

Birla Institute of Technology and Science, Pilani

Work Integrated Learning Programmes Division

Cluster Programme - M.Tech. in Data Science and Engg.

II Semester 2018-19

Course Number	DSECF ZC416	
Course Name	Mathematical Foundation for Data Science	
Nature of Exam	Open Book	# Pages 2
Weightage for grading	40%	# Questions 4
Duration	2 hours and 30 minutes	
Date of Exam	28/09/2019 (10:00 - 12:30)	

Instructions

1. All questions are compulsory
2. Questions are to be answered in the order in which they appear in this paper and in the page numbers mentioned before each of them.

Pages 2-6

Q1a) Prove or disprove: If S is a finite subset of a vector space V , then the linear span $L(S)$ is the smallest subspace of V containing S . (2)

b) Prove or disprove: There is a linear transformation $T : \mathbb{R}^4 \rightarrow \mathbb{R}^3$ with $\text{Ker}T = \{0\}$. (2)

c) Prove or disprove: The eigenvectors of $\begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix}$ are $\begin{bmatrix} i \\ 1 \end{bmatrix}$ and $\begin{bmatrix} -i \\ 1 \end{bmatrix}$ for $\theta \neq 0, \pi$ (2)

d) Apply Gauss elimination with partial pivoting to solve (4)

$$\begin{pmatrix} 0.02 & 0.01 & 0 & 0 \\ 1 & 2 & 1 & 0 \\ 0 & 1 & 2 & 1 \\ 0 & 0 & 100 & 200 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} 0.02 \\ 1 \\ 4 \\ 800 \end{pmatrix}$$

Pages 7-11

Q2a) Prove or disprove $\lfloor x \rfloor + \lfloor y \rfloor + \lfloor x + y \rfloor \leq \lfloor 2x \rfloor + \lfloor 2y \rfloor$ for all real numbers x and y . (2)

b) Draw the graph of the function $f(x) = \lfloor 2 \lceil \frac{x}{2} \rceil + \frac{1}{2} \rfloor$ (2)

c) Use Warshall's algorithm to find the transitive closure on $\{a, b, c, d, e\}$ for the relation $\{(a, b), (a, c), (a, e), (b, a), (b, c), (c, a), (c, b), (d, a), (e, d)\}$. (2)

d) A relation R is called *circular* if aRb and bRc imply that cRa . Show that R is reflexive and circular if and only if it is an equivalence relation. (4)

Pages 12-15

Q3a) Find the number of paths of length 3 between any two adjacent vertices in $K_{3,3}$ (3)

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