper AMA 204 of Branch I (B) Applied Mathematics)

Practicals for Semigroup Theory: CC:5B

1. Construct the Cayley graph of the free semigroup generated by $X=\{a,b\}$ up to length 2.
2. Work with generating sets, ideals, and construct Rees congruences.
3. Explore the lattice structure of equivalences and congruences, and analyze Green's equivalences for given semigroups.
4. Study the structure of D-classes in regular semigroups, construct examples.
5. Construct examples and identify principal factors, verifying simplicity and Q-simplicity.
6. Apply Rees's Theorem to construct completely 0-simple semigroups and identify primitive idempotents.
7. Explore congruences and the lattice structure of congruences, particularly in Rees matrix semigroups.

Practicals for Linear Algebra: CC:6B

1. Test the consistency of system of linear equations
2. Reduce row echelon form of simultaneous equations
3. Verify Rank-Nullity theorem for the Linear Transformation
4. Obtain the Characteristic equation, eigen values and eigen vectors of linear system of Equations.
5. Explain the Jordan canonical form of the characteristic polynomial of linear transformation.
6. Write the Bilinear form corresponding to a given matrix.

SKILL ORIENTED COURSE (SOC-II)

MAT 205: SOC: 3A - MATHEMATICAL STATISTICS (Common with the paper AMA 205: SOC-3A of Branch I(B) Applied Mathematics)

Course objectives:

1. To introduce basic concepts of statistics and the probability set functions.
2. To study the Binomial, Poisson, Gamma, chi-square, normal distribution.
3. Explain stochastic convergence
4. To explain the objective of Point estimation-Measures of quality of estimations.

UNIT –I:

Probability and Distributions:

Introduction-The probability set function – Conditional probability- Independence-Random variables–The distribution function-Expectations-Some special mathematical expectations – Chebyshev's inequality. (Section 1.1 to 1.10 of chapter 1)

UNIT- II:

Marginal and conditional distributions- Distributions of two variables- conditional distributions and expectations-The Correlation coefficient- Independent of Random variables. (Section 2.1 to 2.4 of chapter 2)

UNIT–III:

The Binomial, Poisson, Gamma, chi-square and Normal distribution. Distributions of functions of Random variables –Sampling theory- Transformation of Variables of Discrete type- Transformation of Variables of the continues type. (Section 3.1 to 3.4 of chapter 3, sections 4.1 to 4.3 of chapter 4)

UNIT – IV:

The t and F Distributions – Distribution of order statistics –The moment generating function Technique-The Distribution of X and Limiting distribution –Stochastic convergence-Limiting moment generating function-The central limit theorem. (Section 4.4, 4.6 & 4.7 of chapter 4, 5.1 to 5.4 of chapter 5)

Scope and Standard as in “ Introduction to Mathematical Statistics” by Robert V. Hogg Allen T. Craig, Macmillan publishing co., Inc., New York -1978,

References: 1. Mathematical Statistics by J.N. Kapur, H.C. Saxena- S. Chand Publications
2. Introduction to Mathematical Statistics Robert V Hogg, Allencraig, Joseph W Mekean , Pearson Publishers
3. Fundamentals of mathematical Statistics by S.C.Gupta and V.K.Kapoor, 11th edition S.Chand and sons, New Delhi
4. Probability and Statistics for engineers and scientists by Walpole Myers and Keying ye, ninth edition, Pearson Publications

Course outcomes:

1. To learn the fundamental concepts of statistics and techniques required for data analysis.
2. Apply the knowledge of Binomial, Poisson, Gamma, chi-square, normal distribution in solving various problems,.
3. To explain stochastic convergence
4. To discuss measures of quality of estimations

MAT 205: SOC- 3(B) - DATA STRUCTURES AND ALGORITHMS

(Common with the paper AMA 205: SOC-3 (B) of Branch I(B) Applied Mathematics)

Course objectives:

1. Learn complexity analysis with examples
2. Study queues operations and applications of queues
3. Acquire knowledge on Binary trees and representations
4. Understand Basic algorithms to sort and to find the shortest paths

Unit-I

Performance and Complexity Analysis: Space Complexity, Time Complexity, Asymptotic Notation (Big-Oh), Complexity Analysis Examples.

Stacks: Basic Stack Operations, Representation of a Stack using Static Array and Dynamic Array, Multiple stack implementations using single array

Stack Applications: Reversing list, Factorial Calculation, In fix to post fix Transformation,

Evaluating Arithmetic Expressions.

Unit-II

Queues: Basic Queue Operations, Representation of a Queue using array, Implementation of Queue Operations using Stack

Applications of Queues: Round Robin Algorithm, Circular Queues.

Linked Lists: Introduction, Single Linked List, Representation of a Linked List in Memory, Different Operations on a Single Linked List, Reversing a Single Linked List, Advantages and Disadvantages of Single Linked List, Circular Linked List, Double Linked List and Header Linked List.

Unit-III

Trees: Definition of Tree, Properties of Tree, Binary Tree, Representation of Binary Trees using Arrays and Linked Lists, Operations on a Binary Tree, Binary Tree Traversals (recursive), Binary Search Tree.

Hashing: Hash Table Representation, Application-Text Compression.

Unit-IV

Basic Search Algorithms: Linear Search and Binary Search Techniques and their Complexity Analysis.

Basic Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort

Divide-and-Conquer Algorithms: merge sort, quick sort

Basic Graph Algorithms: traversals and shortest path.

Scope and Standard as in Data Structures and Algorithms by Alfred V. Aho, John E. Hopcraft and Jeffrey D. Ullman

References:

1. Data Structures and Algorithms by R.D. Sathiya
2. Data Structures and Algorithms Made Easy" by Narasimha Karumanchi
3. Data Structures and Algorithm Analysis in C++" by Mark Allen Weiss
4. Data Structures and Algorithm Analysis in Java" by Mark Allen Weiss

Course outcomes:

1. To understand the complexity analysis
2. To use queues operations and study applications of queues
3. To understand Binary trees and representations
4. To explain Basic sorting algorithms and Basic graph algorithms to find the shortest paths

MAT 206: SOC- 4A: OPERATIONS RESEARCH FOR INDUSTRY AND COMMUNITY DEVELOPMENT

(Common with the paper AMA 206: SOC-4A of Branch (B) Applied Mathematics)

Course Objectives:

- 1) To understand Linear Programming Methods
- 2) To solve linear programming problem through Dynamic Programming.
- 3) To introduce game theory.
- 4) To analyze Critical path method and program Evaluation and Review Technique.

UNIT –I :

Linear programming: Graphical Method-Simplex Method-Big M Method-Two phase method -Transportation Problem-(Sections 2.4 and 2.5.1, 2.5.2, 2.5.4 of chapter 2, sections 3.2, 3.3 and 3.4 of chapter 3).

UNIT – II:

Dynamic programming: Introduction –Capital Budgeting problem –Reliability improvement problem –Stage coach problem –Optimal subdividing problem (Chapter 8)

UNIT-III:

Game Theory: Introduction -Game with Pure Strategies-Game with Mixed Strategies – Dominance property-Graphical Methods for $2 \times n$ and $m \times 2$ Games. (Chapter 12)

UNIT-IV:

Project Management: Guidelines for Network Construction –Critical Path Method (CPM) – Program Evaluation and Review Technique (PERT) (Sections 10.3, 10.4 and 10.6 of Chapter 10)

Scope and standard as “**OPERATIONS RESEARCH**” By pannerselvam, R. published by Prentice Hall of India, New Delhi, 2002 Edition,

- References:**
1. Introduction to Management Science “ Operation Research” by Manmohan . P.K. Gupta, Kantiswarup, Sultan Chand & Sons Publishing house.
 2. Operations Research –Theory and Applications by J.K. Sharma- Macmillan Publishers, India.
 3. Operations Research –by Gupta, Prem Kumar, Hira S. Chand Publishers

Course Outcomes:

- 1) Formulate some real life problems into Linear Programming Problems.
- 2) Understand Dynamic Programming.
- 3) Solve the problems of Game with pure Strategies and Mixed Strategies.

- 4) Construct Reliable Networks.

MAT 206: SOC- 4B - Python

(Common with paper AMA 206: SOC- 4B of Branch I (B) Applied Mathematics)

Course Objectives:

1. To get familiar with Python
2. To learn various operators and conditional statements
3. To create Modules and Strings
4. To understand functions, files and lists

Unit -I:- Basics of Python: Python Installation and Working of it, get familiar with python variables and data types, Operator understanding and its usage, understanding of python blocks

Operators in Python: Arithmetic Operators, Relational Operators, Assignment Operators, Logical Operators, Bitwise Operators, Shift Operators, Ternary Operators, Membership Operators, Identity Operators, Expressions and order of evaluations.

Input and Output statements: input() function, reading multiple values from the keyboard in a single line, print() function, 'sep' and 'end' attributes, Printing formatted string, replacement operator ({}).

Control flow statements: Conditional statements – if, if-else and if-elif-else statements. Iterative statements – for, while. Transfer statements – break, continue and pass.

Unit-II:-Functions: Defining Functions, Calling Functions, Types of Arguments - Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Function Returning Values, Global and Local Variables.

Modules: Creating modules, import statement, from Import statement.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Unit-III:- Lists: Creation of list objects, Accessing and traversing the elements of list. Important functions of list – len(), count(), index(), append(), insert(), extend(), remove(), pop(), reverse() and sort().

Basic Operations on List: Aliasing and Cloning of List objects, Mathematical Operators for list objects, Comparing list objects, Membership operators on list, Nested Lists, List Comprehensions.

Tuples: Creation of Tuple objects, Accessing elements of tuple, Mathematical operators for tuple, Important functions of Tuple – len(),count(),index(), sorted(), min(), max(), cmp().Tuple Packing and Unpacking.

Files: Opening files, Text files and lines, Reading and writing files, Searching through a file, Using try, except and open, handling exceptions, debugging.

Unit-IV

Scientific and Mathematical Computing Using Python: Numerical Computing using NumPy, Matplotlib, SciPy

Python libraries and modules used in Data Science, AI and ML: Pandas, tensorflow, scikit-learn, pytorch, keras etc...

Scope and Standard as in “Learn Python the right way How to think like a computer scientist, Ritza,” 2021-2022

References:

1. Think Python: How to Think Like a Computer Scientist’, 3rd edition, Allen B. Downey, O’Reilly 2024
2. Learning To Program With Python. Richard L. Halterman. Copyright © 2018

Course Outcomes: After completion of this course students are able to

1. Familiar with basic concepts of Python
2. Make use of various operators and conditional statements
3. Create Modules and Strings
4. Understand functions, files and lists

MAT 207: PRACTICAL-III (Related to SOC -3A and 4A)

(Common with paper AMA 207: SOC-3A and 4A of Branch I (B) Applied Mathematics)

Practicals on Mathematical Statistics –SOC 3A

1. Basic programs to find mean, median and mode
2. Binomial distribution
3. Poisson Distribution
4. Normal Distribution
5. t-distribution

6. F-distribution

**Practicals on Operations Research for Industry and Community Development:
SOC-4A:**

1. A computer manufacturing company has the following monthly compensation policy to their sales-person:

Minimum base salary: 1500.00

Bonus for every computer sold: 200.00

Commission on the total monthly sales: 2 percent

Since the prices of the computers are changing, the Sales price of each computer program is fixed at the beginning of every month to compute a sales person's gross Salary.

2. The cost of operation of a unit consists of two components C_1 and C_2 which can be expressed as functions of a parameter p as follows:

$C_1 = 430 - 8P$ $C_2 = 10 + p^2$ The parameter ranges from 0 to 10. Determine the Value of P with an accuracy of ± 0.1 where the cost of operation would be minimum.

3. In an organization, the employers are grouped according to their basic pay for the purpose of certain perks. The pay-range and the number of employees in each group are as follows:

Group	Pay-Range	No. of Employees
1	750-1500	12
2	1501-3000	23
3	3001-4500	35
4	4501-6000	20
5	above 6000	11

Draw a histogram to highlight the group sizes.

4. Plot the graphs of the functions of the type $y_1 = \exp(-ax)$, $y_2 = \exp(-ax^2/2)$ for x varying from 0 to 5.0.

5. Write a program to calculate the ratio $a/b-c$

6. Write a program that selects and prints the largest of the three numbers using nested if... else statement.

(OR)

**MAT 207: PRACTICAL-IV
(Common with paper AMA 207 of Branch I (B) Applied Mathematics)
(Related to SOC -3B and 4B)**

Practicals for Data Structures and Algorithms: SOC-3(B)

1. Round Robin Algorithm

2. Basic Search Algorithms: Linear Search and Binary Search
3. Basic Sorting Algorithms: Bubble Sort, Insertion Sort, Selection Sort
4. Divide-and-Conquer Algorithms: merge sort, quick sort
5. Basic Graph Algorithms: traversals and shortest path.

Practicals for Python: SOC-4(B)

1. Create a 2D array (matrix) and compute the transpose.
2. Perform numerical integration
3. Solve differential equations
4. Solve initial value problem
5. Implement a linear regression model to predict house prices.

MAT 208 : edX/Swayam/NPTEL/ MOOCS

MAT 209: Vedic Mathematics

(Common with paper AMA 209 of Branch I (B) Applied Mathematics)

Course objectives:

1. To inculcate interest on Vedic Mathematics.
2. To understand the development of basic concepts
3. To know about Vedic Sutras.
4. To create awareness on Vedic techniques

Unit -I:-Actual applications the Vedic Sutras- Arithmetical computations- Factorization

Unit-II:- Simple equations-simultaneous simple equations-quadratic equations- cubic equations

Unit-III:-Partial fractions-integration by partial fractions.

Unit-IV:-Vedic Numerical code -recurring decimals

Standard Text Book:

Vedic Mathematics by Jagadguru Swamisri Bharathi Krsna Thirthaji Maharaja

Course Outcomes:After the completion of the course students are able to

1. Understand Vedic sutras and Techniques
2. Solve simple equations using Vedic formulae
3. Apply techniques to integrate by partial fractions
4. Write Numerical code

Instructions for evaluation:

1. Core 7 is evaluated for 100 Marks out of which 70 Marks through end examination and internal assessment would be for 30 Marks mandatory with 4 credits.
2. Core courses 8 & 9 and SOC 5 & SOC 6 are evaluated for 75 marks out of which 50 Marks through end examination and internal assessment would be for 25 Marks with 3 credits.
3. Practicals for Core courses 8 & 9: SOC-5 & SOC-6 are for 50 marks out of which 35 Marks

through end examination and internal assessment would be for 15 Marks with 2 credits.

4. Student must complete Open Online Transdisciplinary Course III Semester with 2 credits.
5. IV semester Students have to complete Open online Skill Development courses for 8

Credits. Students have the option to select one or two or more courses to accumulate the

designated 8 credits. Each course is designated to be at least 20 hours in duration to earn

one credit.

6. In IV semester, Students have to take project work. It is evaluated for 300 marks as

internal assessment which carries 12 credits .

7. The minimum marks for qualifying in theory subject shall be 40%.

2. End Examination Question Paper Pattern for Theory is as follows:

Sections A & B	Questions	Units of the Syllabus	Marks for core 7	Marks for Core 8 & 9 and SOC 5&6
A	Questions 1 To 8 (four short answer Questions, TWO from each unit)	Form UNIT-I to UNIT-IV	5x4M=20	5x2M=10
B	Questions 9.(a) or (b)	Form UNIT-I	12.5	10
B	Questions 10. (a) or (b)	From UNIT-II	12.5	10
B	Questions 11(a) or (b)	From UNIT-III	12.5	10
B	Questions 12(a) or (b)	From UNIT-IV	12.5	10

Total:			70	50

Procedure to evaluate internal examinations: Theory:

Internal Examinations –I &II	30 marks for core 7
	25 marks for Core :8&9 and SOC 5&6.

Note:

1. If the final marks are in fraction, it shall be rounded off to the next number.
2. If the student is absent for the internal examination, no re-exam shall be conducted.
3. If the student failed to attend both the internal examinations, his/her aggregate marks shall be considered zero.
4. Final internal semester marks shall be awarded as average of two internal examinations.

Practical/Lab:

*Continuous assessment/ Day to day work	End examination	Total
15M	35M	50M

Internal marks will be awarded by internal examiner only.

III-SEMESTER: M.Sc., MATHEMATICS

MAT 301: 7. CLASSICAL MECHANICS

(Common with paper AMA 301 of Branch I (B) Applied Mathematics)

Course Objectives:

- 1) This course is intended to provide a treatment of basic knowledge in mechanics used in deriving a range of important results and problems related to rigid bodies.
- 2) The objective is to provide the student the classical mechanics approach to solve a mechanical problem.
- 3) To enable the students to acquire knowledge of Mechanics. Also to understand the concepts of Lagrange's Equation and Hamiltonian Principle.

UNIT – I :

D'Alembert's Principle and Lagrange's Equations: Some Definitions-Classification of Dynamical System-Some Examples of Constraints Virtual Displacement-Principle of Virtual Work –Generalised Force in Holonomic System-Mathematical Expression for the principle of Virtual work-D'Alembert's principle-Lagrange's Equations for a Holonomic system-Velocity-dependent potential –Lagrange's Equations of Motion for conservative , Non-holonomic system-physical Significance of λ -Harmonic Oscillator.

UNIT – II:

Variational Principle and Lagrange's Equations: Variational Principle-Calculus of Variations-Hamilton Principle-Derivation of Hamilton's Principle from Lagrange's Equations-Derivation of Lagrange's Equations from Hamilton's Principle –Extension of Hamilton's Principle –Hamilton's Principle for Non-conservative, Non-holonomic System –Generalised Force in Dynamic system-Hamilton Principle for Conservative-Non holonomic System -Lagrange's Equations for Non –conservative –Holonomic System –Cyclic or Ignorable Coordinates –Conservation Theorem-Conservation of Linear Momentum in Lagrangian Formulation-Conservation of Angular Momentum in Lagrangian Formulation –Conservation of Angular Momentum –Conservation of Energy in Lagrangian Formulation.

UNIT – III:

Hamilton's Equations of Motion: Derivation of Hamilton's Equations of Motion (using Lagrange's Equations)-Routh's Procedure-Equations of Motion-Derivation of Hamilton's Equations from Hamilton's

Principle –Principle of Least Action-Distinction between Hamilton’s Principle and Principle of Least Action.

UNIT-IV:

Canonical Transformations: Canonical Coordinates and Canonical Transformations –The necessary and Sufficient Condition for a Transformation to be Canonical –Examples of Canonical Transformations- Properties of Canonical Transformations- Infinitesimal Contact Transformation-Relation between Infinitesimal Contact Transformation and Poisson’s Bracket.

Syllabus and treatment as in the Book “ **Classical Mechanics**” by **C.R. MONDAL** Prentice Hall of India Private Limited, New Delhi, 110001,2001, Chapter 1,2,4 and Sections 5.1 to 5.4 of Chapter 5.

References:

1. Classical Mechanics by Goldstein Herbert, Charles P Poole, John safiko-Pearson India
2. Introduction to Classical Mechanics by Takwale R. Puranik P, Mc.GrawHill Education

Course Outcomes:

- 1) Understand D’ Alembert’s Principle and simple applications of the Lagrangian Formulation.
- 2) Derive the Lagrange’s Equation from Hamilton’s Principle.
- 3) Study the concept of the Equations of Motion and the Equivalent One-Dimensional Problems.
- 4) Distinguish the concept of the Hamilton Equations of Motion and the Principle of Least Action.
- 5) Get familiar with canonical transformations, conditions of cononicity of a transformation in terms of Lagrange and Poisson brackets.

MAT 302: 8(A): ADVANCED COMPLEX ANALYSIS

(Common with paper AMA 302: 8(A) of Branch I (B) Applied Mathematics)

Course Objectives:

1. To introduce some topics of contemporary advanced complex analysis.
2. To explain Laurent Series, poles and singular points.
3. To understand Residue theorem and its applications.
4. To discuss Laplace's equation, Harmonic functions and Dirichlet problem.
5. To analyse various methods to solve problems in day to day life.

UNIT –I:

Laurent Series-Singular Points: Laurent Series-Laurent's Theorem-Poles and Essential Singular points.

Sections 54, 55 and 56 in Chapter 11 of Text book.

UNIT – II:

The Residue Theorem and its Applications: The Residue Theorem-Residues at infinity-Jordan's Lemma-Evaluation of Definite Integrals – The Argument principal-The Theorems of Rouché and Hurwitz.

Sections 59,60 and 61 in Chapter 12 of Text book.

UNIT – III:

Harmonic Functions: Laplace's Equations-Conjugate Harmonic Functions-Poisson's integral. Schwarz's Formula-The Dirichlet problem.

Sections 63,64 and 65 in Chapter 13 of Text book.

UNIT-IV:

Infinite product and Partial Fraction Expansions: Preliminary Results- Infinite Products-Weierstrass' Theorem – Mittag-Leffler's Theorem.

Sections 66,67 and 68 in Chapter 11 of Text book.

Scope and Standard as in “**Introductory Complex Analysis**” by **Richard A. Silverman, Dover Publications, Inc. New York (1972)**

References:

1. Fundamentals of Complex Analysis- Edward B. Saff, Arthur David Snider, Pearson Education
2. Foundations of Complex Analysis by S. Ponnusamy- Narosa Publications.

Course Outcomes:

1. Explain the basic properties of complex integration and compute such integrals.
2. Learn topics of contemporary Advanced complex analysis in particular spaces of holomorphic functions, entire functions, harmonic functions and conformal mapping functions.
3. Apply advanced techniques to evaluate definite integrals and differential equations in applied areas.
4. Explain general principles of conformal mapping.
5. Compute the residue of a function and use the Residue Theory to evaluate a contour integral or an integral over the real line.

MAT 302: 8(B):MEASURE AND INTEGRATION

(Common with paper AMA 302:8(B) of Branch I(B) Applied Mathematics)

Course Objectives

1. To acquire basic knowledge of measure Theory.
2. To Explain the Contents : Lebesgue integral, general theory of measure spaces .
3. To understand the Riemann integtal and lebesgue integral of a bounded function.
4. To analyse the differentiation of monotone functions of bounded variation.

UNIT –I :

Lebesgue Measure: Introduction, Outer measure, Measurable sets and Lebesgue measure, a non measurable set, Measurable functions, Little wood's three principles.

UNIT – II:

The Lebesgue Integral: The Riemann integral, the Lebesgue integral of a bounded function over a set of finite measure, the integral of a non negative function, the general Lebesgue integral , convergence in measure.

UNIT – III:

Differentiation and Integration: Differentiation of Monotone functions –Functions of bounded variations- Differentiation of an integral – Absolute continuity –Convex functions.

UNIT-IV:

The Classical Banach Spaces: The L^p Spaces, The MinKowski and Holder inequalities, Convergence and completeness, Approximation in L^p , Bounded linear functional on the L^p Spaces.

Syllabus and Scope and Standard as in “ **Real Analysis**” by **H.L. Royden, Prentice Hall of India private limited, New Delhi, 2001-Third edition**. Chapter 3, Chapter 4, Chapter 5, and Chapter 6.

References:

1. Principles of Mathematical Analysis, Third Edition by Walter Rudin.
2. A Real Analysis by H.L.ROYDEN, III ED., Pearson publishers.
3. Measure theory by P.R. HALMOS, 1974. Spingerverlag.
4. Measure theory by V.I.BOGACHVE, 1997, Spingerverlag.

Course Outcomes:

To document insight in modern theory of integration as a tool in advanced analysis and in statistics

1. Compute Lebesgue measures.
2. Establish the measurability or non-measurability of sets and functions.
3. Approximate measurable functions by simple and step functions.
4. Compute Lebesgue integrals of bounded functions over a set of finite measure.

Explain Fourier analysis.

5. Decide under which conditions the fundamental theorem of calculus is applicable
in the context of Lebesgue integration.

(Common with paper AMA 303:9(A) of Branch I (B) Applied Mathematics)

The aim of the course is to provide knowledge of the geometry of curves and surfaces. The course integrates concepts from different parts of mathematics, such as linear algebra, calculus and differential equations. It also provides intuitive examples for many concepts in linear algebra, calculus and differential equations. These examples are fundamental to physics and mechanics: they play a role in our understanding of the movements of particles and the theory of relativity.

Course Objectives:

1. Define the equivalence of two curves.
2. Find the derivative map of an isometry.
3. Analyse the equivalence of two curves by applying some theorems.
4. Defines surfaces and their properties
5. Express definition and parametrization of surfaces.
6. Express tangent spaces of surfaces.
7. Explain differential maps between surfaces and find derivatives of such maps.
8. Integrate differential forms on surfaces.

UNIT –I :

The Theory Space Curves: Introductory remarks about space curves –Definitions –Arc length-Tangent, normal, and binormal –Curvature and torsion of a curve given as the intersection of two surfaces – Contact between curves and surfaces-Tangent surface, involutes and evolutes. (Sections 1 to 7 of Chapter 1).

UNIT – II:

The Metric: Local Intrinsic Properties of a Surface: Definitions of a Surface- Curves on a surface- Surfaces of revolution –Helicoids- Metric-Direction Coefficients-Families of curves –Isometric correspondence –Intrinsic properties. (Sections 1 to 9 of Chapter 11).

UNIT – III:

Geodesics-Canonical Geodesic Equations-Normal Property of geodesics –Existence theorems-Geodesic parallels-Geodesic curvature-Gauss-Bonnet theorem –Gaussian curvature-Surfaces of constant curvature –Conformal mapping-Geodesic mapping (Sections 10 to 20 of Chapter 11).

UNIT-IV:

The second Fundamental Form: Local non – intrinsic properties of a surface: The second fundamental form-principal curvatures –Lines of curvature -Developables associated with space curves-Developables associated with curves on surfaces –Minimal surfaces-Ruled surfaces-The fundamental equations of surface theory –Parallel surfaces. (Sections 1 to 10 Chapter III).

Scope and Standard as in Sections and chapters as specified above of the book “ **An Introduction to Differential Geometry**” of T.J Willmore, Oxford University Press, Thirteenth Impression, 1997.

References :

A first course in Differential Geometry- D. Soma sundaram – Narosa Publications.

Course Outcomes: After completing this course, students should be able to

1. Determine and calculate curvature of curves in different coordinate systems.
2. Parameterize surfaces and use the metric tensor. Calculate isometries.
3. Treat geodesic curves and parallel translation.
4. Calculate and analyse curvature of surfaces in different settings.
5. Know the concept of tensor and recognize tensors that are used in mechanics, image processing and theory of relativity.

MAT 303: 9(B): FUNCTIONAL ANALYSIS

(Common with paper AMA 303:9(B) of Branch I (B) Applied Mathematics)

Functional analysis is one of the primary branches of mathematics mainly dealing with a variety of metrics’ and linear operators.

Course Objectives:

- 1) Define and illustrate several normed spaces.
- 2) Introduce linear operators and derive their properties.
- 3) Elaborate basic theorems like open and closed mapping theorem, implicit function theorem and spectral theorem.

UNIT –I : Banach Spaces

The definitions and some examples –continuous –linear transformations-the Hahn-Banach Theorem.

UNIT – II:

Natural imbedding of N in N^{**} -Open mapping theorem –Conjugate of an Operator.

UNIT – III: Hilbert Spaces:

Definition and Simple Properties –Orthogonal Complements.

UNIT-IV:

Orthonormal sets –Conjugate spaces –Adjoint of an Operator.

Scope and Standard as in Sections 46 to 51 of Chapter 9, section 52 to 56 of chapter 10 of

“ Introduction to Topological and Modern analysis by G.F. Simmons McGraw Hill Book Company.

References:

1. “Foundations of Functional Analysis” by S. Ponnyusamy-Narosa
Publications
2. “Text book of Functional Analysis – A Problem oriented Approach”
by V.K. Krishnan-Prentice Halls of India Publishers
3. “Functional Analysis” by B.V. Limaye New age International
Publishers

Course Outcomes:

- 1) They can work with different distance metrics and normed spaces.
- 2) Understand continuous linear transformations and the Hahn-Banach Theorem.
- 3) Comprehend the Open mapping theorem and Closed graph theorem.
- 4) Construct orthonormal sets and conjugate spaces.
- 5) Understand the relevance of self-adjoint operators, normal, unitary operators and projections.
- 6) Comprehend the ideas of determinants and the spectrum of an operator.

MAT 304: PRACTICAL-1

(Related to core courses 8 & 9)

SKILL ORIENTED COURSES**MAT305: 5(A) NUMBER THEORY****Course Objectives:**

1. Identify and apply various properties of and relating to the integers including the Well-Ordering Principle, primes, unique factorization, the division algorithm and greatest common divisors.
2. Identify certain number theoretic functions and their properties.
3. Understand the concept of a congruence and use various results related to Congruence including the Chinese Remainder Theorem.
4. Solve certain types of Diophantine equations.
5. Identify how number theory is related to and used in cryptography.

UNIT –I :

Arithmetical Functions and Dirichlet Multiplication: Introduction-The Mobius function $\mu(n)$ -The Euler totient function $\phi(n)$ –A relation connection ϕ and μ -A product formula for $\phi(n)$ - The Dirichlet product of arithmetical functions –Dirichlet inverses and the Mobius inversion formula-The Mangoldt function $\Lambda(n)$ –Multiplicative functions-Multiplicative functions and Dirichlet multiplication-The inverse of a completely multiplicative function-Liouville's Function $\lambda(n)$ -the divisor functions $\sigma_{\infty}(n)$ – Generalized convolutions –Formal power series –The Bell series of an arithmetical function –Bell series and Dirichlet multiplications –Derivatives of arithmetical functions-The Selberg identity .

UNIT – II:

Averages of Arithmetical Functions : Introduction –The big oh notation Asymptotic equality of functions- Euler’s summation formula –Some elementary asymptotic formulas-The average order of $d(n)$ -The average order of the divisor functions $\sigma_{\infty}(n)$ -The average order of $\phi(n)$ -An application to the distribution of lattice points visible from the origin-The average order of $\mu(n)$ and of $\Lambda(n)$ - Another identity for the partial sums of a Dirichlet product.

UNIT – III:

Congruences: Definition and basic properties of congruences-Residue classes and complete residue systems-Linear congruences –Reduced residue systems and the Euler-Fermat theorem- Polynomial congruences modulo p . Lagrange’s theorem-Applications of Lagrange’s theorem-Simultaneous linear congruences – The Chinese remainder theorem –Applications of the Chinese remainder theorem – Polynomial congruences with prime power moduli- The Principle of cross-classification- A decomposition property of reduced residue systems.

UNIT-IV:

Quadratic Residues and the Quadratic Reciprocity Law: Quadratic residues-Legendre’s symbol and its properties –Evaluation of $(-1|p)$ and $(2|p)$ –Gauss’ lemma-The quadratic reciprocity law –Applications of the reciprocity law –The Jacobi symbol

Scope and Standard as in chapter 2, Chapter 3, Chapter 5, Sections 9.1 to 9.7 of Chapter 9 by **Tom. M. Apostol** , “ **Introduction to Analytical Number Theory**” Springer International Student Edition .

Course outcomes:

1. Find quotients and remainders from integer division
2. Apply Euclid’s algorithm and backwards substitution
3. Understand the definitions of congruences, residue classes and least residues
4. Add and subtract integers, modulo n , multiply integers and calculate powers, modulo n
5. Determine multiplicative inverses, modulo n and use to solve linear congruence.

MAT 305 :5(B) CRYPTOGRAPHY

UNIT –I : Definition, Cryptography

Encryption Schemes- Symmetric and asymmetric Cryptosystems- Cryptanalysis – Alphabets and Words- Permutations- Block Ciphers-Multiple Encryption- The use of Block Ciphers - Stream Ciphers- The Affine Cipher-Matrices and Linear Maps- Affine Linear Block Ciphers -Vigenere, Hill and Permutation Ciphers – Cryptanalysis of Affine Linear Block Ciphers – Secure Cryptosystems

UNIT – II: DES

Feistel Ciphers-DES Algorithm-An Example-Security of DES-Exercises

UNIT – III: AES

Notation-Cipher-Key Expansion- AN Example- Invcipher- Exercises

UNIT-IV: Public Key Encryption

Public –Key Encryption: Idea- Security-RSA Cryptosystem-Rabin Encryption-Diffie-Hellman Key Exchange-ElGamal Encryption- Exercises.

Scope and Standard as in Sections 3.1 to 3.15 of chapter 3, 5.1 to 5.5 of Chapter 5, and 6.1 to 6.6 of chapter 6, and 8.1 to 8.7 of chapter 8 above of the book “ **Introduction to Cryptography: " of Johannes A. Buchmann, Springer Publishers.**

References :

1. Cryptography and Network Security- authors Forozzan, Behrouz A.
Mukhopadhyay Debdeep- MC Graw hill Education PVT Ltd
2. Cryptography : Theory and Practice , Douglas Stinson, Stinson- CRC Publishers

MAT 306: 6(A) GRAPH THEORY

(Common with the paper AMA 306: 6(A) of Branch (1B) Applied Mathematics)

Course Objectives:

1. To introduce the fundamental concepts of graph theory
2. To Study the properties of Trees and Connectivity.
 3. To explain Eulerian graphs and Hamiltonian graphs
 4. To apply graph theory in diversified fields such as Electrical Engineering computers science and communication networks etc

UNIT –I:

Graphs & Subgraphs: Graphs and simple Graphs- Incidence and adjacency Matrices-Sub graphs-Vertex Degrees-Paths and connection –Cycles –Shortest path Problem-Sperner’s Lemma.

Sections 1.1,1.3,1.4,1.5,1.6,1.7,1.8,1.9 in chapter 1 of Text book.

UNIT – II:

Trees: Trees-Edges and Bonds –Cut vertices, Cayley’s Formula .

Sections 2.1, 2.2,2.3,2.4 in chapter 2 of Text book

UNIT – III:

Connectivity : Connectivity –Blocks-Applications- Construction of Reliable communications Networks.

Sections 3.1, 3.2, 3.3 in Chapter 3 of Txt book.

UNIT-IV:

Euler Tours and Hamiltonian Cycles: Euler Tours – Hamilton cycles

Sections 4.1,4.2 in chapter 4 of Text book

Scope and standard as in chapters 1 to 4 “ **Graph Theory with application**” **J.A. Bondy and U.S.R. Murthy, M.C. Millan Press**

Rererences:

1. Discrete Mathematics & Graph Theory, by Satyanarayana Bhavanari,
K. Syam Prasad, PHI Pvt Ltd, New Delhi Second Edition,2014
2. Mathematical Foundation of Computer Science by Satyanarayana Bhavanari,
T. V. Pradeep Kumar, Sk. Mohiddin Shaw, BS Publications, Hyderabad,2016.
3. Graph Theory with applications to Engineering and Computer Science –
Narsingh Deo
4. First look at Graph Theory- John Clark Derek Allaw Holton.
5. Introduction to Graph Theory- Robin . J. Wilson
6. Introduction to Graph Theory- Douglas B. West
7. Discrete mathematics for computer scientists and Mathematics by
J.L.Mott, A.Kandel and T.P.Baker, Prentice Hall of India

Course outcomes:

1. Able to define basic concepts of graphs
2. Understand the properties of trees and use of connectivity
3. Apply Cayley's formula to find number of spanning trees
4. Identify Eulerian and Hamiltonian graphs.
5. Utilize the algorithms to find the shortest path,Optimal tree from a given graph
6. Understand the concepts of practical problems like Chinese postman problem and travelling salesman problem

MAT 306:6(B) FUZZY SETS AND FUZZY LOGIC**UNIT –I :**

Fuzzy Sets : An overview –Basic Types and Concepts-Characteristics and significance of the Paradigm-Properties of –Cuts-Representation of Fuzzy sets-Extension Principle for Fuzzy Sets.

UNIT – II:

Operations on Fuzzy Sets: Types of Operations –Fuzzy complements –t-norms-conorms-Combinations of operations-Aggregation of Operations-Fuzzy Arithmetic –Fuzzy Numbers-Linguistic Variables-Arithmetic Operations on Intervals-Arithmetic Operations on Fuzzy Numbers-Lattice of Fuzzy Numbers –Fuzzy Equations.

UNIT – III:

Fuzzy Relations : Crisp versus Fuzzy Relations –Projections and Cylindric Extensions-Binary Fuzzy Relations-Binary Relations on a Single Set-Fuzzy Compatibility Relations –Fuzzy Ordering Relations – Fuzzy Morphisms-Sup –i Compositions of Fuzzy Relations –inf-wi Compositions of Fuzzy Relations – Fuzzy Relation Equations –General Discussion –Problem partitioning-Solution Method-Fuzzy Relation Equations Based on sup-i Compositions Fuzzy Relation Equations Based on inf –wi Compositions – Approximate Solutions –The use of Neural Networks.

UNIT-IV:

Possibility Theory –Fuzzy Measures-Evidence Theory –Possibility Theory-Fuzzy sets and possibility Theory Versus-Probability Theory-Fuzzy logic –Classical Logic-Multivalued Logics- Fuzzy propositions – Fuzzy Quantifiers –Linguistic Hedges-Inference from Conditional Fuzzy Propositions – Inference from quantified propositions.

Scope and standard as in chapters 1 to 8 “ Fuzzy sets and Fuzzy logic Theory and Applications” by George J. Klir/ Bo Yuan, PH, 2001.

References : 1. Introduction to Fuzzy sets and Fuzzy Logic –M. Ganesh –Phi Learning Pvt Ltd.

2. Fuzzy logic with Engineering Applications , Timothy J. Ross Wiley students

Edition

MAT 307 :Practical-II

(Related to Skill Oriented Courses-5 &6)

MAT:308

(Open Online Transdisciplinary Courses)

(SWAYAM/ NPTEL/anyequivalent Courses)

OR

(OPEN ELECTIVE)

SEMESTER-IV :MATHEMATICS

MAT 401: OOSDC

(Open online skill Development Courses)

(SWAYAM/ NPTEL/anyequivalent Courses)

MAT 402: Project Work

**Algebra/ Graph Theory / Coding Theory/ Operation Research/ Mathematical Statistics/
Cryptography/ Number Theory**

SVU COLLEGE OF SCIENCES, SVU, TIRUPATI
DEPARTMENT OF MATHEMATICS
Open Elective (Other Departments)
III SEMESTER: M.Sc., MATHEMATICS/APPLIED MATHEMATICS
308: BUSINESS MATHEMATICS -1

Course Objectives:

- i. To understand the basic concepts of Mathematics.
- ii. To calculate percentages- profit and loss.
- iii. To solve Linear equations.
- iv. To understand Conversion of one Number System to Another.

Unit – I

Number- H.C.F. and L.C.M. of Numbers - Decimal Fractions.

Unit - II

Surds and Indices – Percentage - Profit and loss.

Unit - III

Linear Equations in Two Variables – Ratio and Proportion- Variation.

Unit -IV

Number System: Types of Number Systems – Conversion of Decimal Number to Binary Number and Vice versa -Conversion of Decimal numbers to Octal numbers and Vice versa - Conversion of Hexadecimal number into Decimal number and Vice versa - Binary Arithmetic.

Scope and Standard Treatment as in Chapters 1,2,3,9,10,11,31,12 of "OBJECTIVE ARITHMETIC", by R.S.AGGARWAL, S.Chand and Company.
Scope and Standard Treatment as in Chapter 1 of "BUSINESS MATHEMATICS", by P.R.VITTAL, MARGHAM PUBLICATIONS.

Course Outcomes:

- i. Apply the knowledge in mathematics (algebra, matrices, calculus) in solving business problems.
- ii. Analyse and demonstrate mathematical skills required in mathematically intensive areas in Economics and business.
- iii. Explain the concepts and use equations, formulae and mathematical expressions and relationships in a variety of contexts
- iv. Understand The Binary Octal, Octal, Decimal and Hexadecimal Systems.


AOS, CHAIRMAN
Department of Mathematics
S.V.U.C.S., TIRUPATI.

IV SEMESTER: M.Sc., MATHEMATICS

MAT 401: SDC-I: ALGEBRAIC CODING THEORY

Course Objectives:

- To develop the knowledge among students about coding and decoding.
- To explain linear codes and reliability of IMLD.
- To study Hamming codes and extended Golay codes
- To Introduce cyclic codes and polynomial Encoding and Decoding.

UNIT -I :

Introduction to Coding Theory: Introduction –Basic Assumptions- Correcting and Detecting Error Patterns-Information Rate-The Effects of Error Corrections and Detection-Finding the Most Likely Codeword Transmitted-Some Basic Algebra-Weight and Distance –Maximum Likelihood Decoding-Reliability of MLD-Error-Detecting Codes-Error-Correcting Codes.

UNIT – II:

Linear Codes: Two Important Subspaces-Independence, Basis, Dimension-Matrices-Bases for $C = \langle S \rangle$ and $C^\perp$ -Generating Matrices and Encoding-parity –Check Matrices-Equivalent Codes-Distance of a Linear Code-Cosets-MLD for Linear Codes- Reliability of IMLD for Linear Codes.

UNIT – III:

Perfect and Related Codes- Some Bounds for Codes-Perfect Codes-Hamming Codes-Extended Codes-The Extended Golay Code- Decoding the Extended Golay Code- The Golay Code –Reed-Muller Codes-Fast Decoding for RM (1,m)

UNIT-IV:

Cyclic Linear Codes; Polynomials and Words – Introduction to Cyclic Codes-Polynomial Encoding and Decoding –Finding Cyclic Codes-Dual Cyclic Codes.

Scope and Standard as in Sections 1.1 to 1.12 of Chapter 1, sections 2.1 to 2.12 of Chapter 2, sections 3.1 to 3.9 of chapter 3, sections 4.1 to 4.5 of chapter 4 and sections “Coding Theory the Essentials: by D.G. Hoffman, D.A Leonard, C.C. Lindner, K.T. Phelps, C.A. Rodger, J.R. Wall, Monographs and text books in pure and Applied Mathematics.

- References:**
1. Algebraic coding theory and Applications Longo. G. Hartmenn C.R. Springer publications
 2. Introduction to coding theory by J.H. Vanlint, Springer publications.
 3. Introduction to Algebraic and combinatorial coding theory, Academi press, INC. Newyork, 1977.
 4. The Theory of ERROR Correcting codes by N.J.A.Sloane, Vol I&V, North –Holland Amsterdam, 1977.

Course Out comes:

- Analyze Error detecting and error correcting codes.
- Understand and apply algorithms in applications like sending messages without errors.
- Obtain bounds for different types of codes.
- Understand the polynomial encoding and decoding.


HOS. CHAIRMAN

MAT 402: SDC-II: Introductory Methods of Numerical Analysis
(Common with paper AMA 402: SDC-II of Branch I (B) Applied Mathematics)

Course objectives:

- i. To provide suitable Numerical Methods, for solving ordinary and Partial Differential Equations.
- ii. To study Finite difference Approximations.
- iii. To learn Iterative Methods for the solution of Equations.
- iv. To study the various methods of Approximations..

UNIT-I:

Numerical Solution of Ordinary Differential Equations: Predictor- Corrector Methods-The Cubic Spline Method-Boundary Value Problems.

[Sections 7.1, 7.7 & 7.10 of Chapter-7 of the Text Book]

UNIT-II:

Numerical Solution of Partial Differential Equations: Introduction-Finite Difference Approximations to Derivatives-Laplace's equation.

[Sections 8.1, 8.2, 8.3 of Chapter-8 of the Text Book]

UNIT-III:

Numerical Solution of Partial Differential Equations (Continued):Parabolic Equations-Iterative Methods for the Solution of Equations-Hyperbolic Equations-Software for Partial Differential Equations.

[Sections 8.4, 8.5, 8.6 & 8.7 of Chapter-8 of the Text Book]

UNIT-IV:

The Finite Element Method: Introduction-Methods of Approximation-Application to Two-dimensional problems.

[Sections 10.1,10.2 &10.3 of Chapter-10 of the Text Book]

Text Book:

Scope and standard as "Introductory methods for Numerical Analysis by S.S.Sastry fourth edition".

Reference Book:

1. An Introduction to Numerical Analysis by Kendall E. Atkinson.
2. Theory and problems in Numerical Methods with programs in C and C++.
3. Numerical Methods and computing by Ward Cheney and David Kincaid
4. 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

- i. Solve ordinary and Partial Differential equations using numerical Methods.
- ii. Understand Laplace's Equation.
- iii. Study Parabolic and Hyperbolic equations.
- iv. Learn Methods of Approximation.


BOS, CHAIRMAN
Department of Mathematics
S.V.U.C.S., TIRUPATI.

B- 236-03-08

**M.Sc DEGREE EXAMINATION
THIRD SEMESTER
BRANCH:-MATHEMATICS
308: Open Elective: Business Mathematics-I
(Regular/Supplementary)**

Time: 3hours

Marks: 70

Answer any FOUR questions.

All questions carry equal marks.

(Marks : $4 \times 5 = 20$)

1. If $47.2506 = 4A + \frac{7}{B} + 2C + \frac{5}{D} + 6E$, then find the value of $5A + 3B + 6C + D + 3E$.
2. What is the unit digit in $(3157)^{754}$?
3. Evaluate 45% of $280 + 28\%$ of 450 .
4. If $abc = 1$ then $\frac{1}{1+a+b^{-1}} + \frac{1}{1+b+c^{-1}} + \frac{1}{1+c+a^{-1}} = 1$.
5. If $4a = 5b$ and $8b = 9c$, then find $a : b : c$.
6. Two numbers are in the ratio of $3 : 5$. If each number is increased by 10 , the ratio becomes $5 : 7$, then find the numbers.
7. Convert the decimal number 44_{10} into octal.
8. Conversion 14_{10} of decimal into binary.

PART - B

Answer ALL questions.

Each question carries 15 marks.

(Marks: $4 \times 12.5 = 60$)

UNIT - I

9. (a) Find the H.C.F and L.C.M of $1.5, 3, 0.6$.
(b) Find the L.C.M of $15, 18, 24, 27, 56$.

Or

[P.T.O.]

Dr. S. S. S.
BOG, CHAIRMAN
Department of Mathematics
C.V.U.C.S., TIRUPATI.

10. Evaluate

(a) $869 \times 738 + 869 \times 262$

(b) What is the unit digit in $3^{97} \times 6^{41} \times 7^{63}$.

UNIT - II

11. By selling 100 pens a shopkeeper gains the selling price of 20 pens. Find his gain percent.

Or

12. Rs. 395 are divided among A, B and C in such a manner that B gets 25% more than A and 20% more than C. Find the share of A?

UNIT - III

13. Solve $\frac{3x-y+1}{3} = \frac{2x+y+2}{5} = \frac{3x+2y+1}{6}$.

Or

14. (a) If $a : b = 1 : 3$, $b : c = 5 : 7$ and $c : d = 9 : 8$. Find $a : b : c : d$.

(b) On dividing a sum of Rs. 832 between A and B in the ratio $\frac{1}{3} : \frac{1}{5}$, then find their shares.

UNIT - IV

15. (a) Convert $(190)_{10}$ into hexa decimal.

(b) Convert $(B5)_{16}$ into decimal.

Or

16. (a) How to convert of decimal into binary with examples.

(b) Add $111100_2 + 011111_2$.



BOS, CHAIRMAN
Department of Mathematics
S.V.U.C.S., TIRUPATI.

**M.Sc DEGREE EXAMINATION
FOURTH SEMESTER
BRANCH:-MATHEMATICS
MAT 401 : SDC-I: ALGEBRAIC CODING THEORY
(Regular/Supplementary)**

Time: 3hours

Marks: 70

SECTION-A

4X5=20

Answer any **FOUR** questions. All questions carry **equal** marks.

1. Define binary code and Block code. List all words of length 3?
2. Modify $C_1 = \{00, 01, 10, 11\}$ by (i) repeating each code word three times
(ii) by adding a third digit to each code word so that number of each code word is even?
3. Define linear code. Give an example for linear Code and not a linear code?
4. List the cosets of the linear code $C = \{0000, 1011, 0101, 1110\}$?
5. If $0 \leq t \leq n$ and if v is a words of length n , then find the number of words of length n of distance at most t from v is precisely ?
6. Find an upper bounds for the size or dimension of a linear codes with the values $n=8, d=3$ & $n=23, d=27$?
7. Represent each code word C with the polynomials a) $C = \{000, 001, 010, 011\}$
b) $C = \{0000, 0001, 1110\}$
8. Let $g(x) = 1+x^2+x^3$ let the generator of a linear cyclic code of length 7. Find the message polynomial corresponding to the code words $C(x); x^2+x^4+x^5, x+x^2+x^4, x^2+x^3+x^4+x^6$.

SECTION-B

4X12.5=50

Answer **ALL** questions. All questions carry **equal** marks

UNIT – I

9. a) Let C be a code word of length 3. Add a parity check digit to the codewords in the code and use the resulting code C to answer the following questions
 - i) If 1101 is received can we detect an error?
 - ii) If 1101 is received what codewords were most likely to have been transmitted?
 - iii) Is any word of length 4 that is not in the code, closest to a unique codeword?
- b) Let $|M|=2, n=3$ and $C = \{000, 111\}$. If $v=000$ transmitted, when will IMLD conclude this correctly, and when will IMLD incorrectly conclude that 111 was sent?

(OR)

10. a) Define Hamming weight and Hamming distance. Let $u=01011, v=11010, w=01100$ compare the following pair of quantities:

- i) $wt(u+w)$, and $wt(v) = wt(w)$
- ii) $d(v, w)$, and $d(y, u) + d(u, w)$

b) Suppose $p=.90, |M|=3, n=4$, and $C = \{0000, 1010, 0111\}$, For each v in C , we compute $\sigma_p(C, v)$?

UNIT – II

11. a) Show that $C = \{0000, 1100, 0011, 1111\}$ is a linear code that its distance is $d=2$
- b) Explain the following terms with examples
 - i) Linear Independent set
 - ii) Basis
 - iii) Dimension

(OR)

12. a) Test for Linear Independence and find Basis

$$S = \{110, 011, 101, 111\}.$$

- b) Find a generator matrix for the code $C = \{0000, 1110, 0111\}$ by using the REF.

UNIT – III

13. a) Compute the upper bound for the size or dimension k of a linear code C of length $n=6$ and distance $d=3$?

- b) Let $n=23$ with $t=3$ show that it is a linear perfect code?

(OR)

14. a) Explain the Hamming Code. Find the generator matrix in standard form for a Hamming code of length 15, then encode the message 11111100000?

- b) Explain for Algorithm of IMLD for C_{24} ? Also decode $w=101111101111, 010010010010$?

UNIT – IV

15. a) Write out the Hamming code of length 7 generated by the matrix G and then represent this code by polynomials.

$$G = \begin{bmatrix} 1000111 \\ 0100110 \\ 0010101 \\ 0001011 \end{bmatrix}$$

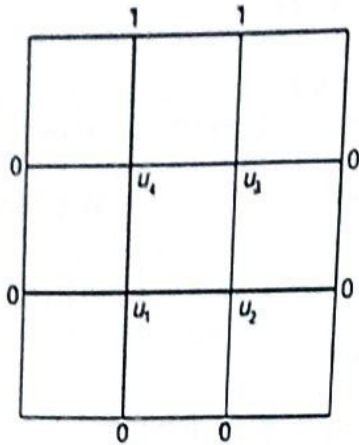
- b) Define Cyclic Code. Find the generator polynomial for the smallest linear cyclic code containing that word. 010101.

(OR)

16. a) Let C be the linear cyclic code of length $n=7$ with generator polynomial $g(x) = 1+x+x^3$ of degree $n-k=3$. Find a basis for C ?

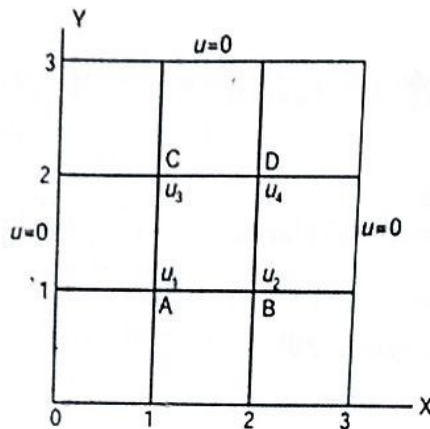
- b) For $n=6$, Factor $1+x^6$ into irreducible factors $1+x^6 = (1+x^3)^2 = (1+x)^2(1+x+x^2)^2$ then find the generators of proper cyclic codes of length 6?


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S.V.U.C.S., TIRUPATI.



(OR)

12. Solve the Poisson equation $u_{xx} + u_{yy} = -10(x^2 + y^2 + 10)$ in the domain of following figure



UNIT-III

13. Use the Bender-Schmidt recurrence relation to solve the equation $\frac{\partial^2 u}{\partial x^2} = 2 \frac{\partial u}{\partial t}$ with conditions $u(x, 0) = 4x - x^2$, $u(0, t) = u(4, t) = 0$

(OR)

14. Solve the Heat equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to conditions $u(x, 0) = 0$, $u(0, t) = 0$, $u(1, t) = t$

UNIT-IV

15. Find the functional for the boundary -value problem defined by $\frac{\partial^2 y}{\partial x^2} = f(x)$ and $y(a) = y(b) = 0$

(OR)

16. Solve the boundary- value problem defined $y'' + y = -x$, $0 < x < 1$, with $y(0) = y(1) = 0$

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