Government Degree College Ramachandrapuram
Department of Mathematics
2025-26
Semester wise Syllabus

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for 4-Year UG Honours in B.Sc. (Mathematics) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

COURSE STRUCTURE (for Semester I to VI)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Differential Equations	4	5
		2	Solid Geometry	4	5
	II	3	Group Theory	4	5
		4	Elementary Real Analysis	4	5
II	III	5	Ring Theory	4	5
		6	Advanced Real Analysis	4	5
		7	Theory of Matrices	4	5
	IV	8	Linear algebra	4	5
		9	Vector Calculus	4	5
		10	Linear Programming Program	4	5
III	V	11	Special Functions	4	5
		12 A	Laplace Transforms	4	5
		OR			
		12 B	Foundations of Automata Theory	4	5
		13 A	Numerical Methods	4	5
		OR			
		13 B	Mathematical Methods using MatLab	4	5
	VI	14 A	Integral Transforms	4	5
		OR			
		14 B	Statistical Analysis using R	4	5
		15 A	Advanced Numerical Methods	4	5
		OR			
		15 B	Mathematical Computations using Python	4	5

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SEMESTER-II

COURSE 4: ELEMENTRAY REAL ANALYSIS

Theory	**Credits: 4**	**5 hrs/week**

Course Objectives

1. To develop a strong foundation in the real number system and its axiomatic structure.
2. To introduce the concepts of order, bounds, completeness, and related foundational properties of real numbers.
3. To explore the properties of sets in real analysis, including neighborhoods, limit points, open and closed sets.
4. To build analytical skills in handling sequences, convergence criteria, and monotonicity.
5. To understand the behavior of infinite series and apply standard convergence tests effectively.

Course Outcomes

After successful completion of this course, the student will be able to

1. Understand the real number system, its axioms, and properties, including completeness, supremum, and infimum.
2. Apply the Archimedean property, denseness, and concepts of neighborhoods, limit points, and derived sets in problem-solving.
3. Analyze sequences for boundedness and convergence using definitions and the Cauchy criterion.
4. Understand the concept of subsequences, apply the Bolzano-Weierstrass theorem, and test convergence using Cauchy's general principle.
5. Determine the convergence of infinite series using various tests and solve related analytical problems.

Course Content

Unit – 1

Real number system - Field axioms – Properties of real numbers - Order axioms – Properties of Order relation - Principal of induction - Extended real number system – Modulus of a real number – Properties of modulus – Triangle property - Aggregates – Finite and infinite aggregates – Boundedness of an aggregate – Least upper bound (supremum) and greatest lower bound (infimum) of an aggregate – Properties of boundedness – Completeness axiom – Dedekind's theorem - Theorem on Dedekind's axiom and completeness axiom.

Unit – 2

Archemedian Property - It's corollaries – Integral part of a real number - Denseness of the real number system – Intervals – Neighbourhood of a point - Limit point of an aggregate – Derived Set - Bolzano - Weierstrass theorem – Interior point of a set - Open and closed Sets – It's properties (without proofs) - Countable and uncountable sets - Properties of countable sets.

Unit – 3

Sequences – Operations of sequences - Subsequences - Range and Boundedness of Sequences - Limit of a sequence and Convergent sequence – Divergent sequence – Uniqueness of a limit – Sandwich theorem on sequences - Monotone sequences - Problems

Unit – 4

Limit Point of a Sequence - Bolzano-Weierstrass theorem on subsequences – Cauchy Sequences – Cauchy's general principle of convergence - Problems

Unit – 5

Infinite Series – Convergence and divergence of series - Cauchy's general principle of convergence for series – Series of non-negative terms - Convergence of geometric series – p

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SEMESTER-III

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 – Laplacetrans form 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

LaplaceTransforms by A.R.Vasishtha,Dr.R.K.Gupta,KrishnaPrakashanMedia 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, PragathiPrakashan, 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'sIntegrals-Betaand Gamma Functions, Elementary properties of GammaFunctions, TransformationofGamma Functions.

Another form of BetaFunction, Relation between BetaandGamma Functions. Chebyshevpolynomials, orthogonalpropertiesofChebyshevpolynomials,recurrence relations, generatingfunctions for Chebyshev polynomials.

Unit–2

PowerseriesandPowerseriessolutionsofordinarydifferentialequations

Introduction, summary of useful results, powerseries, radius of convergence, theorems on Power series Introduction of power series solutions of ordinary differentialequationOrdinary and singular points, regular and irregular singular points, power series solution.

Unit–3

Hermitepolynomials

HermiteDifferential Equations, Solution of HermiteEquation,Hermite polynomials, generating function for Hermite polynomials.OtherformsforHermitePolynomials,RodriguesformulaforHermite Polynomials, to find first fewHermite Polynomials.OrthogonalpropertiesofHermitePolynomials,RecurrenceformulaeforHermitePolynomials.

Unit–4

Legendrepolynomials

Definition,SolutionofLegendre'sequation,Legendrepolynomialofdegree n, generating function of Legendrepolynomials.Definitionof$P_n(x)$and$Q_n(x)$,GeneralsolutionofLegendre'sEquation(derivationsnot required)toshowthat$P_n(x)$isthecoefficientofh^n, in the expansionof $(1-2xh+h^2)^{-1/2}$OrthogonalpropertiesofLegendre'spolynomials,RecurrenceformulasforLegendre's Polynomials.

Unit–5

Bessel'sequation

Definition, Solution of Bessel'sequation,Bessel's function of the firstkind of ordern,Bessel'sfunction of thesecondkindofordern.

IntegrationofBessel'sequationinseriesform=0, Definition of $J_n(x)$ recurrenceformulaefor$J_n(x)$

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SEMESTER-IV

COURSE 10: INTRODUCTION TO REAL ANALYSIS

Theory Credits: 4 5 hrs/week

Course Outcomes

After successful completion of this course, the student will be ableto

1. get clearidea 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 geometric a linter pretation of mean value theorems.
5. know about the fundamental theorem of integral calculus

Course Contents

Unit – 1
REALNUMBERS,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 -Subsequencesand the Bolzano-weierstrass theorem – Cauchy Sequences – Cauchy's general principle of convergence.

Unit – 2
INFINITIE SERIES

Introduction to series -convergenceofseries -Cauchy'sgeneralprincipleof convergencefor series tests for convergence of series - Series of non-negative terms - P-test - Cauchy'sn^{th} roottest -D'-Alembert'sTest-AlternatingSeries–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 -MeanvalueTheorems -Rolle'sTheorem,Lagrange's Theorem, Cauchy's Mean value Theorem

Unit – 5
RIEMANNINTEGRATION

Riemann Integral - Riemann integral functions - Darboux theorem -Necessary and sufficientcondition 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.

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SEMESTER-IV

COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS

Theory Credits: 4 5 hrs/week

LearningOutcomes

Studentsaftersuccessfulcompletionofthecoursewillbeableto

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 thepropertiesofFouriertransformsandsolveproblemsrelatedtofinite Fourier 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

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SEMESTER-V

COURSE 13: VECTOR CALCULUS

Theory Credits: 4 5 hrs/week

Course Outcomes

Students after successful completion of the course will be able to

1. Learn multiple integrals as anaturalextension of definite integraltoa function of two variables in the case of double integral/three variables in the case of tripleintegral.
2. Learnapplicationsintermsoffindingsurfaceareabydoubleintegralandvolumebytripleintegral .
3. Determinethegradient,divergence and curlof avector and vectori dentities.
4. Evaluateline,surfaceandvolumeintegrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem),relation between line integral and volumeintegral(Green'stheorem),relation between line and surface integral(Stokestheorem)

Course Content

Unit–1
MultipleIntegrals-I

Introduction -Doubleintegrals -Evaluationofdoubleintegrals –Propertiesofdouble integrals -Regionofintegration -double integration in PolarCo-ordinates – Change of variables in double integrals –change of order of integration.

Unit–2
Multipleintegrals-II

Tripleintegral -regionofintegration -changeofvariables -Plane areasbydoubleintegrals - surfaceareabydoubleintegral -Volumeasadoubleintegral,volumeasatripleintegral.

Unit–3
Vectordifferentiation

Vector differentiation –ordinary – derivatives of vectors – Differentiability –Gradient –Divergence - Curloperators - Formulaeinvolvingtheseparators.

Unit–4
Vectorintegration

Line Integralswithexamples - Surface Integralwithexamples - Volumeintegralwithexamples.

Unit–5
Vectorintegrationapplications

Gausstheoremandapplicationsof Gausstheorem - Green'stheoreminplane and applicationsofGreen'stheorem - Stokes's the orem and applications of Stokestheorem.

Activities

Seminar/ Quiz/ Assignments/ Applications of Vector calculus to Real life Problems /Problem Solving Sessions.

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SEMESTER-V
NUMBER THEORY

UNIT – 1: THE FUNDAMENTAL THEOREM OF ARITHMETIC

Introduction, Divisibility, Greatest common divisor, Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of the primes, The Euclidean algorithm, The greatest common divisor of more than two numbers

UNIT – 2: ARITHMETICAL FUNCTIONS AND DIRICHLET MULTIPLICATION

Introduction- The Mobius function $\mu\ (n)$ – The Euler quotient function $\varphi\ (n)$ - A relation connecting φ and μ - A product formula for $\varphi\ (n)$ - The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt functionΛ (n)- multiplicativefunctions- multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Louville's function $\lambda\ (n)$ - The divisor functions $\sigma_\alpha\ (n)$

UNIT – 3: 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 $\sigma\alpha\ (n)$- The average order of $\varphi\ (n)$- An application to the distribution of lattice points visible from the origin- The average order of $\mu\ (n)$ and $\Lambda(n)$-The partial sums of a Dirichlet product- Applications to $\mu\ (n)$ and $\Lambda\ (n)$

UNIT – 4: 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

UNIT – 5: 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, Gauss sums and the quadratic reciprocity law, the reciprocity law for quadratic Gauss sums, Another proof of the quadratic reciprocity law.

Text Book: Introduction to Analytic Number Theory by T.M. Apostol, Springer Verlag- New York, Heidalberg-Berlin-1976.

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