MID-TERM EXAMINATION

Question Paper 2024-25

NCERT BASED SYLLABUS

FOR CBSE AND STATE BOARD
FOLLOWING NCERT

Mid Term Exam Question Paper 2024-25

SET – A

Name : .....

Roll No. : .....

Date : 21.09.2024

Class : XII

MIDTERM EXAMINATION 2024

SUBJECT : APPLIED MATHEMATICS

Time : 3 Hrs.

M.M. : 80

GENERAL INSTRUCTIONS

1. This Question paper contains – **five sections** A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. Section A has 18 MCQ's and 02 Assertion – Reason based questions of 1 mark each.
3. Section B has 5 Very Short Answer (VSA) – type questions of 2 marks each.
4. Section C has 6 Short Answer (SA) – type questions of 3 marks each.
5. Section D has 4 Long Answer (LA) – type questions of 5 marks each.
6. Section E has 3 source based/case based/passage based/integrated units of assessment of 4 marks each with sub-parts.

SECTION – A

(This section comprises of Multiple Choice Questions (MCQ) of 1 mark each)

1. (8×14) in 12 hour clock is
   (A) 4 O' clock (B) 8 O' clock (C) 6 O' clock (D) 2 O' clock

2. If $A^2 - A + I = 0$, then A^{-1} is equal to
   (A) $A + I$ (B) $A - I$ (C) $A + 2I$ (D) $I - A$

3. A die is rolled thrice. If the event of getting an even number is a success, then the probability of getting atleast two successes is
   (A) $\frac{7}{8}$ (B) $\frac{1}{2}$ (C) $\frac{2}{3}$ (D) $\frac{11}{2}$

4. If $y = \frac{e^x + e^{-x}}{e^x - e^{-x}}$ then $\frac{dy}{dx}$ is equal to
   (A) y^2 (B) $1 - y^2$ (C) $y^2 - 1$ (D) $1 + y^2$

5. The graph of the inequality $2x + 3y > 6$ is
   (A) half plane that contains the origin
   (B) half plane that neither contains origin nor the points of the line $2x + 3y = 6$
   (C) whole XOY-plane excluding the points on the line $2x + 3y = 6$
   (D) entire XOY plane.

6. A fire in a factory delaying production for some time is
   (A) long term trend (B) Cyclical trend (C) Seasonal trend (D) Irregular trend

7. For a random variable X, $E(X) = 3$ and $E(X^2) = 11$. Then variance of X is
   (A) 8 (B) 5 (C) 2 (D) 1

8. In what ratio must a grocer mix two varieties of pulses costing ₹ 85 per kg and ₹ 100 per kg respectively so as to get a mixture worth ₹ 92 per kg?
   (A) 7 : 8 (B) 8 : 7 (C) 5 : 7 (D) 7 : 5

9. If A is a non-singular matrix, then
   (A) $|A| \neq |A'|$ (B) $|A^{-1}| \neq |A|^{-1}$ (C) $|AA'| \neq |A^2|$ (D) $|A| + |A'| \neq 0$

10. The trend line equation $y = a + bx$, 'a' is the
    (A) mean of x (B) mean of y (C) slope (D) none of these.

11. Corner points of the feasible region determined by the system of linear constraints are (0,3), (1,1) and (3,0). Let $Z = px + qy$, where $p,q > 0$. Condition on p and q so that the minimum of Z occurs at (3,0) and (1,1) is
    (A) $p = 2q$ (B) $p = \frac{q}{2}$ (C) $p = 3q$ (D) $p = q$

12. The speed of a boat in still water is 500% more than the speed of the current. The respective ratio between the speed of the boat downstream and speed of the boat upstream is
    (A) 9: 2 (B) 7: 3 (C) 7 : 5 (D) 9 : 4.

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13. If $y = f(x^2)$ and $f'(x) = e^{\sqrt{x}}$, then $\frac{dy}{dx}$ is equal to

(A) $2xe^{2\sqrt{x}}$ (B) $2xe^{x}$ (C) $4xe^{\sqrt{x}}$ (D) $4xe^{x}$

14. If for two matrices A and B, AB = A and BA = B, then $(B^2 + B)$ equals

(A) 2A (B) 0 (C) 2I (D) 2B

15. Pipe A is 2 times slower than pipe B and takes 9 min more time than pipe B. How much time will pipe A take to fill the tank?

(A) 18min (B) 12min (C) 10min (D) 15min

16. For the given five values 15, 24, 18, 33, 42, the three years moving averages are

(A) 19, 22, 33 (B) 19, 25, 31 (C) 19, 30, 31 (D) 19, 25, 33

17. P is $2\frac{1}{3}$ times as fast as Q. If P gives Q a start of 80m, how long should the race course be so that both of them reach at the same time?

(A) 150m (B) 170m (C) 140m (D) 160m

18. If the matrix $\begin{bmatrix} 0 & -1 & 3x \\ 1 & y & -5 \\ -6 & 5 & 0 \end{bmatrix}$ is skew-symmetric, then

(A) x = -2, y = 0 (B) x = 2, y = 0 (C) x = -2, y = 1 (D) x = 2, y = -1

Assertion Reason Based Questions

In the following questions, a statement of Assertion(A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true and R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

19. **Assertion (A)** : If two positive numbers are such that their sum is 16 and sum of their cubes is minimum, then the numbers are 8, 8.

Reason (R) : If f be a function defined on an interval I and $c \in I$ and let f be twice differentiable at c, then x = c is a point of local minima, if f'(c) = 0 and f''(c) > 0 and f (c) is the local minimum value of f.

20. **Assertion (A)** : Two dice are thrown simultaneously. There are 11 possible outcomes and each has a probability $\frac{1}{11}$.

Reason (R) : Three events A, B, C are said to be independent, if $P(A \cap B \cap C) = P(A).P(B).P(C)$.

SECTION – B

(This section comprises of very short answer type questions (VSA) of 2 marks each)

21. Using properties of determinants, prove that

$$\begin{vmatrix} 3a & -a+b & -a+c \\ -b+a & 3b & -b+c \\ -c+a & -c+b & 3c \end{vmatrix} = 3(a + b + c)(ab + bc + ca).$$

22. Determine the binomial distribution whose mean is 20 and standard deviation is 4.

OR

Two cards are drawn successively with replacement from a well shuffled pack of 52 cards, find the probability distribution of number of kings.

23. In a 100m race, A runs at a speed of $\frac{5}{6}$ m/s. If A gives B a start 4m and still beats him by 12s, what is the speed of B?

OR

Two pipes A and B can fill a tank in 24min and 32min, respectively. If both the pipes are opened simultaneously, after how much time should B be closed so that the tank is full in 18min?

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24. The cost function for a certain commodity is $C(x) = 12 + 3x - \frac{1}{3}x^2$. Write down the total cost, fixed cost, variable cost and average cost when 3 units are produced.

25. One kind of cake requires 200g of flour and 25g of fat and another kind of cake requires 100g of flour and 50g of fat. Formulate a linear programming problem to make maximum number of cakes if 5kg of flour and 1kg of fat is available and there is no shortage of other ingredients.

SECTION - C
(This comprises of short answer type questions (SA) of 3 marks each)

26. Obtain the 3-year moving averages for the following series of observations:

Year	1995	1996	1997	1998	1999	2000	2001	2002
Annual sale (in Lakhs)	3.6	4.3	4.3	3.4	4.4	5.4	3.4	2.4

27. Solve the LPP graphically
Minimise $Z = 5x + 7y$ subject to the constraints
$2x + y \geq 8$
$x + 2y \geq 10,\ x,y \geq 0.$

OR

Solve graphically
Maximise $Z = 5x + 2y$ subject to the constraints
$x - 2y \leq 2$
$3x + 2y \leq 12$
$-3x + 2y \leq 3,\ x,y \geq 0.$

28. Find the values of x for which $f(x) = (x(x-2))^2$ is an increasing function. Also find the points on the curve, where the tangent is parallel to x-axis.

OR

Show that the function $f(x) = 4x^3 - 18x^2 + 27x - 7$ has neither maxima nor minima.

29. Two vessels A and B contain milk and water in the ratio 7 : 5 and 17 : 7 respectively. In what ratio mixtures from two vessels should be mixed to get a new mixture containing milk and water in the ratio 5 : 3?

30. Fit a straight line trend by the method of least squares and tabulate the trend values from the following data:

Year	2005	2006	2007	2008	2009	2010
Profit (in Lakhs)	5	7	9	10	12	17

31. If a young man rides motor cycle at 25km/hr, he has to spend ₹ 2 per kilometre on petrol, if he rides at a faster speed of 40km/hr, the petrol cost increases to ₹ 5 per kilometre. He has ₹ 100 to spend on petrol and wishes to find the maximum distance he can travel within one hour. Express this as a linear programming problem and solve it graphically.

SECTION – D
(This section comprises of long answer type questions (LA) of 5 marks each)

32. If $A = \begin{bmatrix} 1 & 2 & -3 \\ 2 & 3 & 2 \\ 3 & -3 & -4 \end{bmatrix}$, find A^{-1}. Using A^{-1}, solve the system of linear equations:

$x + 2y - 3z = -4,\ 2x + 3y + 2z = 2,\ 3x - 3y - 4z = 11.$

OR

If $B = \begin{bmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$, find $B^2 - 5B + 4I$ and hence find a matrix X such that

$B^2 - 5B + 4I + X = 0.$

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33. Three numbers are selected at random (without replacement) from first six positive integers. If X denotes the smallest of the three numbers obtained, find the probability distribution of X. Also, find the mean of the distribution.

34. Of all the closed right circular cylindrical cans of volume 128π cm^3, find the dimensions of the can which has minimum surface area.

OR

A window has the shape of a rectangle surmounted by an equilateral triangle. If the perimeter of the window is 12m, find the dimensions of the rectangle that will produce the largest area of the window.

35. (i) Solve the inequality $|3x| \geq |6 - 3x|$.
(ii) The length of a rectangle is three times its breadth. If the minimum perimeter of the rectangle is 160 cm, then find the shortest value of its breadth.

SECTION E

(This section comprises of 3 case- study/passage based questions of 4 marks each with sub parts. The first two case study questions have three sub parts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two sub parts of 2 marks each.)

36. **CASE STUDY – 1**

A rectangular hall is to be developed for the meeting of farmers in an agriculture college to make them aware of the new techniques in cultivation. It is given that the floor having length 'x' and breadth 'y', has a fixed perimeter P.

(i) Write the relationship between 'x', 'y' and 'P'.
(ii) Express the area of the floor 'A' as a function of 'x'.
(iii) Find the value of 'x' in terms of 'P', so that the area of the floor is maximum.

OR

Find the maximum value of the floor in terms of 'P'?

37. **CASE STUDY – 2**

On the occasion of Children's Day, Class teacher of III – B, decided to distribute some chocolates to students.
If there were 8 students less, every student would have got 10 more chocolates. However, if there were 16 students more, everyone would have got 10 chocolates less.
If the number of students in the class is 'x' and the total number of chocolates given to each student be 'y', answer the following questions.

(i) Write a system of linear equations to represent the above information.
(ii) Write the above system of linear equations as a matrix equation of the form AX = B
(iii) If A represents the coefficient matrix, find A^{-1}.

OR

Find the values of 'x' and 'y'.

38. **CASE STUDY – 3**

Shubham is rowing a boat. He takes 8hours to row 48km upstream whereas he takes 4 hours to go the same distance downstream. Based on the above information, answer the following questions.

(i) Find Shubham's speed of rowing in still water and the speed of the stream.
(ii) If the stream is flowing at a speed of 6km/hr, Shubham rows a certain distance upstream in 4.5hrs and returns in 2.5hrs. Find the speed of the boat.

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