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JSS MAHAVIDYAPEETHA
JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU

Fourth Semester B.E. Degree Examination, Event-1
Department of Mathematics

Linear Algebra

Time : 1 Hours | Branches:CSE & ISE | Date: 04-05-2023 | Max. Marks : 20

Q.No.	CO	CD	PI	Question	Marks
1 a)	1	1, 2, 3	1.1.1	Apply elementary row operations to transform the matrix $A = \begin{bmatrix} 0 & -3 & -6 & 4 & 9 \\ -1 & -2 & -1 & 3 & 1 \\ -2 & -3 & 0 & 3 & -1 \\ 1 & 4 & 5 & -9 & -7 \end{bmatrix}$ into row echelon form and and locate the pivot columns of A.	5
b)	1	2, 3	2.1.1	Describe the solutions of the following system in parametric vector form. Also, give a geometric description of the solution set. $x_1 + 2x_2 - 3x_3 = 5$; $2x_1 + x_2 - 3x_3 = 13$; $-x_1 + x_2 = -8$.	5
2 a)	1	2, 3	2.1.1	Let $A = \begin{bmatrix} 1 & 0 & -4 \\ 0 & 3 & -2 \\ -2 & 6 & 3 \end{bmatrix}$ and $b = \begin{bmatrix} 4 \\ 1 \\ -4 \end{bmatrix}$. Denote the columns of A by a_1, a_2, a_3, and let $W = \text{Span}\{a_1, a_2, a_3\}$. i) Is b in W? How many vectors are in W? ii) Show that a_3 is in W.	5
b)	1	3	2.1.1	Let $v_1 = \begin{bmatrix} 1 \\ -3 \\ -5 \end{bmatrix}$, $v_2 = \begin{bmatrix} -3 \\ 9 \\ 15 \end{bmatrix}$ and $v_3 = \begin{bmatrix} 2 \\ -5 \\ h \end{bmatrix}$. i) for what values of h is v_3 in Span$\{v_1, v_2\}$, and ii) for what values of h is $\{v_1, v_2, v_3\}$ linearly dependent?	5
OR					
3 a)	1	2, 3	2.1.1	Let $A = \begin{bmatrix} 1 & 4 & 1 & 2 \\ 0 & 1 & 3 & -4 \\ 0 & 2 & 6 & 7 \\ 2 & 9 & 5 & -7 \end{bmatrix}$. How many rows of A contain a pivot position? Does the equation $Ax = b$ have a solution for each b in $\mathbb{R}^4$? Can each vector in $\mathbb{R}^4$ be written as a linear combination of the columns of the matrix A? Do the columns of A span $\mathbb{R}^4$?	5
b)	1	1, 2, 3	1.1.1	Determine if the following homogeneous system has a nontrivial solution. Then describe the solution set. $3x_1 + 5x_2 - 4x_3 = 0$; $-3x_1 - 2x_2 + 4x_3 = 0$; $6x_1 + x_2 - 8x_3 = 0$.	5

Course Outcome: At the end of the course the students will have the ability to	
CO 1	Apply the numerical methods to solve Systems of linear equations, row reduction and Echelon form, vector equations, Matrix equation, solution sets of linear systems.

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JSS MAHAVIDYAPEETHA
JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU

Fourth Semester B.E.

EVENT-3

Department of Mathematics

Linear Algebra

Time : 1 Hour

Branches; CS/IS

Date: 12 /06/2023

Max. Marks : 20

Q.No.	CO	CD	PI	Question	Marks
1	CO3	2,3	1.1.1	Find the bases and dimensions for the row space, column space, null space of the matrix. Also verify rank theorem for the following matrix. $$A = \begin{pmatrix} -2 & -5 & 8 & 0 & -17 \\ 1 & 3 & -5 & 1 & 5 \\ 3 & 11 & -19 & 7 & 1 \\ 1 & 7 & -13 & 5 & -3 \end{pmatrix}$$	10

2(a)	CO3	1,2	1.1.1	Show that for $n \geq 0$, the set P_n of polynomials of degree atmost 'n' is a vector space.	05
2 (b)	CO3	1,2	2.1.1	Find the spanning set for the null space of the following matrix $$A = \begin{pmatrix} -3 & 6 & -1 & 1 & -7 \\ 1 & -2 & 2 & 3 & -1 \\ 2 & -4 & 5 & 8 & -4 \end{pmatrix}$$	05

OR

3(a).	CO3	3	1.1.1	Let $$A = \begin{pmatrix} 10 & -8 & -2 & -2 \\ 0 & 2 & 2 & -2 \\ 1 & -1 & 6 & 0 \\ 1 & 1 & 0 & -2 \end{pmatrix} \text{ and } w = \begin{pmatrix} 2 \\ 2 \\ 0 \\ 2 \end{pmatrix}$$ Determine if w is in Col A.	05
3 (b)	CO3	1,3	1.1.1	Let $$b_1 = \begin{pmatrix} 1 \\ -3 \end{pmatrix} \quad b_2 = \begin{pmatrix} -2 \\ 4 \end{pmatrix} \quad c_1 = \begin{pmatrix} -7 \\ 9 \end{pmatrix} \quad c_2 = \begin{pmatrix} -5 \\ 7 \end{pmatrix}$$ and consider the bases for R^2 given by $B = \{b_1, b_2\}$ and $C = \{c_1, c_2\}$. Find the change of bases coordinates matrix from B to C.	05

$\frac{95}{2} - 72$

$144 - 95$

$-\frac{49}{2}$

$\frac{7}{7} - \frac{25}{14}$

$-\frac{21}{14} = -\frac{3}{2}$

$\frac{17 \times 5}{55}$

Course Outcome: At the end of the course the students will have ability to

$7 + \frac{34}{2}$ $\quad 5 - \frac{55}{2}$ $\quad -\frac{75}{2}$

$7 + 17$

CO-3	Analyze the concepts of inter process communication, deadlocks, memory allocation strategies, page replacement algorithms of OS.

USN	0	1	J	C	E	2	1	C	S	1	2	1

20MA412

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU

Department of Mathematics

IV Semester: Event 4

LINEAR ALGEBRA

Duration: One hours. Date: 06/07/2023 Max. Marks:20

SECTIONS:CS A,B,&C

NOTE: Answer all questions.

Q.NO	CO	CD	PI	QUESTION	MARKS
1(a)	CO 4	1	1.1.1	Let $A = \begin{bmatrix}-2\\1\end{bmatrix}, b = \begin{bmatrix}-3\\1\end{bmatrix}, C = \begin{bmatrix}\frac{4}{3}\\-1\\\frac{2}{3}\end{bmatrix}, \quad d = \begin{bmatrix}5\\6\\-1\end{bmatrix}$ (i).compute $\frac{a.b}{a.a}$ and $\left(\frac{a.b}{a.a}\right)$.a. (ii)Find a unit vector u in the direction of c (iii) Show that d is orthogonal to c.	05
OR					
1(b)	CO 4	2,3	1.1.1	Show that $\{u_1, u_2, u_3\}$ is an orthogonal set where $u_1 = \begin{bmatrix}3\\1\\1\end{bmatrix}, u_2 = \begin{bmatrix}-1\\2\\1\end{bmatrix}, u_3 = \begin{bmatrix}-\frac{1}{2}\\-2\\\frac{7}{2}\end{bmatrix}$. S=$\{u_1, u_2, u_3\}$ is an orthogonal basis forR^3Express the vector $y = \begin{bmatrix}6\\1\\-8\end{bmatrix}$ as a linear combination of vectors in S.	05
2(a)	CO 4	1	1.1.1	Let $y = \begin{bmatrix}7\\6\end{bmatrix}, u = \begin{bmatrix}4\\2\end{bmatrix}$ Find the component of y orthogonal to u and also the component of u orthogonal to y.	05
OR					

2(b)	CO 4	2	1.3.1	Let$u_1 = \begin{bmatrix}2\\5\\1\end{bmatrix}, a_2 = \begin{bmatrix}-2\\1\\1\end{bmatrix}, \quad y = \begin{bmatrix}1\\2\\3\end{bmatrix}$.observe that $\{u_1, u_2\}$ is an orthogonal basis for w=span $\{u_1, u_2\}$ write y as sum of a vector in w and a vector orthogonal to w.	05
3.	CO 5	2,3	1.3.1	*Let* $A = \begin{bmatrix}1 & -1\\1 & 4\\1 & -1\\1 & 4\end{bmatrix}$ *and b=* $\begin{bmatrix}-1\\6\\5\\7\end{bmatrix}$ *Use the factorization A=QR to find the least squares solution of Ax=b*	10

Course Outcome: At the end of the course the students will have the ability to	
CO–4	Determine and describe the characteristic equation, diagonalization,Eigen vectors and linear transformation, complex eigen values .Orthogonality,Innerproduct ,length and orthogonal projections.
CO-5	Determine and describe the Gram-schmidt process, least squaresproblems, Innerproduct spaces, diagonalizationof symmetric matrices, quadratic forms.

PI's	
1.1.1	Apply mathematical techniques such as calculus, linear algebra, and statistics to solve problems.
1.3.1	Apply fundamental engineering concepts to solve engineering problems.

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JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU

Fourth Semester B.E. Degree Examination
Department of Mathematics
Linear Algebra
(Common to CSE and ISE)

Duration: 3 Hours

Max. Marks : 100

NOTE:

1. Answer all the questions in **PART-A**.
2. Questions in **PART-B** have internal choice.

PART-A

Q.No.	CO	CD	PI	Question	Marks
1 a)	1	1, 2, 3	1.2.1	Row reduce the matrix $A = \begin{bmatrix} 0 & -3 & -6 & 4 & 9 \\ -1 & -2 & -1 & 3 & 1 \\ -2 & -3 & 0 & 3 & -1 \\ 1 & 4 & 5 & -9 & -7 \end{bmatrix}$ into row echelon form.	5
b)	1	2, 3	1.2.1	Choose h and k such that the following system has (i) no solution, (ii) a unique solution, and (c) many solutions. $x_1 + hx_2 = 2;\ 4x_1 + 8x_2 = k$.	5
2	2	2, 3	1.2.1	Let $A = \begin{bmatrix} 2 & -4 & 2 \\ -4 & 5 & 2 \\ 6 & -9 & 1 \end{bmatrix}$ and $b = \begin{bmatrix} 6 \\ 0 \\ 6 \end{bmatrix}$. Solve the equation $Ax = b$ by using the LU-factorization of A.	10
3	3	2, 3	1.2.1	Find the bases and dimensions for the row space, the column space and the null space of the matrix $A = \begin{bmatrix} -2 & -5 & 8 & 0 & -17 \\ 1 & 3 & -5 & 1 & 5 \\ 3 & 11 & -19 & 7 & 1 \\ 1 & 7 & -13 & 5 & -3 \end{bmatrix}$.	10
4	4	2, 3	1.2.1	Let $A = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 3 \end{bmatrix}$. Diagonalize the matrix A, if possible.	10
5	5	1, 2, 3	1.2.1	Let $A = \begin{bmatrix} 1 & -1 \\ 1 & 4 \\ 1 & -1 \\ 1 & 4 \end{bmatrix}$ and $b = \begin{bmatrix} -1 \\ 6 \\ 5 \\ 7 \end{bmatrix}$. Use the factorization $A = QR$ to find the least-squares solution of $Ax = b$.	10

PART-B

Q.No.	CO	CD	PI	Question	Marks
6 a)	1	2, 3	1.2.1	Let $A = \begin{bmatrix} 1 & 4 & 1 & 2 \\ 0 & 1 & 3 & -4 \\ 0 & 2 & 6 & 7 \\ 2 & 9 & 5 & -7 \end{bmatrix}$. Can every vector in $\mathbb{R}^4$ be written as a linear combination of the columns of the matrix A above? Do the columns of A span $\mathbb{R}^3$? Do the columns of A span $\mathbb{R}^4$? Does the equation $Ax = y$ have a solution for each y in $\mathbb{R}^4$?	5
b)	1	3	1.2.1	For what value(s) of h will y be in Span$\{v_1, v_2, v_3\}$ if $v_1 = \begin{bmatrix} 1 \\ -1 \\ -2 \end{bmatrix}$, $v_2 = \begin{bmatrix} 5 \\ -4 \\ -7 \end{bmatrix}$, $v_3 = \begin{bmatrix} -3 \\ 1 \\ 0 \end{bmatrix}$ and $y = \begin{bmatrix} -4 \\ 3 \\ h \end{bmatrix}$.	5
				OR	
7 a)	1	2, 3	1.2.1	Describe all solutions of $Ax = b$ in parametric vector form, where $A = \begin{bmatrix} 3 & 5 & -4 \\ -3 & -2 & 4 \\ 6 & 1 & -8 \end{bmatrix}$ and $b = \begin{bmatrix} 7 \\ -1 \\ -4 \end{bmatrix}$. Also, give a geometric description of the solution set.	7
b)	1	1, 2, 3	1.2.1	Determine if the columns of the matrix $A = \begin{bmatrix} 0 & 1 & 4 \\ 1 & 2 & -1 \\ 5 & 8 & 0 \end{bmatrix}$ are linearly independent.	3

Q.No.	CO	CD	PI	Question	Marks
8 a)	2	2, 3	1.2.1	Let T be the linear tranasformation whose standard matrix $A = \begin{bmatrix} 2 & 1 & -3 \\ -6 & 4 & 0 \\ 2 & 5 & -1 \\ 0 & -2 & 3 \end{bmatrix}$. i). Decide, if T is one-to-one mapping ii). Decide, if T maps $\mathbb{R}^3$ onto $\mathbb{R}^4$.	5
b)	2	2, 3	1.2.1	Find the inverse of the matrix $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 4 & -3 & 8 \end{bmatrix}$, if it exists.	5
				OR	
9 a)	2	2, 3	1.2.1	A matrix of the form $A = \begin{bmatrix} A_{11} & A_{12} \\ 0 & A_{22} \end{bmatrix}$ is said to block upper triangular. Assume that A_{11} is $p \times p$, A_{22} is $q \times q$ and A is invertiable. Find a formula for A^{-1}.	5
b)	2	2, 3	1.2.1	If T is a linear transformation from $\mathbb{R}^2$ into $\mathbb{R}^2$ defined by $T(x_1, x_2) = (6x_1 - 8x_2, -5x_1 + 7x_2)$. Show that T is invertiable and find a formula for T^{-1}.	5

Q.No.	CO	CD	PI	Question	Marks
10 a)	3	1, 2, 3	1.2.1	Let $A = \begin{bmatrix} 2 & 4 & -2 & 1 \\ -2 & -5 & 7 & 3 \\ 3 & 7 & -8 & 6 \end{bmatrix}$, $u = \begin{bmatrix} 3 \\ -2 \\ -1 \\ 0 \end{bmatrix}$ and $v = \begin{bmatrix} 3 \\ -1 \\ 5 \end{bmatrix}$. i) Determine, if u is in Nul$A$. Could u be in Col$A$? ii) Determine, if v is in Col$A$. Could v be in Nul$A$?	5
b)	3	1, 2, 3	1.2.1	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 $\mathbb{R}^2$ given by $B = \{b_1, b_2\}$ and $C = \{c_1, c_2\}$. Find the change of coordinates matrix from C to B.	5
				OR	
11 a)	3	1, 2, 3	1.2.1	Find the dimension of the subspace $H = \left\{ \begin{bmatrix} s-2t \\ s+t \\ 3t \end{bmatrix} : s, t \in \mathbb{R} \right\}$.	5
b)	3	1, 2, 3	1.2.1	Let $S = \{1+2t^3, 2+t-3t^2, -t+2t^2-t^3\}$, use the coordinate vectors to test the linear independence of the polynomials in S.	5

Q.No.	CO	CD	PI	Question	Marks
12	4	2, 3	1.2.1	Define $T : \mathbb{P}_3 \to \mathbb{R}^4$ by $T(p) = \begin{bmatrix} p(-2) \\ p(3) \\ p(1) \\ p(0) \end{bmatrix}$. i). Show that T is a linear transformation. ii). Find the matrix for T relative to the basis $\{1, t, t^2, t^3\}$ for $\mathbb{P}_3$ and the standard basis for $\mathbb{R}^4$.	10
				OR	
13 a)	4	2, 3	1.2.1	Let $y = \begin{bmatrix} 7 \\ 6 \end{bmatrix}$ and $u = \begin{bmatrix} 4 \\ 2 \end{bmatrix}$. Find the orthogonal projection of y onto u. Then write y as the sum of two orthogonal vectors, one in Span$\{u\}$ and one orthogonal to u.	5
b)	4	2, 3	1.2.1	Let $u_1 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$, $u_2 = \begin{bmatrix} -1 \\ 4 \\ 1 \end{bmatrix}$, $u_3 = \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix}$ and $x = \begin{bmatrix} 8 \\ -4 \\ -3 \end{bmatrix}$. Show that $\{u_1, u_2, u_3\}$ is an orthogonal basis for $\mathbb{R}^3$. Then express x as a linear combination of u_1, u_2 and u_3.	5

Q.No.	CO	CD	PI	Question	Marks
14	5	2, 3	1.2.1	Orthogonally diagonalize the matrix $A = \begin{bmatrix} 6 & -2 & -1 \\ -2 & 6 & -1 \\ -1 & -1 & 5 \end{bmatrix}$.	10
				OR	
15	5	1, 2, 3	1.2.1	Make a change of variable $x = Py$, that transforms the quadratic form $9x_1^2 - 8x_1x_2 + 3x_2^2$ into a quadratic form with no cross-product term. Give P and the new quadratic form.	10