ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

MINOR

Subject: Mathematics

w.e.f. AY 2023-24

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	II	1	Differential Equations & Problem Solving Sessions	3	3
			Differential Equations & Problem Solving Sessions	2	1
II	III	2	Group Theory &Problem Solving Sessions	3	3
			Group Theory &Problem Solving Sessions	2	1
	IV	3	Ring Theory & Problem Solving Sessions	3	3
			Ring Theory & Problem Solving Sessions	2	1
		4	Introduction to Real Analysis & Problem Solving Sessions	3	3
			Introduction to Real Analysis & Problem Solving Sessions	2	1
III	V	5	Linear Algebra &Problem Solving Sessions	3	3
			Linear Algebra &Problem Solving Sessions	2	1
		6	Vector Calculus & Problem solving Sessions	3	3
			Vector Calculus & Problem solving Sessions	2	1

SEMESTER-II

COURSE 1: DIFFERENTIAL EQUATIONS

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. solve first order first degree linear differential equations.
2. convert a non-exact homogeneous equation to exact differential equation by using an integrating factor.
3. know the methods of finding solution of a differential equation of first order but not of first degree.
4. solve higher-order linear differential equations for both homogeneous and non-homogeneous, with constant coefficients.
5. understand and apply the appropriate methods for solving higher order differential equations.

Course Content

Unit – 1

Differential Equations of first order and first degree

Linear Differential Equations – Bernoulli's Equations - Exact Differential Equations –Integrating factors - Equations reducible to Exact Equations by Integrating Factors -

i) Inspection Method ii) $\frac{1}{Mx+Ny}$ iii) $\frac{1}{Mx-Ny}$

Unit – 2

Differential Equations of first order but not of first degree

Equations solvable for p, Equations solvable for y, Equations solvable for x – Clairaut's equation - Orthogonal Trajectories: Cartesian and Polar forms.

Unit – 3

Higher order linear differential equations

Solutions of homogeneous linear differential equations of order n with constant coefficients - Solutions of non-homogeneous linear differential equations with constant coefficients by means of polynomial operators

(i) $Q(x) = e^{ax}$ (ii) $Q(x) = Sin\ ax$ (or) $Cos\ ax$

Unit – 4

Higher order linear differential equations (continued.)

Solution to a non-homogeneous linear differential equation with constant coefficients

P.I. of $f(D)y = Q$ when $Q = bx^k$

P.I. of $f(D)y = Q$ when $Q = e^{ax}V$, where V is a function of x

P.I. of $f(D)y = Q$ when $Q = xV$, where V is a function of x

Unit – 5

Higher order linear differential equations with non-constant coefficients

Linear differential Equations with non-constant coefficients; Cauchy-Euler Equation; Legendre Equation; Method of variation of parameters

Activities

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

Text Book

Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

Reference Books

1. Ordinary and Partial Differential Equations by Dr. M.D. Raisinghania, published by S. Chand &Company, New Delhi.
2. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- Universities Press.
3. Differential Equations -Srinivas Vangala&Madhu Rajesh, published by Spectrum University Press.

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SEMESTER-III

COURSE 2: 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 subgroups; 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 groups – 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, KrishnaPrakashanMedia 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 PragathiPrakashan

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SEMESTER-IV

COURSE 3: 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

Ringsand 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 – NonCommutative 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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SEMESTER-IV

COURSE 4: INTRODUCTION TO REAL ANALYSIS

Theory Credits: 4 5 hrs/week

CourseOutcomes

Aftersuccessfulcompletionofthiscourse,thestudentwillbeableto

1. get clearideaabouttherealnumbersandrealvaluedfunctions.
2. obtaintheskillsofanalysingtheconceptsandapplyingappropriatemethodsfortesting convergence of a sequence/ series.
3. testthecontinuityand differentiabilityandRiemannintegrationofafunction.
4. knowthegeometricalinterpretationofmeanvalue 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

Introductiontoseries -convergenceofseries -Cauchy'sgeneralprincipleof convergencefor series tests for convergence of series - Series of non-negative terms - P-test - Cauchy'snth 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.

TextBook

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

ReferenceBooks

1. ElementsofRealAnalysis by ShanthiNarayan andDr.M.D.Raisinghania, S. Chand & Company Pvt. Ltd., New Delhi.
2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

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SEMESTER-V

COURSE 5: LINEAR ALGEBRA

Theory Credits: 4 5 hrs/week

Course Outcomes

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

1. understand the concepts of vector spaces, subspaces
2. understand the concepts of basis, dimension and their properties
3. understand the concept of linear transformation and its properties
4. apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higher powers of matrices without using routine methods
5. learn the properties of inner product spaces and determine orthogonality in inner product spaces.

Course Content

UNIT – I

Vector Spaces-I

Vector Spaces - General properties of vector spaces - n-dimensional Vectors - addition and scalar multiplication of Vectors - internal and external composition - Null space - Vector subspaces -Algebra of subspaces - Linear Sum of two subspaces - linear combination of Vectors- Linear span Linear independence and Linear dependence of Vectors.

UNIT –II

Vector Spaces-II

Basis of Vector space - Finite dimensional Vector spaces - basis extension - co-ordinates- Dimension of a Vector space - Dimension of a subspace - Quotient space and Dimension of Quotient space.

UNIT –III

Linear Transformations

Linear transformations - linear operators- Properties of L.T- sum and product of L.Ts - Algebra of Linear Operators - Range and null space of linear transformation - Rank and Nullity of linear transformations - Rank- Nullity Theorem.

UNIT –IV

Matrices

Characteristic equation - Characteristic Values - Characteristic vectors of a square matrix - Cayley Hamilton Theorem – problems on Cayley Hamilton Theorem.

UNIT –V

Inner product space

Inner product spaces- Euclidean and unitary spaces- Norm or length of a Vector- Schwartz inequality- Triangle Inequality- Parallelogram law- Orthogonality- Orthonormal set- Problems on Gram– Schmidt orthogonalisation process - Bessel's inequality.

Activities :

Seminar/ Quiz/ Assignments/Applications of Linear Algebra in real life problems\ Problem Solving.

Text Books

1.Linear Algebra by J.N. Sharma and A.R. Vasishtha, published by Krishna Prakashan Media (P) Ltd.

2.Matrices by A.R.Vasishtha and A.K.Vasishtha published by Krishna Prakashan Media (P) Ltd.

Reference Books

1. Linear Algebra by Stephen H. Friedberg et. al. published by Prentice Hall of India Pvt. Ltd. 4th Edition, 2007
2. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson education low priced edition), New Delhi.
3. Matrices by Shanti Narayana, published by S.Chand Publications

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SEMESTER-V

COURSE 6: VECTOR CALCULUS

Theory Credits: 4 5 hrs/week

Course Outcomes

Studentsaftersuccessfulcompletionofthecoursewillbeableto

1. Learnmultipleintegrals asanaturalextensionofdefiniteintegraltoafunctionoftwovariables inthecaseofdoubleintegral/threevariables inthecaseoftripleintegral.
2. Learnapplicationsintermsoffindingsurfaceareabydoubleintegralandvolumebytripleintegral .
3. Determinethegradient,divergenceandcurlofavectorandvectoridentities.
4. Evaluateline,surfaceandvolumeintegrals.
5. understand relation between surface and volume integrals (Gauss divergence theorem),relationbetweenlineintegralandvolumeintegral(Green'stheorem),relationbetween lineandsurfaceintegral(Stokestheorem)

Course Content

Unit–1
MultipleIntegrals-I

Introduction -Doubleintegrals -Evaluationofdoubleintegrals –Propertiesofdouble integrals - Regionofintegration -doubleintegrationinPolarCo-ordinates – Changeofvariablesindoubleintegrals -changeoforderofintegration.

Unit–2
Multipleintegrals-II

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

Unit–3
Vectordifferentiation

Vectordifferentiation –ordinary - derivativesofvectors – Differentiability –Gradient –Divergence - Curloperators - Formulaeinvolvingtheseparators.

Unit–4
Vectorintegration

Line Integralswithexamples - Surface Integralwithexamples - Volumeintegralwithexamples.

Unit–5
Vectorintegrationapplications

Gausstheoremandapplicationsof Gausstheorem - Green'stheoreminplane and applicationsofGreen'stheorem - Stokes'stheoremandapplications ofStokestheorem.

Activities

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

Text Book
A text Book of Higher Engineering Mathematics by B.S.Grawal, Khanna Publishers, 43rd Edition
ReferenceBooks
1. Vector Calculus by P.C.Matthews, Springer Verlag publications.
2. Vector Analysis by Murray Spiegel, Schaum Publishing Company, NewYork

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