	P.R.Government College (Autonomous) **KAKINADA**	**Program&Semester** II B.Sc. (IV Sem)
CourseCode **MAT-402/4225**	**TITLEOFTHECOURSE** **Linear Algebra**	

		L	T	P	C
Teaching	HoursAllocated:60(**Theory**)	L	T	P	C
Pre-requisites:	Basic Mathematics Knowledge on Abstract Algebra.	4	1	-	4

Course Objectives:

This course will cover the analysis and implementation of algorithms used to solve linear algebra problems in practice. This course will enable students to acquire further skills in the techniques of linear algebra, as well as understanding of the principles underlying the subject.

Course Outcomes:

On Completion of the course, the students will be able to-	
CO1	Understand the concepts of vector spaces, subspaces, basises, dimension and their properties.
CO2	Understand the concepts of linear transformations and their properties.
CO3	Apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higher powers of matrices without using routine methods.
CO4	Learn the properties of inner product spaces and determine orthogonality in inner product spaces.

Course with focus on employability/entrepreneurship /Skill Development modules

Skill Development			Employability			Entrepreneurship	

Unit - I: Vector Spaces – I **(12 Hrs)**

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 dependence and linear independence of Vectors.

Unit - II: Vector spaces – II **(12 Hrs)**

Basis of vector space, Finite dimensional vector space, Basis extension, Co-ordinates, Dimension of vector space, Dimension of subspace, Quotient space and Dimension of Quotient space.

Unit - III: Linear transformations **(12 Hrs)**

Linear transformations, Linear operators, Properties of linear transformation, Sum and product of linear transformations, Algebra of Linear Operators, Range space and Null Space of LT, Rank and Nullity of a LT, Rank & Nullity theorem.

Unit - IV: Matrix **(12 Hrs)**

Rank of a Matrix, Linear Equations, Characteristic Values and Characteristic Vectors of square matrix – Cayley - Hamilton Theorem.

Unit - V: Inner Product Space **(12 Hrs)**

Inner Product spaces, Euclidean and Unitary spaces, Norm or length of a vector, Schwartz's inequality, Triangle Inequality, Parallelogram law, Orthogonality and orthonormal set, Complete orthonormal set, Gram-Schmidt Orthogonalisation Process, Bessel's inequlity and Parsvel's identity.

Co-Curricular: Assignment, Seminar, Quiz, etc. **(15 Hrs)**

Additional Inputs: Diagonalization of a matrix.

Prescribed Text Books:

J.N. Sharma & A.R.Vasista, Linear Agebra, Krishna Prakasham Mandir, Meerut.

Books for Reference:

1. III year Mathematics Linear Algebra and Vector Calculus, Telugu Academy.
2. A Text Book of B.Sc. Mathematics, Vol-III, S. Chand & Co.

CO-PO Mapping:

(1:Slight[Low]; 2:Moderate[Medium]; 3:Substantial[High], '-':NoCorrelation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	1	2	2	3	2	3	2
CO2	3	2	3	3	2	3	3	1	3	3	3	2	1
CO3	2	3	2	3	2	3	2	2	2	3	2	2	3
CO4	3	2	3	3	2	2	3	3	1	2	3	1	2

BLUE PRINT FOR QUESTION PAPER PATTERN

SEMESTER-IV PAPER-V

Unit	TOPIC	S.A.Q	E.Q	Marks allotted to the Unit
I	Vector Spaces – I	2	1	20
II	Vector Spaces – II	2	1	20
III	Linear transformations	1	1	15
IV	Matrix	1	2	25
V	Inner Product Space	1	1	15
Total		7	6	95

S.A.Q. = Short answer questions (5 marks)

E.Q = Essay questions (10 marks)

Short answer questions : 4 X 5 = 20

Essay questions : 3 X 10 = 30

……………….

Total Marks = 50

………………..

P.R. Government College (Autonomous), Kakinada

II year B.Sc., Degree Examinations - III Semester

Mathematics Course: REAL ANALYSIS

Paper IV (Model Paper w.e.f. 2023-24)

…………………………………………………………………………………………………
.

Time: 2Hrs **Max. Marks: 50**

SECTION-A

Answer any three questions. Selecting at least one question from each part.

Part – A **3 X 10 = 30**

1. Prove that a non empty subset W of a vector space $V(F)$ is a subspace of V if and only if $a, b \in F, \alpha, \beta \in W \Rightarrow a\alpha + b\beta \in W$.
2. Let W be a sub space of a finite dimensional vector space V(F), then prove that $\dim\left(\frac{V}{W}\right) =$ dimV – dimW.
3. State and prove rank and nullity theorem

Part – B

4. Find the characteristic roots and the corresponding characteristic vectors of the matrix A $=\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$
5. State and prove Cayley- Hamilton theorem
6. Apply the Gram-Schmidt process to the vectors $\beta_1 = (2, 1, 3)$, $\beta_2 = (1, 2, 3)$, $\beta_3 = (1, 1, 1)$ to obtain an orthonormal basis for $V_3(R)$ with the standard product

SECTION-B

Answer any four questions **4 X 5 M = 20 M**

7. Determine whether the set of vector {(1, -2, 1), (2, 1, -1), (7, -4, 1)} is linearly dependent or Linearly independent.
8. Let p, q, r be the fixed elements of a field F.Show that the set W of all triads (x, y, z) of elements of F such that $px + qy + rz = 0$ is a vector space of $V_3(F)$.
9. Show that the set $\{(1,0,0), (1,10), (1,1,1)\}$ is a basis of $C^3(C)$. Hence find the coordinates of the vector (3+4i, 6i, 3+7i) in $C^3(C)$.
10. If W is a subspace of a finite dimensional vector space $V(F)$ then prove that W is also finite dimensional and dim $W \leq$ dim V.
11. Find T(x, y, z) where T: $R^3 \to R$ is defined by T(1,1,1)=3, T(0,1,-2)=1, T(0,0,1)= -2.
12. Find the rank of matrix is $\begin{pmatrix} 1 & 1 & 1 \\ 2 & 5 & -2 \\ 1 & 7 & -7 \end{pmatrix}$
13. State and Prove Triangle-Inequality

<table>
<tr><td rowspan="1"></td><td>P.R.Government College
(Autonomous)
KAKINADA</td><td colspan="4" rowspan="2">Program&Semester

II B.Sc. (IV Sem)</td></tr>
<tr><td>CourseCode
MAT-402P</td><td>TITLEOFTHECOURSE

Linear Algebra</td></tr>
<tr><td>Teaching</td><td>HoursAllocated:30(Practicals)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Pre-requisites:</td><td>Basic Mathematics Knowledge on Abstract Algebra.</td><td>-</td><td>-</td><td>2</td><td>1</td></tr>
</table>

Unit - I: Vector Spaces – I **(12 Hrs)**

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 dependence and linear independence of Vectors.

Unit - II: Vector spaces – II **(12 Hrs)**

Basis of vector space, Finite dimensional vector space, Basis extension, Co-ordinates, Dimension of vector space, Dimension of subspace, Quotient space and Dimension of Quotient space.

Unit - III: Linear transformations **(12 Hrs)**

Linear transformations, Linear operators, Properties of linear transformation, Sum and product of linear transformations, Algebra of Linear Operators, Range space and Null Space of LT, Rank and Nullity of a LT, Rank & Nullity theorem.

Unit - IV: Matrix **(12 Hrs)**

Rank of a Matrix, Linear Equations, Characteristic Values and Characteristic Vectors of square matrix – Cayley - Hamilton Theorem.

Unit - V: Inner Product Space (12 Hrs)

Inner Product spaces, Euclidean and Unitary spaces, Norm or length of a vector, Schwartz's inequality, Triangle Inequality, Parallelogram law, Orthogonality and orthonormal set, Complete orthonormal set, Gram-Schmidt Orthogonalisation Process, Bessel's inequlity and Parsvel's identity.

Prescribed Text Books:

J.N. Sharma & A.R.Vasista, Linear Agebra, Krishna Prakasham Mandir, Meerut.

Books for Reference:

1. III year Mathematics Linear Algebra and Vector Calculus, Telugu Academy.
2. A Text Book of B.Sc. Mathematics, Vol-III, S. Chand & Co.

Semester – IV End Practical Examinations

Scheme of Valuation for Practical's

Time : 2 Hours **Max.Marks : 50**

- **Record - 10 Marks**
- **Viva voce - 10 Marks**
- **Test - 30 Marks**
- **Answer any 5questions. At least 2 questions from each section. Each question carries 6 marks.**

BLUE PRINT FOR PRACTICAL PAPER PATTERN

COURSE-V, LINEAR ALGEBRA

Unit	TOPIC	E.Q	Marks allotted to the Unit
I	**Vector Spaces – I**	2	12
II	**Vector Spaces – II**	2	12
III	**Linear transformations**	1	06
IV	**Matrix**	2	12
V	**Inner Product Space**	1	06
	Total	8	48

P.R. GOVT. COLLEGE (AUTONOMOUS), KAKINADA
IIyear B.Sc., Degree Examinations - IV Semester
Mathematics Course-V: LINEAR ALGEBRA
(w.e.f. 2022-23 Admitted Batch)
Practical Model Paper (w.e.f. 2023-2024)

……………………………………………………………………………………………………

Time: 2Hrs **Max. Marks: 50M**

Answer any 5questions. At least 2 questions from each section. **5 x 6 = 30 Marks**

SECTION – A

1. Express the vector α = (1, -2, 5) as a linear combination of the vectors e_1=(1, 1, 1) , e_2=(1, 2 , 3) and e_3=(2, -1, 1) .

2. If S and T are the subsets of a vector space $V(F)$ then prove that

   (i) $S \subseteq T \Rightarrow L(S) \subseteq L(T)$ and (ii) $L(S \cup T) = L(S) + L(T)$.

3. Show that the set of vectors { (2,1,4), (1,-1,2), (3,1,-2)} form a basis for R^3 .
4. Show that the set $\{(1,0,0), (1,10), (1,1,1)\}$ is a basis of $C^3(C)$. Hence find the coordinates of the vector (3+4i, 6i, 3+7i) in $C^3(C)$.

SECTION – B

5. Define linear transformation and show that the function $T: R^3 \to R^3$defined by

   $T(x, y, z) = (x - y, 0, y + z)$ is a linear transformation.
6. Find the characteristic roots and characteristic vectors of the matrix

   A = $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$.
7. Verify Cayley -Hamilton theorem for the matrix A= $\begin{pmatrix} -2 & 1 & -1 \\ 1 & 2 & -1 \\ 3 & 1 & 0 \end{pmatrix}$.
8. Apply the Gram-Schmidt process to the vectors { (2, 1 , 3) , (1, 2, 3), (1, 1, 1) } to obtain an orthonormal basis for $V_3(R)$ with the standard product .

- **Record - 10 Marks**
- **Viva voce - 10 Marks**