JAIN COLLEGE V V Puram	Course:	II year PUC
II PUC Mock Paper I - 2025	**Subject:**	Mathematics
	Max. Marks:	80
	Duration:	3 hours

Instructions:

1. The question paper has five parts namely A, B, C, D and E. Answer all the parts.
2. Part A has 15 Multiple Choice Questions, 5 Fill in the blanks
3. Part A should be answered continuously at one or two pages of Answer sheets and only first answer is considered for the marks in subsection I and II of Part A.
4. Use the graph sheet for the question on linear programming on PART E.

PART A

I. Answer ALL the multiple-choice questions **$15 \times 1 = 15$**

1. The relation R in the set $A = \{1,2,3\}$ given by $R = \{(1,2)\}$ is
   (a) Symmetric (b) Transitive (c) Reflexive (d) equivalence

2. Match the following:

A	B
a) Range of $cos^{-1} x$	i. $(0, \pi)$
b) Range of $cot^{-1} x$	ii. $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$-$\{0\}$
c) Range of $cosec^{-1} x$	iii. $[0, \pi]$

   (a) a) -i b)-iii c)-ii (b) a) -iii b) i c)-ii (c) a) -ii b)-iii c)-i (d) a) -iii b)-ii c)-i

3. $\sin(\tan^{-1} x), |x| < 1$ is equal to
   (a) $\frac{\sqrt{1-x^2}}{x}$ (b) $\frac{x}{\sqrt{1-x^2}}$ (c) $\frac{1}{1+x^2}$ (d) $\frac{x}{\sqrt{1+x^2}}$

4. If a matrix has 8 elements, then the total number of the possible different order matrices are
   (a) 8 (b) 4 (c) 6 (d) 2

5. If A is a non-singular matrix of order 3, then | adj A| =
   (a) $|A|$ (b) $|A|^2$ (c) $|A|^3$ (d) $3|A|$

6. The greatest integer function $f(x) = [x]$,is
   (a) Continuous but not differentiable at $x = 1$ (b) Continuous and differentiable at $x = 1$
   (c) Discontinuous but differentiable at $x = 1$ (d) Discontinuous but not differentiable at $x = 1$

7. $y = \log_7(\log x)$ then $\frac{dy}{dx} =$

(a) $\frac{1}{x\log_7 \log x}$ (b) $\frac{1}{x\log x}$ (c) $\frac{\log 7}{x\log x}$ (d) $\frac{\log 7}{x}$

8. The point of inflection of the function $y = x^3$ is

(a) (2, 8) (b) (0, 0) (c) (1, 1) (d) (-3.-27)

9. If $f(x) = \int_0^x t\sin t \, dt$ then $f^{'}(x)$ is

(a) $\cos x + x\sin x$ (b) $x\sin x$ (c) $x\cos x$ (d) $x\cos x + \sin x$

10. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$ is

(a) 3 (b)2 (c) 1 (d) not defined

11. Assertion (A): The two vectors $\vec{a} = 4i + 4j - 2k$ and $\vec{b} = 4i - 2j + 4k$ are perpendicular vectors.

Reason (B): If two vectors $\vec{a}$ and $\vec{b}$ are perpendicular, then $|\vec{a}| = |\vec{b}|$

(a) (A) is false but (B) is true (b) (A) is true and (B) is true

(c) (A) is true but (B) is false (d) (A) is false and (B) is false

12. If $\vec{a}$ and $\vec{b}$ are unit vectors, such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$, then the angle between the vectors $\vec{a}$ and $\vec{b}$ is

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) π (d) $\frac{\pi}{3}$

13. If a line has a direction ratio 2,-1,-2 then its direction cosines are

(a) $\frac{2}{3}, \frac{-1}{3}, \frac{-2}{3}$ (b) $\frac{2}{3}, \frac{1}{3}, \frac{-2}{3}$ (c) $\frac{2}{3}, \frac{-1}{3}, \frac{2}{3}$ (d) $\frac{-2}{3}, \frac{1}{3}, \frac{2}{3}$

14. If $P(A) = 0.4, P(B) = 0.5$ and $P(A \cap B) = 0.25$ then $P\left(\frac{A^{'}}{B}\right) =$

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{5}{8}$ (d) $\frac{3}{4}$

15. Three cards are drawn successively, without replacement from a pack of 52 cards, the probability that two cards are kings and the third card drawn is an ace is

(a) $\frac{2}{5525}$ (b) $\frac{6}{5525}$ (c) $\frac{2}{1105}$ (d) $\frac{4}{1105}$

II. Fill in the blanks by choosing appropriate answer from those given in the bracket 5 ×1 = 5

$\left[\frac{3}{11}, 3, \frac{-\pi}{2}, -6, 6, 5\right]$

16. The value of $tan^{-1}(\sqrt{3}) - cot^{-1}(-\sqrt{3})$ is ___________

17. The number of points at which $f(x) = [x]$ where $[x]$ is greatest integer function which is discontinuous in the interval (-2,2) is ____________

18. The value of $\int_0^4 |x - 1| dx$ is ______________

19. The value of λ for which the vectors $2i + 3j - 6k$ and $4i - \lambda j - 12k$ are collinear is ___________

20. If A, B, C are three mutually exclusive and exhaustive events of an experiment such that $P(A) = 2P(B) = 3P(C)$, then P(B) is equal to ________

PART – B

III. Answer any SIX questions **$6 \times 2 = 12$**

21. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, Find $A(adjA)$

22. Differentiate $(\log)^{\cos x}$ w.r.t x.

23. Find the rate of change of the area of a circle with respect to its radius 'r' when r = 3cm.

24. Find the local maximum value of the function $f(x) = x^2$

25. Evaluate $\int x \sin x dx$

26. Find the general solution of the differential equation $\frac{dy}{dx} + y = 1 (y \neq 1)$

27. Find the projection of the vector $\vec{a} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ on the vector $\vec{b} = \hat{i} + 2\hat{j} + 2\hat{k}$.

28. Find the equation of the line in vector and in cartesian form that passes through the point (1,2,3) and is parallel to the vector $3\hat{i} + 2\hat{j} - 2\hat{k}$

29. A coin is tossed three times. Consider the following events.
E: head on third toss, F: heads on first two tosses. Determine $P(E/F)$.

PART – C

V. Answer any SIX questions **$6 \times 3 = 18$**

30. Show that the relation R in the set R of real numbers, defined as R = { $(a, b): a \leq b^2$} is neither reflexive nor symmetric nor transitive.

31. Prove that $\cos^{-1}\left(\frac{12}{13}\right) + \sin^{-1}\left(\frac{3}{5}\right) = \sin^{-1}\left(\frac{56}{65}\right)$

32. Express the matrix $A = \begin{bmatrix} 1 & 5 \\ -1 & 2 \end{bmatrix}$ as the sum of symmetric and skew- symmetric matrix.

33. If $x = a\left(\cos t + \log\left(\tan\frac{t}{2}\right)\right)$, $y = a \sin t$, then prove that $\frac{dy}{dx} = \tan t$

34. Find the intervals in which the function f given by $f(x) = -2x^2 - 6x + 10$ is
(i) strictly increasing (ii) strictly decreasing

35. Find $\int \frac{5x}{(x+1)(x^2-4)} dx$

36. Find the area of the triangle with the vertices A(1,1,2), B(2,3,5) and C(1,5,5) by using vectors cross product.

37. Find shortest distance between the lines $\vec{r} = \hat{i} + 2\hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = 2\hat{i} - \hat{j} - \hat{k} + \mu\left(2\hat{i} + \hat{j} + 2\hat{k}\right)$

38. A man is known to speak truth 3 out of 4 times. He throws a die and reports that it is a six. Find the probability that it is actually a six.

PART - D

VI. Answer any FOUR questions **4 x 5 = 20**

39. State whether the function f: R → R defined by $f(x) = 3 - 4x$ is one-one or bijective. Justify your answer.

40. If A= $\begin{bmatrix} -2 \\ 4 \\ 5 \end{bmatrix}$ and $B = [1 \quad 3 \quad -6]$ verify that $(AB)' = B'A'$

41. Solve the following system of equations by matrix method:

$$x - y + z = 4 \ , \ 2x + y - 3z = 0 \quad \text{and} \quad x + y + z = 2$$

42. If $y = \sin^{-1}x$, then prove that $(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = 0$

43. Find the integral of $\frac{1}{\sqrt{x^2 - a^2}}$ with respect to x and hence evaluate $\int \frac{1}{\sqrt{9x^2 - 16}}dx$

44. Find the area of the region bounded by the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ using integration

45. Solve the differential equation $(x + 3y^2)\frac{dy}{dx} = y \ (y > 0)$

PART-E

VII. Answer the following questions

46. Prove that $\int_{-a}^{a} f(x)dx = \begin{cases} 2\int_0^a f(x)dx & , if\ f(x)\ is\ even \\ 0 & , if\ f(x)\ is\ odd \end{cases}$ and hence evaluate $\int_{-1}^{1} x^{17}\cos^4 x dx$

OR

Solve the following problem graphically: Maximize and minimize $z = 5x + 10y$

Subject to the constraints: $x + 2y \le 120,$

$x + y \ge 60$

$x - 2y \ge 0 \quad and \quad x \ge 0, y \ge 0$

(6)

47. Find the value of k, $f(x) = \begin{cases} \frac{k\cos x}{\pi - 2x} & if\ x \ne \frac{\pi}{2} \\ 3 & if\ x = \frac{\pi}{2} \end{cases}$ is continuous at $x = \frac{\pi}{2}$

OR

If A = $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ verify that $A^3 - 6A^2 + 9A - 4I = 0$ and hence find A^{-1}

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