ANDHRA KESARI UNIVERSITY

Programme: B.A. Mathematics (Major)

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Fundamentals of Social Sciences	4	4
		2	Perspectives on Indian Society	4	4
	II	3	Differential Equations & Problem Solving Sessions	5	4
		4	Analytical Solid Geometry & Problem Solving Sessions	5	4
II	III	5	Group Theory &Problem Solving Sessions	5	4
		6	Numerical Methods & Problem Solving Sessions	5	4
		7	Laplace Transforms & Problem Solving Sessions	5	4
		8	Special Functions & Problem Solving Sessions	5	4
	IV	9	Ring Theory & Problem Solving Sessions	5	4
		10	Introduction to Real Analysis & Problem Solving Sessions	5	4
		11	Integral Transforms & Problem Solving Sessions	5	4

COURSE 5: GROUP THEORY

Theory   Credits: 4   5 hrs/week

Course Outcomes

After successful completion of this course, the student will be able to
1. acquire the basic knowledge and structure of groups
2. get the significance of the notation of a subgroup and cosets.
3. understand the concept of normal subgroups and properties of normal subgroup
4. study the homomorphisms and isomorphisms with applications.
5. understand the properties of permutation and cyclic groups

Course Content

Unit – 1
Groups

Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

Unit – 2
Sub Groups

Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition-examples-criterion for a complex to be a subgroup; Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. Coset Definition – properties of Cosets – Index of a subgroups of a finite group – Lagrange's Theorem.

Unit – 3
Normal Subgroups

Normal Subgroups: Definition of normal subgroup – proper and improper normal subgroup–Hamilton group- Criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups Sub group of index 2 is a normal sub group

Unit – 4
Homomorphisms

Quotient groups, Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

Unit – 5
Permutations and Cyclic Groups

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.
Cyclic Groups - Definition of cyclic group – elementary properties – classification of cyclic groups.

Activities

Seminar/ Quiz/ Assignments/ Applications of Group Theory to Real life Problem /Problem Solving Sessions.

Text Book

Modern Algebra by A.R. Vasishtha and A.K. Vasishtha, Krishna Prakashan Media Pvt. Ltd., Meerut.

Reference Books

1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna, Jai Prakash and Co. Printing Press, Meerut
3. Rings and Linear Algebra by Pundir & Pundir, published by Pragathi Prakashan

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COURSE 6: NUMERICAL METHODS

Theory   Credits: 4   5 hrs/week

Course Outcomes
After successful completion of this course, the student will be able to
1. difference between the operators Δ, ∇, E and the relation between them
2. know about the Newton – Gregory Forward and backward interpolation
3. know the Central Difference operators δ, μ, σ and relation between them
4. solve Algebraic and Transcendental equations
5. understand the concept of Curve fitting

Course Content
Unit – 1
The calculus of finite differences
The operators Δ, ∇, E - Fundamental theorem of difference calculus- properties of Δ, ∇, E and

problems on them to express any value of the function in terms of the leading terms and the leading differences - relations between E and D - relation between D and Δ - problems on one or more missing terms- Factorial notation- problems on separation of symbols- problems on Factorial notation.
Unit – 2
Interpolation with equal and unequal intervals
Derivations of Newton – Gregory Forward and backward interpolation and problems on them. Divided differences - Newton divided difference formula - Lagrange's and problems on them.
Unit – 3
Central Difference Interpolation formulae
Central Difference operators δ, μ, σ and relation between them - Gauss forward formula for equal intervals - Gauss Backward formula - Stirlings formula - Bessel's formula and problems on the above formulae.

Unit – 4
Solution of Algebraic and Transcendental equation
Method for finding initial approximate value of the root - Bisection method - to find the solution of given equations by using (i) Regula Falsi method (ii) Iteration method (iii) Newton – Raphson's method and problems on them.

Unit – 5
Curve Fitting
Least-squares curve fitting procedures - fitting a straight line-nonlinear curve fitting-curve fitting by a sum of exponentials
Activities
Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.
Text Book
Numerical Analysis by G. Shanker Rao, New Age International Publications
Reference Books
1. Applied Numerical Analysis by Curtis F. Gerald and Patrick O. Wheatley, Pearson, (2003) 7thEdition
2. Introductory Methods of Numerical Analysis by S.S. Sastry, (6th Edition) PHI New Delhi 2012

3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S.R. K. Iyengar and R. K. Jain, New Age International Publishers (2012), 6th edition.

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COURSE 7: LAPLACE TRANSFORMS

Theory   Credits: 4   5 hrs/week

Course Outcomes
After successful completion of this course, the student will be able to
1. understand the definition and properties of Laplace transformations
2. get an idea about first and second shifting theorems and change of scale property
3. understand Laplace transforms of standard functions like Bessel, Error function etc
4. know the reverse transformation of Laplace and properties
5. get the knowledge of application of convolution theorem

Course Content

Unit – 1
LAPLACE TRANSFORMS – I
Definition of Laplace Transform - Linearity Property - Piecewise Continuous Function - Existence of Laplace Transform - Functions of Exponential order and of Class A.

Unit – 2
LAPLACE TRANSFORMS – II
First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace transform of the derivative of f(t), Initial value theorem and Final value theorem.

Unit – 3
LAPLACE TRNASFORM – III
Laplace Transform of Integrals - Multiplication by t, Multiplication by t^n - division by t -Laplace transform of Bessel Function - Laplace Transform of Error Function – Laplace transform of Sine and Cosine integrals.

Unit – 4
INVERSE LAPLACE TRANSFORMS – I
Definition of Inverse Laplace Transform - Linearity Property - First Shifting Theorem -Second Shifting Theorem - Change of Scale property - use of partial fractions - Examples.

Unit – 5
INVERSE LAPLACE TRANSFORMS – II
Inverse Laplace transforms of Derivatives - Inverse Laplace Transforms of Integrals -Multiplication by Powers of 'p' - Division by powers of 'p' - Convolution Definition -Convolution Theorem - proof and Applications - Heaviside's Expansion theorem and its applications.

Activities
Seminar/ Quiz/ Assignments/ Applications of Laplace Transforms to Real life Problem /Problem Solving Sessions.

Text Book
 Laplace Transforms by A.R. Vasishtha, Dr. R.K. Gupta, Krishna Prakashan Media Pvt. Ltd., Meerut.

Reference Books
1. Introduction to Applied Mathematics by Gilbert Strang, Cambridge Press
2. Laplace and Fouries transforms by Dr. J.K. Goyal and K.P. Guptha, Pragathi Prakashan, Meerut.
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COURSE 8: SPECIAL FUNCTIONS

Theory   Credits: 4   5 hrs/week

Learning Outcomes
After successful completion of the course will be able to
1. Understand the Beta and Gamma functions, their properties and relation between these two functions, understand the orthogonal properties of Chebyshev polynomials and recurrence relations.
2. Find power series solutions of ordinary differential equations.
3. Solve Hermite equation and write the Hermite Polynomial of order (degree) n, also Find the generating function for Hermite Polynomials, study the orthogonal properties of Hermite Polynomials and recurrence relations.
4. Solve Legendre equation and write the Legendre equation of first kind, also find the generating function for Legendre Polynomials, understand the orthogonal properties of Legendre Polynomials.
5. Solve Bessel equation and write the Bessel equation of first kind of order n, also find the generating function for Bessel function understand the orthogonal properties of Bessel unction.

Course Content
Unit–1
Beta and Gamma functions, Chebyshev polynomials
Euler's Integrals-Beta and Gamma Functions, Elementary properties of Gamma Functions, Transformation of Gamma Functions.
Another form of Beta Function, Relation between Beta and Gamma Functions. Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrence relations, generating functions for Chebyshev polynomials.
Unit–2
PowerseriesandPowerseriessolutionsofordinarydifferentialequations
Introduction, summary of useful results, power series, radius of convergence, theorems on Power series Introduction of power series solutions of ordinary differential   equation
Ordinary and singular points, regular and irregular singular points, power series solution.
Unit–3
Hermite polynomials
Hermite Differential Equations, Solution of Hermite Equation, Hermite polynomials, generating function for   Hermite   polynomials. Other   forms   for   Hermite   Polynomials, Rodrigues formula for Hermite Polynomials,   to   find
        first   few   Hermite Polynomials. Orthogonal properties of Hermite Polynomials, Recurrence formulae for   HermitePolynomials.
Unit–4 Legendre polynomials
Definition, Solution of Legendre's equation, Legendre polynomial of degree n, generating function of Legendre   polynomials. Definition of $P_n(x)$and $Q_n(x)$,
General solution of Legendre's Equation (derivations not   required)   to   show   that $P_n(x)$ is   the coefficient of h^n, in the expansion of $(1- 2xh + h^2)^{-1/2}$ Orthogonal properties of Legendre's polynomials, Recurrence formulas for Legendre's Polynomials.

Unit–5
Bessel's equation

Definition, Solution of Bessel's equation, Bessel's function of the first kind of order n, Bessel's function of the second kind of order n.

Integration of Bessel's equation in series form=0, Definition of x recurrence formulae for $J_n x$ J_n Generating function for J_n, x orthogonally of Bessel functions.**Activities**

Seminar/ Quiz/ Assignments/ Applications of Special functions to Real life Problem /Problem Solving Sessions.

Text Book

Special Functions by J.N. Sharma and Dr. R.K. Gupta, Krishna Prakashan,

Reference Books

1. Dr. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt.Ltd., Ram Nagar, New Delhi-110055.
2. Shanti Narayan and Dr. P.K. Mittal, Integral Calculus, S. Chand & Company Pvt. Ltd., Ram Nagar,New Delhi-110055.
3. George F. Simmons, Differential Equations with Applications and Historical Notes, Tata Mc GRAW-Hill Edition, 1994.

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COURSE 9: RING THEORY

Theory   Credits: 4   5 hrs/week

Course Outcomes
After successful completion of this course, the student will be able to
1. acquire the basic knowledge of rings, fields and integral domains
2. get the knowledge of subrings and ideals
3. construct composition tables for finite quotient rings
4. study the homomorphisms and isomorphisms with applications.
5. get the idea of division algorithm of polynomials over a field.

Course Content
Unit - 1
Ring sand Fields
Definition of a ring and Examples –Basic properties – Boolean rings - Fields – Divisors of 0 and Cancellation Laws– Integral Domains – Division ring - The Characteristic of a Ring, Integral domain and Field – Non-Commutative Rings - Matrices over a field – The Quaternion ring.
Unit   –   2
Subrings and Ideals
Definition and examples of Subrings – Necessary and sufficient conditions for a subset to be a subring – Algebra of Subrings – Centre of a ring – left, right and two-sided ideals – Algebra of ideals – Equivalence of a field and a commutative ring without proper ideals
Unit III: Principal ideals and Quotient rings
Definition of a Principal ideal ring (Domain) – Every field is a PID – The ring of integers is a PID – Example of a ring which is not a PIR – Cosets – Algebra of cosets – Quotient rings – Construction of composition tables for finite quotient rings of the ring Z of integers and the ring Z_n of integers modulo n.

Unit   –   4
Homomorphism of Rings
 Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorems of homomorphism of rings – Maximal and prime Ideals – Prime Fields
Unit – 5
Rings of Polynomials
 Polynomials in an indeterminate – The Evaluation morphism -- The Division Algorithm in $F[x]$ – Irreducible Polynomials – Ideal Structure in $F[x]$ – Uniqueness of Factorization $F[x]$.

Activities
Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Text book
Modern Algebra by A.R. Vasishta and A.K. Vasishta, Krishna Prakashan Media Pvt. Ltd.
Reference books
1. A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
2. Linear Algebra by Stephen. H. Friedberg and Others, Pearson Education India
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COURSE 10: INTRODUCTION TO REAL ANALYSIS

Theory   Credits: 4   5 hrs/week

Course Outcomes

After successful completion of this course, the student will be able to
1. get clear idea about the real numbers and real valued functions.
2. obtaintheskillsofanalysingtheconceptsandapplyingappropriatemethodsfortesting convergence of a sequence/ series.
3. Test the continuity and differentiability and Riemann integration of a function.
4. Know the geometrical interpretation of mean value theorems.
5. know about the fundamental theorem of integral calculus

Course Contents

Unit – 1
REAL NUMBERS, REAL SEQUENCES

The algebraic and order properties of R - Absolute value and Real line - Completeness property of R - Applications of supremum property - intervals. (**No question is to be set from this portion)** Sequences and their limits -Range and Boundedness of Sequences - Limit of a sequence and Convergent sequence -The Cauchy's criterion - properly divergent sequences - Monotone sequences - Necessary and Sufficient condition for Convergence of Monotone Sequence - Limit Point of Sequence -Sub sequence sand the Bolzano-weir strass theorem – Cauchy Sequences – Cauchy's general principle of convergence.

Unit – 2
INFINITIE SERIES

Introduction to series -convergence of series -Cauchy's general principle of convergence for series tests for convergence of series - Series of non-negative terms - P-test - Cauchy's n^{th} root test -D'-Alembert's Test-Alternating Series–Leibnitz Test.

Unit –3
LIMIT & CONTINUITY

Real valued Functions - Boundedness of a function - Limits of functions - Some extensions of the limit concept - Infinite Limits - Limits at infinity (**No question is to be set from this portion).** Continuous functions - Combinations of continuous functions - Continuous Functions on intervals - uniform continuity.

Unit – 4
DIFFERENTIATION ANDMEANVALUETHEORMS

The derivability of a function at a point and and on an interval - Derivability and continuity of a function -Mean value Theorems -Rolle's Theorem, Lagrange's Theorem, Cauchy's Mean value Theorem

Unit – 5
RIEMANNINTEGRATION

Riemann Integral - Riemann integral functions – Dar boux theorem -Necessary and sufficient condition for R integrability - Properties of integrable functions - Fundamental theorem of integral calculus - integral as the limit of a sum - Mean value Theorems.

Activities

        Seminar/ Quiz/ Assignments/ Applications of Real Analysis to Real life Problem /Problem Solving Sessions.

Text Book

An Introduction to Real Analysis by Robert G. Bartle and Donlad R. Sherbert, John Wiley and sons Pvt. Ltd

Reference Books

1. Elements of Real Analysis by Shanthi Narayan and Dr. M.D. Raisinghania, S. Chand & CompanyPvt. Ltd., New Delhi.
2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

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COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS

Theory   Credits: 4   5 hrs/week

Learning Outcomes
Students after successful completion of the course will be able to
1. understand the application of Laplace transforms to solve ODEs
2. understand the application of Laplace transforms to solve Simultaneous DEs
3. understand the application of Laplace transforms to Integral equations
4. basic knowledge of Fourier-Transformations
5. Comprehend the properties of Fourier transforms and solve problems related to finiteFourier transforms.

Course Content
Unit – 1
Application of Laplace Transform to solutions of Differential Equations
Solutions of ordinary Differential Equations - Solutions of Differential Equations with constants coefficients - Solutions of Differential Equations with Variable coefficients.

Unit – 2
Application of Laplace Transform to solutions of Differential Equations
Solutions of Simultaneous Ordinary Differential equations - Solutions of Partial Differential Equations.

Unit – 3
Application of Laplace Transforms to Integral Equations
Definitions of Integral Equations - Abel's Integral Equation - Integral Equation of Convolution Type - Integral Differential Equations - Application of L.T. to Integral Equations.

Unit – 4
Fourier Transforms - I
Definition of Fourier Transform - Fourier sine Transform - Fourier cosine Transform - Linear Property of Fourier Transform - Change of Scale Property for Fourier Transform - sine Transform and cosine transform shifting property - Modulation theorem.
Unit – 5 Fourier
Transforms – II
Definition of Convolution - Convolution theorem for Fourier transform - Parseval's Identity - Relationship between Fourier and Laplace transforms - problems related to Integral Equations -Finite Fourier Transforms - Finite Fourier Sine Transform - Finite Fourier Cosine Transform - Inversion formula for sine and cosine transforms only - statement and related problems.

Activities
        Seminar/ Quiz/ Assignments/Applications of Integral Transforms in real life problems /Problem Solving Sessions.

Text Book
B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
Reference Book

1. Fourier Series and Integral Transformations by Dr. S. Sreenadh and others, published by S. Chandand Co, New Delhi
2. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003).
3. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).

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Time: 3 Hours   Total Marks: 75

Section –A
Answer any Five of the following

5X5=25 Marks

1.

2.

3.

4.

5.

6.

7.

8.

9.

10

Section –B   **5x10=50 Marks**
Answer the following

Note: (One Question from Each Unit)

11a.

Or

11b.

12a

Or

12b.

13a.

Or

13b

14a.

Or

14b.

15a.

Or

15b.