

1 Determine whether the following relation is reflexive, symmetric or transitive.

Relation  $R$  on  $Z$ , the set of all integers, defined as  $R = \{ (x, y) : x - y \text{ is an integer} \}$

2. (a) Find the values of  $x, y$  from the following.

$$\begin{bmatrix} 4 & 3 \\ x & 5 \end{bmatrix} = \begin{bmatrix} y & 3 \\ 1 & 5 \end{bmatrix}$$

(1)

(b) Construct a  $2 \times 2$  matrix  $A = [a_{ij}]$  whose elements are given by:  $a_{ij} = \frac{(i+j)^2}{2}$

(2)

3. Find the area of the triangle whose vertices are  $(2, 7), (1, 1), (10, 8)$

4. Find the intervals in which the function  $f(x) = x^2 - 4x + 6$  is

(a) Increasing

(b) Decreasing.

5. The volume of a cube is increasing at the rate of  $9 \text{ cm}^3/\text{s}$ . How fast is the surface area increasing when the length of an edge is  $10 \text{ cm}$ .

6 (a) Find the vector from the point  $A(1, 3, 5)$  to  $B(4, 3, 2)$  (1)

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

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

8) Bag I contains 3 red and 4 black balls. Bag II contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and found to be red. Find the probability that it was drawn from Bag II.



Answer any 6 questions from 9-16  
Each carries 4 marks

9. Check whether the function is one one, onto or bijective.

$f: \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = 3 - 4x$ .

10. Find the principal value of  $\sin^{-1}(-\frac{1}{2})$ . (2)

(6) Show that  $\sin^{-1}(2x\sqrt{1-x^2}) = 2\sin^{-1}x$   $\frac{1}{\sqrt{2}} \leq x \leq \frac{1}{\sqrt{2}}$  (2)

11. Express the following matrix as the sum of a symmetric and a skew symmetric matrix.

$$\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$

12. (a) Find the area bounded by the curve  $y = f(x)$ ,  $x = a$ ,  $x = b$  and  $x$ -axis is (1)

(a)  $\int_a^b y dx$  (b)  $\int_a^b x dy$

(c)  $\int_a^b f(y) dx$  (d) None of the above

(b) Find the area enclosed by the circle  $x^2 + y^2 = 9$  (3)

13. (a) Find the order and degree of the following differential eqn.  $xy \frac{d^2y}{dx^2} + x \left(\frac{dy}{dx}\right)^2 - y \frac{dy}{dx} = 0$ . (1)

(b) Find the general solution of the differential equation  $x \frac{dy}{dx} + 2y = x^2$  ( $x \neq 0$ ) (3)

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

Find the area of the parallelogram whose adjacent sides are determined by the vectors  $\vec{a} = \hat{i} - \hat{j} + 3\hat{k}$  and  $\vec{b} = 2\hat{i} - 7\hat{j} + \hat{k}$ . (3)

15 (a) If A and B are independent events then  $P(A \cap B) = \underline{\hspace{2cm}}$  (1)

(b) If A and B are independent events  $P(A) = 0.3$ ,  $P(B) = 0.4$  find  
 1)  $P(A \cap B)$   
 2)  $P(A|B)$   
 3)  $P(A \cup B)$  (3)

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



Answer any 3 questions from 17 to 20  
Each carries 6 mark.

17. Solve the following system of equations by matrix method.

$$3x - 2y + 3z = 8$$

$$2x + y - z = 1$$

$$4x - 3y + 2z = 4$$

18. Integrate

(a)  $\int \frac{1}{(x+1)(x+2)} dx$  (3)

(b)  $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$  (3)

19. (a) Find the value of  $k$  such that the function

$$f(x) = \begin{cases} kx+1 & \text{if } x \leq 5 \\ 3x-5 & \text{if } x > 5 \end{cases} \text{ is}$$

continuous at  $x=5$  (3)

(b) If  $y = \sin^{-1} x$ . show that (3)

$$(1-x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} = 0$$

20. Solve the linear programming problem graphically.

Minimise  
Constraints

$$Z = 200x + 500y$$

subject to the

$$x + 2y \geq 10$$

$$3x + 4y \leq 24$$

$$x \geq 0, y \geq 0$$

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