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CLASS: XII
PRE-MID TERM (2025 – 26)
SUBJECT: MATHEMATICS (041)
SET-B2

Time: 2 Hrs. **Max. Mark: 50**

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 9 MCQ's and 01 Assertion-Reason based question of 1 mark each.
3. Section-B has 3 Very Short Answer (VSA)- type questions of 2 marks each.
4. Section-C has 5 Short Answer (SA)- type questions of 3 marks each.
5. Section-D has 3 Long Answer (LA)- type questions of 5 marks each.
6. Section-E has 1 case-based assessment (4 marks) with sub parts.

SECTION A

(Multiple Choice Questions) Each question carries 1 mark.

1. If $y = Ae^{5x} + Be^{-5x}$, then $\frac{d^2y}{dx^2}$ is equal to

   a) $25y$ b) $5y$ c) $-25y$ d) $15y$

2. The set of points of discontinuity of the function $f(x) = x - [x]$, is

   a) Q b) R c) N d) Z

3. If $A = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{pmatrix}$, then value of $|adjA|$ is

   a) 16 b) 32 c) 64 d) 128

4. If A and B are two matrices such that $AB = A$ and $BA = B$, then B^2 is equal to

   a) A b) B c) 1 d) 0

5. If $A = \begin{pmatrix} \alpha & 0 \\ 1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 \\ 5 & 1 \end{pmatrix}$, then value of α for which $A^2 = B$, is

   a) 1 b) -1 c) 4 d) No real values

6. The principal value of $\sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)$ is

   a) $-\frac{2\pi}{3}$ b) $-\frac{\pi}{3}$ c) $\frac{4\pi}{3}$ d) $\frac{5\pi}{3}$

7. If $\tan^{-1} x = \frac{\pi}{10}$ for some $x \in R$, then the value of $\cot^{-1} x$ is

   a) $\frac{\pi}{5}$ b) $\frac{2\pi}{5}$ c) $\frac{3\pi}{5}$ d) $\frac{4\pi}{5}$

8. Which of the following functions from Z to Z is a bijection?

   a) $f(x) = x^3$ b) $f(x) = 2x + 1$ c) $f(x) = x^2 + 1$ d) $g(x) = x + 2$

9. If A is the set of even natural number less than 8 & B is the set of prime numbers less than 7, then the number of relations from A to B is

a) 9^2 b) 2^9 c) 3^2 d) $9^2 - 1$

10. Of the following statements, choose the correct one.

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 correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

Consider the function $f(x) = [\sin x], x \in \left[0, \frac{\pi}{2}\right]$ where $[\cdot]$ denotes greatest integer function.

Assertion (A): $f(x)$ is continuous at $x = \frac{\pi}{2}$.

Reason (R): $\lim_{x \to \frac{\pi}{2}} f(x)$ does not exist.

SECTION B

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

11. If $x^3 + y^3 = 3axy$, find $\frac{dy}{dx}$.

OR

If $f(x) = \begin{cases} k; if\ x = 2 \\ \frac{2^{x+2} - 16}{4^x - 16}; if\ x \neq 2 \end{cases}$ is continuous at $x = 2$, find k.

12. Evaluate: $\tan\left(2 \tan^{-1} \frac{1}{5}\right)$.

13. Show that the relation R on R defined as $R = \{(a, b): a \leq b\}$, is transitive but not symmetric.

SECTION C

(This section comprises of short answer type questions (SA) of 3 marks each.)

14. If $y = (\sin^{-1} x)^2$, prove that $(1 - x^2)y_2 - xy_1 - 2 = 0$.

15. For the matrix $A = \begin{bmatrix} 3 & 1 \\ 7 & 5 \end{bmatrix}$, find x and y so that $A^2 + xI = yA$. Hence, find A^{-1}.

16. Show that the points $(a + 5, a - 4)$, $(a - 2, a + 3)$ and (a, a) do not lie on a straight line for any value of a.

17. Express $\begin{pmatrix} 3 & 2 & 5 \\ 4 & 1 & 3 \\ 0 & 6 & 7 \end{pmatrix}$ as the sum of symmetric and skew-symmetric matrices.

18. Let $X = R - \{3\}$; $Y = R - \{1\}$. Consider the function $f(x) = \frac{x-2}{x-3}$. Is f one-one and onto?

OR

Show that the exponential function $f: R \to R$, given by $f(x) = e^x$, is one-one but not onto.

What happens if the co-domain is replaced by R_0^+.

SECTION D

(This section comprises of short answer type questions (LA) of 5 marks each.)

19. Three shopkeepers A, B and C are using polythene bags, handmade bags and newspaper bags. A use 20,30 and 40 number of bags of respective type. B uses 30, 40 and 20 of each respective kind while C uses 40, 20 and 30 of each type. Each shopkeeper spent Rs.250, Rs.220 and Rs.200 on the bags. Find the cost of each carry bag using matrix method.

OR

If $A = \begin{pmatrix} 2 & -3 & 5 \\ 3 & 2 & -4 \\ 1 & 1 & -2 \end{pmatrix}$, find A^{-1}. Using A^{-1}, solve the following system of equations:

$2x - 3y + 5z = 11, 3x + 2y - 4z = -5, x + y - 2z = -3.$

20. Find $\frac{dy}{dx} y = x^{\cos x} + (\sin x)^{\tan x}$.

21. Let A be the set of all positive integers and R be a relation on $A \times A$, defined by $(a, b)R(c, d) \Leftrightarrow ad = bc, \forall\ (a, b), (c, d) \in A \times A$. Show that R is an equivalence relation on $A \times A$.

SECTION E

(This section comprises of one case-based question of 4 marks with three sub-parts (i), (ii) and (iii) of 1, 1, 2 marks respectively.)

22. Radha and Roshni are two best friends and studying in classes XI and XII respectively. They are playing a game with a matrix $F(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$. Roshni asked some questions from Radha based on given matrix $F(x)$.

Based on above information, Answer the following questions:

i) Show that $\frac{1}{2}(F(x) + (F(x))^T)$ is a diagonal matrix. (1)

ii)For what value of $x \in \left[0, \frac{\pi}{2}\right)$, $(F(x))^2$ becomes identity matrix? (1)

iii) a) Show that $F(x) \cdot F(y) = F(x + y)$. (2)

OR

b) Show that $F(x) \cdot F(-y) = F(x - y)$. (2)