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Reg.No :

Name :

MAHATMA GANDHI UNIVERSITY, KOTTAYAM
MGU-UGP (HONOURS) REGULAR/IMPROVEMENT/REAPPEARANCE
EXAMINATION APRIL 2026
SECOND SEMESTER

Discipline Specific Core Course (DSC) - MG2DSCMAT100 - A GATEWAY TO
MATHEMATICS
(2024 ADMISSION ONWARDS)

Duration: 2 Hours

Maximum Marks: 70

Remember(K), Understand(U), Apply(A), Analyse(An), Evaluate(E), Create(C), Skill(S), Interest(I) and Appreciation(Ap)

Students should attempt at least one question from each course outcome to enhance their overall outcome attainability.

Part A

Short answer type Questions

Answer any **5** questions

Each question carries **2** marks

1. Find $\frac{dy}{dx}$ if $4x^3 + 5x + 6y = 0$. [U] / [CO1]
2. For efficient shipping, a company limits the combined length and girth (perimeter of a cross-section) of rectangular boxes to 108 inches. Create a function that calculates the box's volume [U] / [CO1] based on two of its dimensions, that is, as a function of two variables.
3. Find $\frac{d}{dx} \left[\int_1^x (3t^2 - 3) dt \right]$. [A] / [CO2]
4. Check whether the value of the integral $\int_{-1}^0 x dx$ is positive or negative. [A] / [CO2]
5.
$$\begin{aligned} x + y + z &= 9 \\ y + 3z &= 18 \\ 4z &= 20 \end{aligned}$$
 Solve the linear system: [A] / [CO3]
6. Solve the given system using the Gauss elimination method:
$$\begin{aligned} x + 2y &= 6 \\ 2x - y &= 2 \end{aligned}$$
 [A] / [CO3]
7. Draw the graph whose incidence matrix is
$$\begin{bmatrix} 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$$
. [A] / [CO4]

8. Draw the cycle graph C_6 .

[U] /

[CO4]

[2x5 = 10]

Part B

Short Essay Type Questions

Answer any 5 questions

Each question carries 6 marks

9. Find the critical points of the function $f(x, y) = x^2 - y^2 - 2x + 4y + 6$ and distinguish the points which are local extreme values or saddle points. [U] / [CO1]

10. Determine $\frac{\partial z}{\partial u}$ at $(1, \frac{\pi}{4})$ where $z = 4e^x \ln y$, $x = \ln(u \cos v)$, $y = u$ by the chain rule. [U] / [CO1]

11. Evaluate $\int_1^5 \int_2^4 (3x^2 - 2xy + y^2) dx dy$. [A] / [CO2]

12. (a) Define Riemann integral and use the given values of $a = -1$ and $b = 2$ express the following limit as integral $\lim_{\max \Delta x_k \rightarrow 0} \sum_{k=1}^n (x_k^*)^2 \Delta x_k$. [A] / [CO2]

(b) Interval $[1, 8]$ is divided into five subintervals in which

$x_0 = 1; x_1 = 3.5; x_2 = 4.5; x_3 = 6.5; x_4 = 7; x_5 = 8$. Find the mesh size of this partition.

13. Solve by the Gauss elimination method: $x + 2y - z = 1$. [A] /

$3x + 6y - 3z = 5$ [CO3]

$2x + 4y - 2z = 2$

14. Find the coefficient matrix and augmented matrix of the following system of equations: [A] /

$$x - 2y = 4$$

[CO3]

$$5x + 3y = -2.$$

15. Draw any three subgraphs of the graph K_5 that are regular of degree 2. [U] / [CO4]

16. Draw any three 2-regular graphs. [U] / [CO4]

[6x5 = 30]

Part C

Essay Type Questions

Answer any 3 questions

Each question carries 10 marks

17. Find all the second-order partial derivatives of the function $f(x, y) = \log(x + y)$. [U] / [CO1]

18. Use a double integral to find the volume [A] /

(a) The volume under the plane $z = 2x + y$ and over the rectangle [CO2]

$$R = \{(x, y) : 3 \leq x \leq 5, 1 \leq y \leq 2\}.$$

(b) Volume of the solid enclosed by the surface $z = x^2$ and the planes

$$x = 0, x = 2, y = 3, y = 0, \text{ and } z = 0.$$

19. (a) State the Fundamental Theorem of Calculus, Part 1. [A] /
 (b) Using the Fundamental Theorem of calculus, find $\int_1^4 \left(\frac{1}{\sqrt{t}} - 3\sqrt{t} \right) dt$. [CO2]
20. (a) Explain the Gauss elimination method. [A] /
 (b) Solve the linear system of equations using the Gauss elimination method [CO3]
 $x - 2y + 2z = 8$.
 $x - 2y - 2z = 9$
 $2x + y + 3z = 1$
21. (a) Define the degree sequence of a graph. Write the degree sequence of the path graph P_5 . [U] /
 (b) State the handshaking lemma. [CO4]
22. (a) Sketch a non-simple graph with vertex set [U] /
 $V = \{J, K, L, M, N, O, P, Q, R, S, T, U, V\}$ and edge set [CO4]
 $E = \{JJ, KK, LL, MM, NO, OP, PQ, QR, RS, ST, TU, UV, VJ, JM, KN, LO\}$
 (b) List all loops that exist in the graph.

[10x3 = 30]