

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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Table of Contents Mfds Past Papers

1. Understanding the eBook Mfds Past Papers
 - The Rise of Digital Reading Mfds Past Papers
 - Advantages of eBooks Over Traditional Books
2. Identifying Mfds Past Papers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Mfds Past Papers
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mfds Past Papers
 - Personalized Recommendations
 - Mfds Past Papers User Reviews and Ratings
 - Mfds Past Papers and Bestseller Lists
5. Accessing Mfds Past Papers Free and Paid eBooks
 - Mfds Past Papers Public Domain eBooks

- Mfds Past Papers eBook Subscription Services
- Mfds Past Papers Budget-Friendly Options
- 6. Navigating Mfds Past Papers eBook Formats
 - ePub, PDF, MOBI, and More
 - Mfds Past Papers Compatibility with Devices
 - Mfds Past Papers Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mfds Past Papers
 - Highlighting and Note-Taking Mfds Past Papers
 - Interactive Elements Mfds Past Papers
- 8. Staying Engaged with Mfds Past Papers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mfds Past Papers
- 9. Balancing eBooks and Physical Books Mfds Past Papers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mfds Past Papers
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Mfds Past Papers
 - Setting Reading Goals Mfds Past Papers
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Mfds Past Papers
 - Fact-Checking eBook Content of Mfds Past Papers
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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