

Reg No.:

Name :



U8345



# University of Kerala

First Semester Degree Examination, November 2024

Four Year Undergraduate Programme

Discipline Specific Course

## Mathematics

UK1DSCMAT100, Foundations of Mathematics

Academic Level: 100-199

Time: 2 hours

Max. Marks: 56

Part A. 6 Marks. Time: 5 Minutes

Objective Type. 1 Mark Each. Answer all Questions

(Cognitive Level: Remember/Understand)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
1.	Define an anti-symmetric relation.	Remember	CO4
2.	A matrix $A$ is said to be non singular if..	Remember	CO1
3.	The determinant of the matrix $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ is	Understand	CO1
4.	A homogeneous linear system of $n$ equations with $n$ unknowns has a unique solution if..	Understand	CO2
5.	The linear congruence $ax \equiv b \pmod{m}$ has a unique solution if and only if	Remember	CO3
6.	The sum, $\sum_{i=1}^n (2i - 1)$ is	Remember	CO3

**Part B. 10 Marks.** Time:20 Minutes  
Two-Three sentences. 2 Marks Each. Answer all Questions  
(Cognitive Level: Remember/Understand/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
7.	Define one-to-one function. Give an example.	Remember	CO4
8.	Show that for any square matrix $A$ , $\frac{1}{2}(A+A^t)$ is always symmetric, where $A^t$ is the transpose of $A$ .	Remember	CO1
9.	Express (28, 12) as a linear combination of 28 and 12.	Remember	CO3
10.	Find $gcd$ of 120 and 28.	Understand	CO3
11.	State Rouché's theorem. Give an example of a system of equations which is inconsistent.	Apply	CO2

**Part C. 16 Marks.** Time:35 Minutes

Short-Answer. 4 Marks Each. Answer all Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
12.	<p>A.) Show that the relation <math>\equiv</math> is an equivalence relation in the set of all integers.</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Define congruence relation. The equivalence relation <math>\equiv</math> on the set of integers defined by <math>xRy</math> if <math>x \equiv y \pmod{4}</math>. Find all equivalence classes under this relation.</p>	Understand	CO4
13.	<p>A.) If <math>\begin{vmatrix} a &amp; a^2 &amp; a^3 - 1 \\ b &amp; b^2 &amp; b^3 - 1 \\ c &amp; c^2 &amp; c^3 - 1 \end{vmatrix} = 0</math>, in which <math>a, b, c</math> are different, show that <math>abc = 1</math>.</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Express <math>\begin{bmatrix} 3 &amp; 5 &amp; -7 \\ -8 &amp; 11 &amp; 4 \\ 13 &amp; -14 &amp; 6 \end{bmatrix}</math> as the sum of a lower triangular matrix with zero leading diagonal and an upper triangular matrix.</p>	Apply	CO1

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
14.	<p>A.) For what value of <math>\lambda</math>, the system of equation</p> $2x + 3y + 5z = 9, 7x + 3y - 2z = 8, 2x + 3y + \lambda z = 1$ <p>has unique solution?</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Find the values of <math>k</math> for which the system of equations</p> $\begin{aligned}(3k - 8)x + 3y + 3z &= 0 \\ 3x + (3k - 8)y + 3z &= 0 \\ 3x + 3y + (3k - 8)z &= 0.\end{aligned}$ <p>has a non-trivial solution.</p>	Analyse	CO2
15.	<p>A.) Find the remainder when <math>3^{181}</math> is divided by 17.</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Using canonical decomposition of 1050 and 2574, find their <i>lcm</i>.</p>	Understand	CO3

**Part D. 24 Marks. Time:60 Minutes**

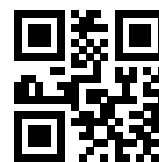
Long-Answer. 6 Marks Each. Answer all 4 Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/ Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
16.	<p>A) Find the number of positive integers in the range 1976 through 3776 that are; (i.) Divisible by 13 or 15. (ii.) Not divisible by 15 or 17.</p> <p style="text-align: center;"><b>OR</b></p> <p>B) Using Euclidean algorithm find <math>(4076, 1024)</math> and express <math>(4076, 1024)</math> as a linear combination of 4076 and 1024.</p>	Understand	CO3

17.	<p>A.) Find the values of <math>a</math> and <math>b</math> for which the equations</p> $x + ay + z = 3, x + 2y + 2z = b, x + 5y + 3z = 9$ <p>are consistent. When these equations have a unique solution?</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Test the consistency and if possible solve</p> $\begin{aligned} 4x + 2y + z + 3w &= 0 \\ 6x + 3y + 4z + 7w &= 0 \\ 2x + y + w &= 0. \end{aligned}$	Understand	CO2
18.	<p>A.) Determine the values of <math>p</math> such that the rank of the matrix</p> $\begin{bmatrix} 1 & 1 & -1 & 0 \\ 4 & 4 & -3 & 1 \\ p & 2 & 2 & 2 \\ 9 & 9 & p & 3 \end{bmatrix}$ <p>is 3.</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Using Gauss-Jordan method find the inverse of the matrix</p> $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}.$	Analyse	CO1
19.	<p>A.) Let the functions <math>f</math> and <math>g</math> defined by <math>f(x) = 2x + 1</math> and <math>g(x) = x^2 - 2</math>. Find <math>f \circ f</math>, <math>f \circ g</math>, and <math>g \circ f</math>.</p> <p style="text-align: center;"><b>OR</b></p> <p>B.) Define partial ordering. What is the difference between an equivalence relation and a partial ordering. Show that the relation <math>\leq</math> on the set of all real numbers is a partial ordering.</p>	Apply	CO4

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# University of Kerala

First Semester Degree Examination, November 2024

Four Year Undergraduate Programme

Discipline Specific Course

## Mathematics

UK1DSCMAT101, Differential Calculus and Linear Algebra

Academic Level: 100-199

Time: 2 hours

Max. Marks: 56

Part A. 6 Marks. Time: 5 Minutes

Objective Type. 1 Mark Each. Answer all Questions

(Cognitive Level: Remember/Understand)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
1.	What is the average velocity of the particle over a time interval $[t_0, t_0 + h]$ , $h > 0$ ?	Remember	CO2
2.	Define a concave up function on an open interval?	Remember	CO2
3.	What is critical point of a function?	Understand	CO1
4.	Find the rank of the matrix $\begin{bmatrix} 4 & -2 & 2 \\ -2 & 1 & -1 \\ 2 & -1 & 1 \end{bmatrix}$ .	Understand	CO3
5.	State the condition for a linear system $AX = B$ of $m$ equations in $n$ unknowns have unique solution.	Remember	CO3
6.	If 2, 5 and 7 are the eigenvalues of a $3 \times 3$ matrix $A$ , then what the eigenvalues of $A^T$ .	Remember	CO3

**Part B. 10 Marks.** Time:20 Minutes  
Two-Three sentences. 2 Marks Each. Answer all Questions  
(Cognitive Level: Remember/Understand/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
7.	Suppose $f$ is concave down on an open interval, what about $-f$ ? Justify your answer.	Remember	CO1
8.	Prove that $f(x) = x^3$ has a point of inflection at $x = 0$ .	Understand	CO2
9.	Prove that the function $f(x) = x^2 - 4x + 3$ is concave up on the interval $(-\infty, \infty)$	Understand	CO2
10.	Do the equations $3x + 2y = 0, 6x + 4y = 0$ have a non-trivial solution? Why?	Understand	CO3
11.	Find the eigenvalues of the matrix $A = \begin{bmatrix} 1 & 6 \\ 5 & 2 \end{bmatrix}$ .	Understand	CO3

**Part C. 16 Marks.** Time:35 Minutes  
Short-Answer. 4 Marks Each. Answer all Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
12.	A) Prove that $f(x) =  x $ is not differentiable at $x = 0$ . <b>OR</b> B) If a function $f(x)$ is differentiable at $x = a$ , then prove that $f(x)$ is continuous at $x = a$ .	Understand	CO1
13.	A) Find the intervals on which $f(x) = x^2 - 6x + 5$ is increasing and the intervals on which it is decreasing. <b>OR</b> B) A garden is to be laid out in a rectangular area and protected by a chicken wire fence. What is the largest possible area of the garden if only 100 running feet of chicken wire is available for the fence?	Apply	CO2

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
14.	<p>A) Solve the system of equations using Gauss elimination method</p> $x + y + z = 6,$ $x + 2y - 3z = -4,$ $-x - 4y + 9z = 18$ <p style="text-align: center;"><b>OR</b></p> <p>B) Using Cramer's Rule, solve the system of equations</p> $x + y + z = 6,$ $y + 3z = 11,$ $x - 2y + z = 0$	Apply	CO3
15.	<p>A) Find the eigenvalues and eigenvectors of the matrix <math>A = \begin{bmatrix} 1 &amp; 2 \\ 2 &amp; 1 \end{bmatrix}</math></p> <p style="text-align: center;"><b>OR</b></p> <p>B) Examine whether the matrix <math>A = \begin{bmatrix} 1 &amp; -3 &amp; 3 \\ 0 &amp; -5 &amp; 6 \\ 0 &amp; -3 &amp; 4 \end{bmatrix}</math> is diagonalizable.</p>	Apply	CO3

**Part D. 24 Marks.** Time:60 Minutes

Long-Answer. 6 Marks Each. Answer all 4 Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/ Apply)

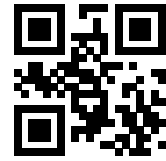
Qn. No.	Question	Cognitive Level	Course Outcome (CO)
16.	<p>A) Find the absolute maximum and minimum values of the function <math>f(x) = 2x^3 - 15x^2 + 36x</math> on the interval <math>[1, 5]</math>, and determine where these values occur.</p> <p style="text-align: center;"><b>OR</b></p> <p>B) Find the radius and height of the right circular cylinder of largest volume that can be inscribed in a right circular cone with radius 6 inch and height 10 inches.</p>	Apply	CO3

17.	<p>A) Prove that <math>f(x) = \ln(x)</math> is differentiable for <math>x &gt; 0</math>, using definition of derivative.</p> <p style="text-align: center;"><b>OR</b></p> <p>B) If <math>4x^2 - 2y^2 = 9</math>, using implicit differentiation method, find <math>\frac{d^2y}{dx^2}</math>.</p>	Apply	CO2
18.	<p>A) Show that the equations</p> $x + 2y + z = 3,$ $2x + 3y + 2z = 5,$ $3x - 5y + 5z = 2$ <p>are consistent and solve the same.</p> <p style="text-align: center;"><b>OR</b></p> <p>B) Find the values of <math>\lambda</math> for which the system of equations</p> $x + y + z = 1,$ $x + 2y + 4z = \lambda,$ $x + 4y + 10z = \lambda^2$ <p>will be consistent.</p>	Apply	CO3
19.	<p>A) Find the eigenvalues and eigenvectors of the matrix <math>A = \begin{bmatrix} -2 &amp; 2 &amp; -3 \\ 2 &amp; 1 &amp; -6 \\ -1 &amp; -2 &amp; 0 \end{bmatrix}</math>.</p> <p style="text-align: center;"><b>OR</b></p> <p>B) Find the matrix that diagonalize the matrix <math>A = \begin{bmatrix} 1 &amp; -3 &amp; 3 \\ 3 &amp; -5 &amp; 3 \\ 6 &amp; -6 &amp; 4 \end{bmatrix}</math>.</p>	Apply	CO3



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U8351



# University of Kerala

First Semester Degree Examination, November 2024

Four Year Undergraduate Programme

Discipline Specific Course

## Mathematics

UK1DSCMAT102, Differentiation, Sequences and Series

Academic Level: 100-199

Time: 2 hours

Max. Marks: 56

**Part A. 6 Marks.** Time:5 Minutes

Objective Type. 1 Mark Each. Answer all Questions

(Cognitive Level: Remember/Understand)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
1.	The value of $\lim_{x \rightarrow 0} \frac{\sin x}{x}$ is a) 0   b) -1   c) 1   d) $\infty$	Remember	CO1
2.	If $y = f(x)$ , define the average rate of change of $y$ with respect to $x$ over the interval $[x_0, x_1]$ .	Remember	CO2
3.	Find $\frac{d}{dx}[\ln x]$ .	Understand	CO1
4.	Find the values of $x$ at which $f(x) = \frac{x+2}{x^2-4}$ is not continuous.	Understand	CO1
5.	What is harmonic series?	Remember	CO3
6.	When do we say a series $\sum_{k=1}^{\infty} u_k$ converge absolutely?	Remember	CO3

**Part B. 10 Marks.** Time:20 Minutes

Two-Three sentences. 2 Marks Each. Answer all Questions

(Cognitive Level: Remember/Understand/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
7.	Define continuity of a function $y = f(x)$ at a point $x = c$ .	Remember	CO1
8.	Define chain rule for differentiation	Remember	CO1
9.	Define Taylor series for a function $f(x)$ about $x = x_0$ and Maclaurin series for $f(x)$	Remember	CO3
10.	Find $\frac{d}{dx}$ of $y = \cos(x^3)$ .	Understand	CO2
11.	Use ratio of successive terms to show that the sequence $\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \dots, \frac{n}{n+1}, \dots$ is strictly increasing.	Apply	CO3

**Part C. 16 Marks.** Time:35 Minutes

Short-Answer. 4 Marks Each. Answer all Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
12.	A. Find $\frac{d}{dx} [\sin(\sqrt{1 + \cos x})]$ . <b>OR</b> B. Find the slopes of the tangent lines to the curve $y^2 - x + 1 = 0$ at the points $(2, -1)$ and $(2, 1)$ .	Understand	CO2
13.	A. Consider the function $f(x) =  9 - x^2 $ . Show that $f$ is not differentiable at $x = -3$ and $x = 3$ . <b>OR</b> B. Evaluate $\lim_{x \rightarrow 0^+} \left( \frac{1}{x} - \frac{1}{\sin x} \right)$ .	Understand	CO1
14.	A. Determine whether the series $\sum_{k=1}^{\infty} \frac{1}{\sqrt{n^3 + 5}}$ converges or diverges. <b>OR</b> B. Determine whether the series $\sum_{k=1}^{\infty} \frac{1}{\sqrt{k-1}}$ converge or diverge.	Analyse	CO3
15.	A. Determine whether the $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{k+3}{k(k+1)}$ converges. <b>OR</b> B. Find the Maclaurin polynomials $p_0, p_1, p_2$ for $e^x$	Apply	CO3

**Part D. 24 Marks. Time:60 Minutes**

Long-Answer. 6 Marks Each. Answer all 4 Questions, choosing among options within each question.  
(Cognitive Level: Understand/Analyse/ Apply)

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
16.	<p>A) Find</p> <p>(i) <math>\frac{d}{dx}[(1 + x^5 \cot x)^{-8}]</math></p> <p>(ii) <math>\frac{d}{dx}[\sin(\sqrt{1 + \cos x})]</math>.</p> <p><b>OR</b></p> <p>B) Find</p> <p>(i) <math>\lim_{x \rightarrow \infty} \frac{(\sqrt{x^6 + 5} - x^3)}{x^3}</math></p> <p>(ii) <math>\lim_{x \rightarrow \infty} \frac{\sqrt{x^2 + 2}}{3x - 6}</math>.</p>	Understand	CO1
17.	<p>A) Determine whether the series <math>\sum_{k=1}^{\infty} \frac{1}{k(k+1)}</math> converges or diverges. If it converges, find the sum.</p> <p><b>OR</b></p> <p>B) Check the convergence of the sequence <math>\left\{ \frac{10^n}{n!} \right\}_{n=1}^{\infty}</math>.</p>	Understand	CO1
18.	<p>A) During the first 40 s of a rocket flight, the rocket is propelled straight up so that in <math>t</math> seconds it reaches a height of <math>s = 0.3t^3</math> ft.</p> <p>(a) How high does the rocket travel in 40 s?</p> <p>(b) What is the average velocity of the rocket during the first 40 s?</p> <p>(c) What is the instantaneous velocity of the rocket at the end of 40 s?</p> <p><b>OR</b></p> <p>B) At what point in the first quadrant is the tangent line to the Folium of Descartes <math>x^3 + y^3 = 3xy</math> horizontal?</p>	Analyse	CO3
19.	<p>A) Find the <math>n^{\text{th}}</math> Maclaurin polynomial for <math>\sin x</math></p> <p><b>OR</b></p> <p>B) Use an <math>n^{\text{th}}</math> Maclaurin polynomial for <math>e^x</math> to approximate <math>e</math> to five decimal-place accuracy.</p>	Apply	CO2



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Reg. No.: .....

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**University of Kerala**

First Semester Degree Examination, November 2024

Four Year Under Graduate Programme

Discipline Specific Core Course

MATHEMATICS

**UKIDSCMAT109- MATHEMATICS FOR SOCIAL SCIENCE I**

Academic Level: 100-199

Time: 2 Hours

Max. Marks: 56

**Part A.****Answer All Questions, Objective Type. 1 Mark Each.****(Cognitive Level: Remember/Understand) 6 Marks. Time: 5 Minutes**

<b>Qn. No.</b>	<b>Question</b>	<b>Cognitive Level</b>	<b>Course Outcome (CO)</b>
1.	Express the set of all odd integers in rule method.	Remember	CO1
2.	Define the complement of set A in universal set U	Remember	CO1
3.	Find the value of x in $2x+5=11$	Understand	CO2
4.	Find the solution of $x^2+2x+1=0$	Understand	CO2
5.	Which of the following is an objective function in LLP (a) Maximize profit (b) Minimize cost (c) Both a and b (d) Neither a nor b	Remember	CO3
6.	Which of the following is an example of a decision variable? (a) x (b) 2 (c) 3y (d) Max Z	Remember	CO3

**Part B.****Answer All Questions, Two-Three sentences. 2 Marks Each.****(Cognitive Level: Remember/Understand/Apply) 10 Marks. Time: 20 Minutes**

<b>Qn. No.</b>	<b>Question</b>	<b>Cognitive Level</b>	<b>Course Outcome (CO)</b>
7.	Find the power set of $A = \{1,2,3\}$	Remember	CO1
8.	Find the cartesian product of $A \times B$ and $B \times A$ if $A = \{1,2\}$ , $B = \{1,2,3\}$	Remember	CO1
9.	What do you mean by multiple optimal solution	Remember	CO3
10.	What are decision variables in LPP	Understand	CO3
11.	Solve $13x - 4(5x - 8) + 17 = 0$	Apply	CO2

**Part C.****Answer all 4 questions, choosing among options within each question.****Short Answer. 4 Marks Each.****(Cognitive Level: Remember/Understand/Apply/Analyse) 16 Marks. Time: 35 Minutes**

<b>Qn.No.</b>	<b>Question</b>	<b>Cognitive Level</b>	<b>Course Outcome (CO)</b>
12.	<p><b>A.</b> If <math>A = \{a,b,c\}</math>, <math>B = \{1,2,3\}</math> and <math>C = \{e,f\}</math> Find <math>A-B</math>, <math>B-C</math> and <math>A-C</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> <math>A = \{a, e, i, o, u, z\}</math>, <math>B = \{i, u, x, y\}</math>. <math>\Omega =</math> Set of all lower case alphabets. Find <math>A \cup B, A \cap B, A^c \cup B^c, A^c \cap B^c</math>.</p>	Understand	CO1
13.	<p><b>A.</b> Explain feasible and Basic feasible solution of an LPP with a proper example</p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Define slack variables. Explain the use of slack variables in an LPP.</p>	Understand	CO3
14.	<p><b>A.</b> Solve <math>x^2 - 16x + 48 = 0</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Solve <math>x^2 - 24x + 144 = 0</math></p>	Analyze	CO2
15.	<p><b>A.</b> Plot the total revenue function <math>TR = x(10 - 2x)^2</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> What are the key concepts in TR function?</p>	Apply	CO4

**Part D.****Answer all 4 questions, choosing among options within each question.****Long Answer. 6 Marks Each.****(Cognitive Level: Remember/Understand/Apply/Analyse) 24 Marks. Time: 60 Minutes**

Qn.No.	Question	Cognitive Level	Course Outcome (CO)
16.	<p><b>A.</b> Let <math>A = \{0,1,2,3\}</math>. For <math>x \in A, y \in A</math>, find the relation (i) <math>y &lt; x</math> (ii) <math>x = y</math>, (iii) <math>x = 2y</math>. Also find the domain and range of each relation.</p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Let <math>A = \{1,2,3\}</math>, <math>B = \{2,3,4\}</math>, <math>C = \{5,6,7\}</math> and <math>D = \{6,7,8\}</math>. Verify that <math>(A \cap B) \times (C \cap D) = (A \times C) \cap (B \times D)</math> holds.</p>	Understand	CO1
17.	<p><b>A.</b> Solve the system of equations;  <math>2.5x + 1.8y = 7.2</math>  <math>1.2x - 0.8y = 2.4</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Solve the system of equations;  <math>14x - 81y = 9</math>  <math>91x - 15y = 31</math></p>	Understand	CO2
18.	<p><b>A.</b> Solve the LPP using graphical method:  Maximize <math>z = 2x + 5y</math>  Subject to  <math>x + 4y \leq 24</math>  <math>3x + y \leq 21</math>  <math>x + y \leq 9</math>  <math>x, y \geq 0</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Solve the LPP  Maximize <math>f = 3x_1 + 4x_2</math>  Subject to  <math>x_1 + x_2 \leq 6</math>;  <math>2x_1 + 4x_2 \leq 21</math>  <math>x_1 + 4x_2 \leq 6</math>  <math>x_1, x_2 \geq 0</math></p>	Analyse	CO3
19.	<p><b>A.</b> Compare the form of demand curves and total revenue curves described from the following case  <math>p = (3-x)</math> and <math>p = (4-x^2)</math></p> <p style="text-align: center;"><b>OR</b></p> <p><b>B.</b> Discuss and trace the demand curves  1. <math>p = 20 - x</math>  2. <math>p = 10 - x^2</math></p>	Apply	CO4



Reg. No.: .....

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**University of Kerala**  
First Semester Degree Examination, November 2024  
Four Year Under Graduate Programme  
Discipline Specific Core Course  
**MATHEMATICS**  
**UK1DSCMAT110 - MATRICES AND LINEAR EQUATIONS**  
Academic Level: 100-199

**Time:2 Hours**

**Max.Marks:56**

**Part A.**

Answer All Questions, Objective Type. 1 Mark Each.

(Cognitive Level: Remember/Understand)

**6 Marks. Time: 5 Minutes**

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
1.	Define a symmetric matrix.	Remember	CO2
2.	When do we say that a square matrix A is singular?	Remember	CO1
3.	If the order of A is 3 X 2 and order of B is 5 X 2, then what is the order of $AB^T$ ?	Understand	CO1
4.	If A is an n X n matrix and k is any scalar then $\det(kA)=\dots\dots\dots$	Understand	CO3
5.	Define norm of a vector in $R^n$ .	Remember	CO4
6.	When do we say that two vectors $\vec{u}$ and $\vec{v}$ are orthogonal ?	Remember	CO4

**Part B.**

Answer All Questions , Two-Three sentences. 2 Marks Each.

(Cognitive Level: Remember/Understand/Apply)

**10 Marks. Time: 20 Minutes**

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
7.	If $A = \begin{bmatrix} 3 & 0 & 1 \\ -2 & 1 & 0 \end{bmatrix}$ , $B = \begin{bmatrix} -1 & 0 \\ 0 & 1 \\ 1 & 2 \end{bmatrix}$ , then show that $AB \neq BA$ .	Remember	CO1
8.	If $A = \begin{bmatrix} 3 & 1 \\ 1 & 4 \end{bmatrix}$ , find $A^{-1}$ .	Remember	CO2

9.	Express the matrix equation as a system of linear equations $\begin{bmatrix} 2 & -1 & 6 \\ 1 & 4 & 5 \\ 7 & 3 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} -1 \\ 6 \\ 0 \end{bmatrix}$	Remember	CO2
10.	Verify that $\det(A) = \det(A^T)$ , where $A = \begin{bmatrix} -2 & 3 \\ 1 & 4 \end{bmatrix}$ .	Understand	CO3
11.	Find the distance between $\vec{u} = (1, 3, -2, 7) \wedge \vec{v} = (0, 7, 2, 2)$ .	Apply	CO4

### Part C.

Answer all 4 questions, choosing among options within each question.

Short Answer. 4 Marks Each.

(Cognitive Level: Remember/Understand/Apply/Analyse) 16 Marks. Time: 35 Minutes

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
12.	A. Find the value of $a, b, c, d$ , given that $\begin{bmatrix} a-b & b+a \\ 3d+c & 2d-c \end{bmatrix} = \begin{bmatrix} 8 & 1 \\ 7 & 6 \end{bmatrix}$ OR B. If A is invertible symmetric matrix, then prove that $A^{-1}$ is symmetric.	Understand	CO1 & CO2
13.	A. If $A = \begin{bmatrix} 2 & 4 \\ -1 & 3 \end{bmatrix}, B = \begin{bmatrix} -1 & 0 \\ 1 & 4 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 \\ -1 & 6 \end{bmatrix}$ , show that $A(BC) = (AB)C$ . OR B. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ , find $A^2 - 3A + 2I$	Understand	CO1 & CO 2
14.	A. Find the value of k for which the matrix $A = \begin{bmatrix} 1 & 2 & 0 \\ k & 1 & k \\ 0 & 2 & 1 \end{bmatrix}$ is singular. OR B. If $\vec{u}$ and $\vec{v}$ are vectors in $R^n$ , prove that $\ u + v\  \leq \ u\  + \ v\ $	Analyse	CO3 & CO4
15.	A. Let $\vec{u} = (2, -1, 3)$ and $\vec{a} = (4, -1, 2)$ . Find the vector component of $\vec{u}$ along $\vec{a}$ and the vector component of $\vec{u}$ orthogonal to $\vec{a}$ . OR B. Find the area of the triangle determined by the points $P_1 = (2, 2, 0), P_2 = (-1, 0, 2) \wedge P_3 = (0, 4, 3)$ .	Apply	CO 4



**Part D.**  
**Answer all 4 questions, choosing among options within each question. Long Answer. 6 Marks Each.**  
**(Cognitive Level: Understand/Apply/Analyse/Evaluate/Create)**  
**24 Marks. Time: 60 Minutes**

Qn. No.	Question	Cognitive Level	Course Outcome (CO)
16.	<p>A. If <math>A = \begin{bmatrix} 2 &amp; -3 \\ 1 &amp; 5 \end{bmatrix}</math>, <math>B = \begin{bmatrix} -4 &amp; 0 \\ 1 &amp; 6 \end{bmatrix}</math>, show that <math>(A + B)(A - B) \neq A^2 - B^2</math>.</p> <p style="text-align: center;">OR</p> <p>B. Using Gauss Jordan Method, solve <math>x + y + 2z = 4, 2x - y + z = 2, x - 2y + 2z = 1</math></p>	Understand	CO1
17.	<p>A. If <math>A = \begin{bmatrix} 1 &amp; 2 &amp; 0 \\ -1 &amp; 6 &amp; 5 \end{bmatrix}</math>, <math>B = \begin{bmatrix} 0 &amp; 3 \\ 1 &amp; 1 \\ -1 &amp; 1 \end{bmatrix}</math>. Show that <math>(AB)^T = B^T A^T</math></p> <p style="text-align: center;">OR</p> <p>B. Express <math>A = \begin{bmatrix} 2 &amp; 4 &amp; 9 \\ 1 &amp; 3 &amp; 0 \\ 2 &amp; 1 &amp; 5 \end{bmatrix}</math> as a sum of a symmetric and a skew symmetric matrix.</p>	Understand	CO 2
18.	<p>A. Find the inverse of the matrix <math>A = \begin{bmatrix} 3 &amp; 2 &amp; -1 \\ 1 &amp; 6 &amp; 3 \\ 2 &amp; -4 &amp; 0 \end{bmatrix}</math>.</p> <p style="text-align: center;">OR</p> <p>B. Using Cramer's rule, solve</p> $\begin{aligned} x_1 + 2x_3 &= 6 \\ -3x_1 + 4x_2 + 6x_3 &= 30 \\ -x_1 - 2x_2 + 3x_3 &= 8 \end{aligned}$	Analyse	CO4
19.	<p>A. Find the distance between the point <math>(1, -4, -3)</math> and the plane <math>2x - 3y + 6z = -1</math>.</p> <p style="text-align: center;">OR</p> <p>B. Find the distance between the planes <math>x + 2y - 2z = 3</math> and <math>2x + 4y - 4z = 7</math>.</p>	Apply	CO4