School of Engineering and Applied Science (SEAS), Ahmedabad University

Name: _____ Roll no.: _____

B. Tech. CSE: Semester II

Subject Name: Applied Linear Algebra, End Term Exam (Winter Sem .:2025); Marks:35 , Wt.:35 %

April 27, 2025, Sunday, 11.00 AM – 12.30 PM

MAT248

Instructions:

1 All questions are compulsory.
2 Figures to right indicate full marks.
3 Open Textbook Exam, hand written material not allowed
4 Write all steps in your answer.

Q-1 Answer the following questions in one or two lines or select the correct option **(5*1)**

(a) What geometric object is represented by the row space for the matrix below ?

$$A = \begin{pmatrix} 2 & 6 & 7 \\ 0 & 0 & 0 \end{pmatrix}$$

(b) Select the correct option for the matrix below

$$A = \begin{pmatrix} 2 & 1 & 7 \\ 4 & 1 & 3 \end{pmatrix}$$

(1) A basis set for A is { (2,1,7)}
(2) A basis set for Row space of A is {(2,1,7), (-4, -1,-3)}
(3) A basis set for A is {(2,1,7), (4, 1, 3)}
(4) Row space of A is {(2,1,7), (4, 1, 3)}
(5) None of the above options are correct
Write the complete option that you find correct in your answerbook.

(c) What is the dimension of the vector space V, where elements of the vector space are two by two diagonal matrices ? Select one set of possible basis set for V.

(d) Given the augmented matrix below for a linear system, state if it has one, infinity or no solutions, also state why.

$$A = \begin{pmatrix} 2 & 6 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(e) For what value of K, $\{u, v\}$ is linearly independent if

$$u = (1, -2), v = (1, K)$$

Q-2 . a. **Find the best-fit line of the form y = mx + c, given the (x,y) data** $(1,2), (2.3) and\ (3,5)$

b. **Let** $W = span\{x_1.x_2\}$, **where** $x_1 = \begin{bmatrix}0\\4\\2\end{bmatrix}$ **and** $x_2 = \begin{bmatrix}5\\6\\-7\end{bmatrix}$. **Construct an orthogonal basis for** W **using Gram-Schmidt orthogonalisation.** **(6+4)**

Q-3 **Consider the iterations**

$$\begin{pmatrix} x_{n+1} \\ y_{n+1} \end{pmatrix} = \begin{pmatrix} 0.6 & 0.4 \\ 0.4 & 0.6 \end{pmatrix} \begin{pmatrix} x_n \\ y_n \end{pmatrix}$$

Find the eiganvalues and eigenvectors of

$$A = \begin{pmatrix} 0.6 & 0.4 \\ 0.4 & 0.6 \end{pmatrix}$$

and use them to find x_4 , y_4 **given that** $x_0 = 6, y_0 = 0.$ **(10)**

Q-4 (a) **Given** $f(x,y) = 5x^2 + 8xy + 5y^2$, **write the equations in the matrix form, Use the symmetric matrix to determine whether this function has a maximum or minimum. If it does, find the point at which it occurs.** **(8)**

(b) **Compare matrix orthogonalisation and SVD. Give one instance where orthogonalisation is useful and one where SVD is useful.** **(2)**

All the best
