SECOND YEAR HIGHER SECONDARY SAMPLE QUESTION PAPER-2023

MATHEMATICS (SCIENCE)

Maximum : 60 Scores

Time: 2Hours

Questions 1-8, Answer any six. 3 marks each.

1. Consider a relation R on A, where A = {1, 2, 3, ……,9} defined as R = $\{(x, y): 2x - y = 0\}$. Verify that R is reflexive, symmetric and transitive. (3)

2. Find matrices X and Y if $X + Y = \begin{bmatrix} 7 & 0 \\ 2 & 5 \end{bmatrix}$ and $X - Y = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$ (3)

3. (i) Find the value of x if $\begin{bmatrix} 3 & 1 \\ x & 2 \end{bmatrix}$ is singular (1)

   (ii) Using determinants, find the area of the triangle with vertices (2,7), (1, 1) and (10, 8) (2)

4. Find the value of 'k' so that the function $f(x) = \begin{cases} kx^2, if\ x \le 2 \\ 3,\ if\ x > 2 \end{cases}$ is continuous. (3)

5. Find $\frac{dy}{dx}$ if $x = a(\theta + \sin\theta)$, $y = a(1 + \cos\theta)$ (3)

6. (i) Find the projection of the vector $\hat{i} - \hat{j}$ on the vector $\hat{i} + \hat{j}$ (2)

   (ii) Find a unit vector in the direction of the vector $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ (1)

7. (i) Find the vector equation of the line passing through the point (1, 2, 3) and parallel to the vector $3\hat{i} + 2\hat{j} - 2\hat{k}$ (1)

   (ii) Find the angle between the lines $\frac{x}{2} = \frac{y}{2} = \frac{z}{1}$ and $\frac{x-5}{4} = \frac{y-2}{1} = \frac{z-3}{8}$ (2)

8. (i) If $P(A) = \frac{3}{5}$ and $P(B) = \frac{1}{5}$, find $P(A \cap B)$ if A and B are independent. (1)

   (ii) Given two independent events A and B such that P(A) = 0.3, P(B) = 0.5, find (a) P(A or B) (b) P(neither A nor B) (2)

Questions 9 - 16, Answer any six. 4marks each.

9. Consider the function $f : R \to R$ defined by $f(x) = 4x + 3$, show that f is invertible and find f^{-1}

10. (i) $\sin^{-1}(\sin(\frac{2\pi}{3})) = \ldots\ldots\ldots\ldots\ldots$ (1)

(ii) Evaluate $\tan^{-1}(1) + \cos^{-1}\left(\frac{-1}{2}\right) + \sin^{-1}\left(\frac{-1}{2}\right)$ (3)

11. (i) If A is a matrix of order 2x3 and B is a matrix of order 3x2, then order of AB is …….. (1)

(ii) Express the matrix $\begin{bmatrix} 1 & 4 & -1 \\ 2 & 5 & 4 \\ -1 & -6 & 3 \end{bmatrix}$ as the sum of a symmetric and a skew symmetric matrix (3)

12. (i) The area of the region bounded by the curve y = f(x), x axis, and the lines x = a and x = b is ……. (1)

(ii) Find the area of the circle $x^2 + y^2 = 16$ using integrals. (3)

13. (i) Find the order and degree of the differential equation $\frac{d^2y}{dx^2} + y = 0$. (1)

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

14. Find a unit vector perpendicular to both $\vec{a} + \vec{b}$ *and* $\vec{a} - \vec{b}$ where $\vec{a} = 3\hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{b} = \hat{i} + 2\hat{j} - 2\hat{k}$ (3)

15. Find the shortest distance between the lines

$\vec{r} = \hat{i} + \hat{j} + \lambda(2\hat{i} - \hat{j} + \hat{k})$ and

$\vec{r} = 2\hat{i} + \hat{j} - \hat{k} + \mu(3\hat{i} - 5\hat{j} + 2\hat{k})$ (3)

16. Bag l contains 3 red and 4 black balls while another Bag ll contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and it is found to be red. Find the probability that it was from Bag ll.

Questions 17- 20, Answer any three. 6marks each

17. Consider the following system of equations

x + y +3z = 5

x + 3y – 3z = 1

x + y + 2z = 5

(i) Convert the system in the form AX = B (1)
(ii) Find A^{-1} (3)
(iii) Hence solve the system of equations. (2)

18. Consider the real function $f(x) = x^3 + 3x^2 - 9x + 4$

(i) Find the intervals in which $f(x)$ is strictly increasing or decreasing. (3)

(ii) Find the points of local maxima or minima if any of the function $f(x)$ (2)

(iii) Find the absolute maximum and absolute minimum value of $f(x)$ in the interval [-4, 2] (1)

19. (i) Find $\int \frac{x}{(x+1)(x-2)} dx$ (3)

(ii) Evaluate $\int_0^{\frac{\pi}{2}} \frac{1}{1+\sqrt{\tan x}} dx$ (3)

20. Solve the following LPP

Maximize z = 3x + 9y subject to the constraints

$x + 3y \leq 60$

$x + y \geq 10$

$x \leq y$

$x \geq 0,\ y \geq 0$ (6)

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