Code No: F-15418/BL

FACULTY OF SCIENCE

B.A./B.Sc. (CBCS) V – Semester (Backlog) Examination, May/June 2024

Subject : Mathematics

Paper – V : Linear Algebra

Time: 3 Hours **Max. Marks: 80**

PART – A

(8x4=32 Marks)

Note : Answer any Eight questions.

1. Show that the set of all matrices $H=\left\{\begin{bmatrix} a & b \\ 0 & d \end{bmatrix} \mid a,b,c,d \in R\right\}$ is a subspace of the vector space $M_{2\times2}(R)$ of all 2 x 2 matrices with real entries.

2. If $\begin{bmatrix} 3 \\ -4 \end{bmatrix} = a\begin{bmatrix} 3 \\ 1 \end{bmatrix} + b\begin{bmatrix} 2 \\ 5 \end{bmatrix}$, then find $\begin{bmatrix} a \\ b \end{bmatrix}$.

3. Show that the set $S=\{1, x+1, x^2+2\}$ is a basis of the vector space of all polynomials $p_2(R)$ of degree less than or equal to 2.

4. Find the rank of the matrix $A=\begin{bmatrix} 1 & 3 & 5 & 6 \\ 3 & 4 & 6 & 8 \\ 2 & 6 & 10 & 12 \\ 4 & 7 & 11 & 14 \end{bmatrix}$.

5. If the null space of a 8 x 5 matrix A is 2-dimensional, then find the dimension of the row space of A.

6. Find the eigen vectors of the matrix $A=\begin{bmatrix} 1 & -1 \\ 5 & 7 \end{bmatrix}$.

7. Show that the mapping defined by $T: P_2(R) \to R^2$ defined by $T(p)=\begin{bmatrix} p(0) \\ p(1) \end{bmatrix}$ is a linear transformation. (Here $p(t)=a_0+a_1t+a_2t^2,\ a_0,a_1,a_2 \in R$)

8. Find the eigen values of the matrix $A=\begin{bmatrix} 0 & 1 \\ -8 & 4 \end{bmatrix}$.

9. Find the matrix of the linear transformation $T: R^3 \to R^3$ defined by $T\begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} a \\ a+b \\ b+c \end{bmatrix}$ with respect to the basis $B=\left\{\begin{bmatrix} 1 \\ 2 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}\right\}$ of the vector space $R^3(R)$.

10. If $u=\begin{bmatrix} 3 \\ 4 \\ 2 \end{bmatrix}$ and $v=\begin{bmatrix} 5 \\ -2 \\ 1 \end{bmatrix}$ then find $u.v$ and $\| u+v \|$.

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11. If $y=\begin{bmatrix}3\\4\end{bmatrix}$ and $u=\begin{bmatrix}2\\1\end{bmatrix}$, then find the orthogonal projection of y onto u.

12. Let W be a subspace of the vector space $R^n(R)$. Show that the set $W^{\perp}=\left\{x\in R^n \mid x.u=0 \text{ for all } u\in W\right\}$ is a subspace of R^n.

PART – B

Note : Answer all the questions. **(4 x 12 = 48 Marks)**

13. (a) Find bases of the Null space and the Column space of the matrix

$$A=\begin{bmatrix}1&5&-4&-3&1\\0&1&2&-1&0\\0&0&0&0&0\end{bmatrix}.$$

OR

(b) (i) Let $B=\{b_1,b_2,...,b_n\}$ be basis of vector space V. Then show that for each $x\in V$ there exists a unique set of scalars $c_1,c_2,...,c_n$ such that $x=c_1b_1+c_2b_2+...+c_nb_n$.

(ii) Show that the set $S=\left\{\begin{bmatrix}3\\6\end{bmatrix},\begin{bmatrix}-1\\-2\end{bmatrix}\right\}$ is a linearly dependent set in the vector space $R^2(R)$.

14. (a) State and prove rank theorem.

OR

(b) Find the eigen vectors of the matrix $A=\begin{bmatrix}0&0&2\\1&0&1\\0&1&-2\end{bmatrix}$.

15. (a) Show that an n x n matrix A is diagonalizable if and only if A has n linearly independent eigen vectors.

OR

(b) Construct the general solution of $x'=Ax$ where $A=\begin{bmatrix}3&1\\-2&1\end{bmatrix}$.

16. (a) (i) If u and v are vectors in the vector space R^n, show that $\| u+v \|^2+\| u-v \|^2=2\left(\| u \|^2+\| v \|^2\right)$.

(ii) If $S=\{u_1,u_2,...,u_p\}$ is an orthogonal set of non zero vectors in R^n, then show that S is linearly independent.

OR

(b) Using Gram Schmidt process, construct an orthogonal basis for the subspace W of R^4 spanned by the vectors $v_1=\begin{bmatrix}1\\2\\0\\3\end{bmatrix}, v_2=\begin{bmatrix}2\\-1\\3\\0\end{bmatrix}$ and $v_3=\begin{bmatrix}4\\2\\1\\0\end{bmatrix}$.

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Code No. F-15418

FACULTY OF SCIENCE

B.A./B.Sc. (CBCS) V- Semester Examination, December 2023/January 2024

Subject: Mathematics

Paper-V: Linear Algebra

Time: 3 Hours **Max. Marks: 80**

PART – A

Note: Answer any eight questions. **(8x4= 32 Marks)**

1. Prove that the intersection of two subspaces is again a subspace.
2. Verify whether the set $\{(1,1,2)\ (2,2,4)\ (1,3,4)\}$ is linearly independent.
3. If a vector space V has a basis set $B=\{b_1,b_2,\dots b_n\}$ then prove that any set in V containing more than n vectors must be linearly dependent.
4. Find the eigen values of $A=\begin{bmatrix}1 & 2\\ 3 & 0\end{bmatrix}$.
5. Find the smallest possible dimensions of nul A, given that A is of 3×7 matrix.
6. Prove that eigen values of matrix A and it's transpose A^T are the same.
7. Mention under what condition the given matrix is diagonalizable.
8. If $A=\begin{bmatrix}1 & -2\\ 1 & 3\end{bmatrix}$ then find eigen values and a basis for each eigen space in C^2.
9. Suppose $A=\begin{bmatrix}7 & 2\\ -4 & 1\end{bmatrix}$ then find A^4 given that $A=PDP^{-1}$, where $P=\begin{bmatrix}1 & 1\\ -1 & -2\end{bmatrix}$ and $D=\begin{bmatrix}5 & 0\\ 0 & 3\end{bmatrix}$.
10. Show that the set vectors $\{u_1,u_2,u_3\}$, where $u_1=\left[\frac{3}{\sqrt{11}},\frac{3}{\sqrt{11}},\frac{3}{\sqrt{11}}\right]^T$, $u_2=\left[\frac{-1}{\sqrt{6}},\frac{2}{\sqrt{6}},\frac{1}{\sqrt{6}}\right]^T$, $u_3=\left[\frac{-1}{\sqrt{66}},\frac{-4}{\sqrt{66}},\frac{7}{\sqrt{66}}\right]^T$ are orthogonal.
11. Prove that two vectors u and v are orthogonal if and only if $\|u+v\|^2=\|u\|^2+\|v\|^2$.
12. In an inner product space, prove that any orthogonal set of non-zero vectors is linearly independent.

PART – B

Note: Answer all the questions. **(4x12= 48 Marks)**

13. (a) (i) Prove that the column space of an $m\times n$ matrix A is a subspace of $\mathbb{R}^m$.

(ii) If $A=\begin{bmatrix}2 & 4 & -2 & 1\\ -2 & -5 & 7 & 3\\ 3 & 7 & -8 & 6\end{bmatrix}$, if column space of A and the null space of A are subspaces of $\mathbb{R}^k$. Then find the value of k.

(OR)

(b) (i) Find the dimension of the null space and the column space of

$$A=\begin{bmatrix}-3 & 6 & -1 & 1 & -7\\ 1 & -2 & 2 & 3 & -1\\ 2 & -4 & 5 & 8 & -4\end{bmatrix}$$

(ii) If a vector space V has a basis of n vectors, then prove that every basis of V must contain exactly n vectors.

14. (a) (i) Find bases for the row space, the column space and the null space of the matrix

$$A=\begin{bmatrix}-2 & -5 & 8 & 0 & -17\\ 1 & 3 & -5 & 1 & 5\\ 1 & 11 & -19 & 7 & 1\\ 1 & 7 & -13 & 5 & -3\end{bmatrix}.$$

(OR)

(b) State and prove Rank theorem.

15. (a) Diagonalize the matrix $A=\begin{bmatrix}2 & 4 & 3\\ -4 & -6 & -3\\ 3 & 3 & 1\end{bmatrix}$ if possible.

(OR)

(b) Suppose $A=\begin{bmatrix}0.5 & -0.6\\ 0.75 & 1.1\end{bmatrix}$.then find the eigen values of A and find a basis for each eigen space.

16. (a) State and prove orthogonal decomposition theorem.

(OR)

(b) Explain the Gram-Schmidt process.

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Code No. E-10417

FACULTY OF SCIENCE

B.A. / B.Sc. (CBCS) V – Semester Examination, December 2022 / January 2023

Subject: Mathematics

Paper – V : Linear Algebra

Time: 3 Hours **Max. Marks: 80**

PART – A

Note: Answer any eight questions. **(8 x 4 = 32 Marks)**

1. Define a vector space and given an example of vector space.
2. Prove that the intersection of two sub spaces is again a subspace.
3. If $A = \begin{bmatrix} 6 & -4 \\ -3 & 2 \\ -9 & 6 \end{bmatrix}$ then find Null space of A.
4. Find the eigen values of $A = \begin{bmatrix} 6 & 8 \\ 8 & -6 \end{bmatrix}$.
5. Find rank of a matrix having order 4×7 with 4 –dimesnional null space.
6. If λ is an eigen value of an invertible matrix A, then porve that $\frac{1}{\lambda}$ is an eigen value of the matrix A^{-1}.
7. Is every matrix diagonalizable? Mention the condition for the given matrix to be diagonalizable.
8. Find the eigen values and a basis for each eigen space in c^2 for $A = \begin{bmatrix} 1 & -2 \\ 1 & 3 \end{bmatrix}$.
9. Prove than an $n \times n$ matrix with n distinct eigen values is diagonalizable.
10. If $u = [2, -5, -1]^T$ and $v = [3, 2, -3]^T$ then find the inner product of u and v.
11. If u, v are two vectors. Then prove that two vectors, u, v are orthogonal if and only if $\|u - v\|^2 = \|u\|^2 + \|v\|^2$.
12. Prove that, in an inner product space, any orthogonal set of non-zero vectors is linearly independent.

PART – B

Note: Answer all the questions. **(4 x 12 = 48 Marks)**

13. (a) (i) Given V_1 and V_2 in a vector space V. Let $H = span\{V_1, V_2\}$ then show that H is a subspace of V.

(ii) Prove that the null space of an $m \times n$ matrix A is a subspace of R^n.

(OR)

(b)(i) Find a spanning set for the null space of the matrix

$$A = \begin{bmatrix} -3 & 6 & -1 & 1 & -7 \\ 1 & -2 & 2 & 3 & -1 \\ 2 & -4 & 5 & 8 & -4 \end{bmatrix}$$

(ii) Let $\beta = \{b_1, b_2 ..., b_n\}$ be a basis for a vector space V. Then prove that for each $x \in V$ there exists a unique set of scalars $c_1, c_2 ..., c_n$ such that $x = c_1b_1 + c_2b_2 + \cdots + c_nb_n$.

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14. (a) (i) State and prove Rank theorem.

(ii) Let $b_1 = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$ $b_2 = \begin{bmatrix} -2 \\ 4 \end{bmatrix}$ $c_1 = \begin{bmatrix} -7 \\ 9 \end{bmatrix}$ $c_2 = \begin{bmatrix} -5 \\ 7 \end{bmatrix}$ and consider the bases for R^2 given by $B = [b_1, b_2]$ and $c = [c_1, c_2]$ then find the change of coordinates matrix from B to C.

(OR)

(b) (i) If $V_1, V_2 \dots, V_r$ are eigen vectors that correspond to distinct eigen values $\lambda_1, \lambda_2 \dots, \lambda_r$ of an $m \times n$ matrix A, then prove that the set $\{V_1, V_2 \dots V_r\}$ is linearly independent.

(ii) Find the characteristic equation of $A = \begin{bmatrix} 5 & -2 & 6 & -1 \\ 0 & 3 & -8 & 0 \\ 0 & 0 & 5 & 4 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

15. (a) Diagonalize the matrix $A = \begin{bmatrix} 1 & 3 & 3 \\ -3 & -5 & -3 \\ 3 & 3 & 1 \end{bmatrix}$ if possible.

(OR)

(b) Suppose $B = [b_1, b_2]$ is a basis for V and $C = [c_1, c_2, c_3]$ is a basis for W. Let $T: V \to W$ be a linear transformation with the property that $T(b_1) = 3c_1 - 2c_2 + 5c_3$ and $T(b_2) = 4c_1 + 7c_2 - c_3$. Then find the matrix M for T relative to B and C.

16. (a) Suppose A is $m \times n$ matix. Then prove that the orthogonal complement of the row space of A is the null space of A and the orthogonal complement of the coloumn space of A is the null space of A^T.

(OR)

(b) Explain the Gram Schmidt Process.

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Code No. 6516

FACULTY OF SCIENCE

B.Sc./ BA V Semester (CBCS) Examination, March 2022

Subject: Mathematics

Paper – V : Linear Algebra

Time: 3 Hours **Max. Marks: 80**

PART – A (8 x 4 = 32 Marks)

Note: Answer any eight questions.

1. Determine whether the Set S = $\{v_1, v_2, v_3\}$ is a basis of $\mathbf{R}^3$, where $v_1 = \begin{bmatrix} 3 \\ 0 \\ -6 \end{bmatrix}$ $v_2 = \begin{bmatrix} -4 \\ 1 \\ 7 \end{bmatrix}$ $v_3 = \begin{bmatrix} -2 \\ 1 \\ 5 \end{bmatrix}$.
2. Prove that intersection of two subspaces is again a subspace.
3. Find the dimension of the subspace H spanned by $\begin{bmatrix} 1 \\ -5 \end{bmatrix}, \begin{bmatrix} -2 \\ 10 \end{bmatrix}, \begin{bmatrix} -3 \\ 15 \end{bmatrix}$.
4. If a 7x5 matrix A has rank 2, Find dim Nul A,
5. If $\begin{bmatrix} 3 \\ -2 \\ 1 \end{bmatrix}$ an eigen vector of $\begin{bmatrix} -4 & 3 & 3 \\ 2 & -3 & -2 \\ 1 & 0 & -2 \end{bmatrix}$ then, find eigen value.
6. Find the characteristic polynomial of A = $\begin{bmatrix} 4 & 0 & -1 \\ 0 & 4 & -1 \\ 1 & 0 & 2 \end{bmatrix}$
7. Show that an *nxn* matrix with n distinct eigen values is diagonalizable.
8. Let $T: V \to W$ be a linear transformation with $T(b_1) = 3c_1 - 2c_2 + 5c_3$ and $T(b_2) = 4c_1 + 7c_2 - c_3$. Find the matrix M for T relative to bases $B = \{b_1, b_2\}$ and $c = \{c_1, c_2, c_3\}$ for vector spaces V and W.
9. Find the complex eigen values of A = $\begin{bmatrix} 0 & 5 \\ -2 & 2 \end{bmatrix}$.
10. Find a unit vector in the direction of $(1, -2, 2, 0)$.
11. Determine if $\{u_1, u_2, u_3\}$ is an orthogonal set, where $u_1 = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}, u_2 = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix}, u_3 = \begin{bmatrix} -1/2 \\ -2 \\ 7/2 \end{bmatrix}$
12. Let $y = \begin{bmatrix} 7 \\ 6 \end{bmatrix}$ *and* $u = \begin{bmatrix} 4 \\ 2 \end{bmatrix}$. Find the orthogonal projection of y onto u.

PART – B

Note: Answer any four questions. **(4 x 12 = 48 Marks)**

13. State and prove spanning set theorem.

14. Define nul space and find basis for the nul space of matrix

$$A=\begin{bmatrix}1 & 1 & -2 & 1 & 5\\ 0 & 1 & 8 & -1 & -2\\ 0 & 1 & 0 & -1 & 14\end{bmatrix}$$

15. State and prove rank theorem.

16. Find eigen values and eigen vectors of $A=\begin{bmatrix}4 & -1 & 6\\ 2 & 1 & 6\\ 2 & -1 & 8\end{bmatrix}$.

17. Compute A^6, where $=\begin{bmatrix}4 & -3\\ 2 & -1\end{bmatrix}$ using $A = PDP^{-1}$

18. Construct general solution of $x' = Ax$ where $A = \begin{bmatrix}-3 & 2\\ -1 & -1\end{bmatrix}$.

19. If $S = \{u_1, u_2 \dots \dots u_P\}$ is orthogonal set of non zero vectors in R^n, then prove that S is linearly independent and hence is a basis for subspace spanned by S.

20. Let W be the subspace spanned by the set $S = \{x_1, x_2, x_3\}$ where

$$x_1=\begin{bmatrix}3\\1\\-1\\3\end{bmatrix}\quad x_2=\begin{bmatrix}-5\\1\\5\\-7\end{bmatrix}\quad x_3=\begin{bmatrix}1\\1\\-2\\8\end{bmatrix}$$. Now Construct an orthogonal basis for W.

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Code No. 18187

FACULTY OF SCIENCE

B.Sc. V Semester (CBCS) Examination, July 2021

Subject: Mathematics

Paper: V – Linear Algebra

Time: 2 Hours | Max. Marks: 60

PART – A

(4 x 5 = 20 Marks)

Note: Answer any four questions.

1 Prove that intersection of a subspace is again a subspace.

2 Determine if $v = \begin{bmatrix} 3 \\ -1 \\ 3 \end{bmatrix}$ is in col A, where $A = \begin{bmatrix} 2 & 4 & -2 & 1 \\ -2 & -5 & 7 & 3 \\ 3 & 7 & -8 & 6 \end{bmatrix}$.

3 Determine if $\{v_1, v_2, v_3\}$ is basis for R^3, where $v_1 = \begin{bmatrix} 3 \\ 0 \\ 6 \end{bmatrix}, v_2 = \begin{bmatrix} -4 \\ 1 \\ 7 \end{bmatrix}, v_3 = \begin{bmatrix} -2 \\ 1 \\ 5 \end{bmatrix}$.

4 Let $B = \{b_1, b_2\}$ and $C = \{c_1, c_2\}$ be bases for a vector space V and suppose $b_1 = 6c_1 - 2c_2$ and $b_2 = 9c_1 - 4c_2$. Then find change of coordinate matrix B to C.

5 Find the complex Eigen values of the matrix $A = \begin{bmatrix} 3 & -3 \\ 3 & 3 \end{bmatrix}$.

6 Compute A^4 where $P = \begin{bmatrix} 5 & 7 \\ 2 & 3 \end{bmatrix}, D = \begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$ and $A = PDP^{-1}$.

7 Compute $\|u+v\|$ where $u = \begin{bmatrix} 2 \\ -5 \\ -1 \end{bmatrix}, v = \begin{bmatrix} -7 \\ -4 \\ 6 \end{bmatrix}$.

8 Find a unit vector in the direction of $v = \begin{bmatrix} -6 \\ 4 \\ -3 \end{bmatrix}$.

PART – B

(2 x 20 = 40 Marks)

Note: Answer any two questions.

9 Define Null space and find spanning set for the Null space of given matrix

$$A = \begin{bmatrix} -3 & 6 & -1 & 1 & -7 \\ 1 & -2 & 2 & 3 & -1 \\ 2 & -4 & 5 & 8 & -4 \end{bmatrix}.$$

10 If a vector space V has a basis $\beta = \{b_1, b_2, ... b_n\}$ then show that any set in V containing more than n vectors must be linear dependent.

11 State and prove that Rank theorem. Also find rank A, where $A = \begin{bmatrix} 1 & -4 & 9 & -7 \\ -1 & 2 & -4 & 1 \\ 5 & -6 & 10 & 7 \end{bmatrix}$.

12 Prove $\lambda = 4$ is an Eigen value of $A = \begin{bmatrix} 3 & 0 & -1 \\ 2 & 3 & 1 \\ -3 & 4 & 5 \end{bmatrix}$ and find the corresponding Eigen vector and characteristic equation of A.

13 Diagonalize $A = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 3 \end{bmatrix}$, if possible.

14 (i) Find the orthogonal projection of $\begin{bmatrix} 1 \\ 7 \end{bmatrix}$ onto the line through $\begin{bmatrix} -4 \\ 2 \end{bmatrix}$ and the origin.

(ii) Determine if the set $\{u, v, w\}$ is orthogonal set. Given $u = \begin{bmatrix} -1 \\ 4 \\ -3 \end{bmatrix}, v = \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix}, w = \begin{bmatrix} 3 \\ -4 \\ -7 \end{bmatrix}$.

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Code No. 18187/BL

FACULTY OF SCIENCE

B.Sc. V Semester (CBCS) Examination, November / December 2021

Subject: MATHEMATICS
Paper: V – Linear Algebra

Time: 2 Hours

Max. Marks: 60

PART – A

Note: Answer any four questions. **(4 x 5 = 20 Marks)**

1 Prove that $H=\left\{\begin{bmatrix} s \\ t \\ o \end{bmatrix} : s,t \text{ are real}\right\}$ is a subspace of R^3.

2 Prove that Null A is subspace of R^n.

3 Determine if $\{v_1, v_2, v_3\}$ is L.D or L.I, where $v_1=\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}, v_2=\begin{bmatrix} 4 \\ 5 \\ 6 \end{bmatrix}, v_3=\begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix}$.

4 Find the dimension of the subspace H of R^2 spanned by $\begin{bmatrix} 1 \\ -5 \end{bmatrix}, \begin{bmatrix} -2 \\ 10 \end{bmatrix}, \begin{bmatrix} -3 \\ 15 \end{bmatrix}$.

5 Let $b_1=\begin{bmatrix} 2 \\ 1 \end{bmatrix}$, $b_2=\begin{bmatrix} -1 \\ 1 \end{bmatrix}$, $x=\begin{bmatrix} 4 \\ 5 \end{bmatrix}$ *and* $\beta=\{b_1, b_2\}$. Find the coordinate vector $[x]_\beta$ *of* x relative to β.

6 Diagonalize A, where $A=\begin{bmatrix} -3 & 12 \\ -2 & 7 \end{bmatrix}$ *and* $v_1=\begin{bmatrix} 3 \\ 1 \end{bmatrix}$, $v_2=\begin{bmatrix} 2 \\ 1 \end{bmatrix}$ are Eigen vectors of A.

7 Compute distance between $u=\begin{bmatrix} 0 \\ -5 \\ 2 \end{bmatrix}$ *and* $v=\begin{bmatrix} -4 \\ -1 \\ 8 \end{bmatrix}$.

8 Suppose y is orthogonal to vectors u and v, then show that y is orthogonal to $u + v$.

PART – B

Note: Answer any two questions. **(2 x 20 = 40 Marks)**

9 Show that H=span $\{v_1, v_2\}$ is a subspace of a vector space V and determine if $W=\begin{bmatrix} 3 \\ 1 \\ 2 \end{bmatrix}$ is subspace spanned by $\{v_1, v_2, v_3\}$ where $V_1=\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}, V_2=\begin{bmatrix} 2 \\ 1 \\ 3 \end{bmatrix}, V_3=\begin{bmatrix} 4 \\ 2 \\ 6 \end{bmatrix}$.

10 Let $\beta=\{b_1, b_2, ..., b_n\}$ be basis for vector space V. Then show that the coordinate mapping $x \to [x]_\beta$ is 1-1 linear transformation from V on to R^n.

11 If two matrices A and B are row equivalent, then show that their row spaces are the same. Also find dim Row A, where A= $\begin{bmatrix} 1 & 3 & 4 & -1 & 2 \\ 2 & 6 & 6 & 0 & -3 \\ 3 & 9 & 3 & 6 & -3 \\ 3 & 9 & 0 & 9 & 0 \end{bmatrix}$.

12 Find eigen values and eigen vectors of A= $\begin{bmatrix} 4 & 0 & 1 \\ -2 & 1 & 0 \\ -2 & 0 & 1 \end{bmatrix}$.,

13 Diagonalize A= $\begin{bmatrix} 2 & 2 & -1 \\ 1 & 3 & -1 \\ -1 & -2 & 2 \end{bmatrix}$, if possible.

14 (i) Prove that two vectors u and v are orthogonal iff $\|u+v\|^2 = \|u\|^2 + \|v\|^2$.

(ii) Determine if the set $\{u, v\}$ is orthogonal. If so, find the orthonormal set. Given

$$u = \begin{bmatrix} 1/3 \\ 1/3 \\ 1/3 \end{bmatrix}, \; v = \begin{bmatrix} -1/2 \\ 0 \\ 1/2 \end{bmatrix}.$$

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