

Max. Marks: 80

(i) This question paper contains 38 questions. All questions are compulsory.

(ii) This question paper is divided into five sections A,B,C,D and E. Each section is compulsory.

However there are internal choices in some questions.

(iii) **Section A** has **18 MCQ's** and 02 assertion-Reason based questions of **1 mark** each.

(iv) **Section B** has 5 Very short answer(VSA) type questions of **2 marks** each.

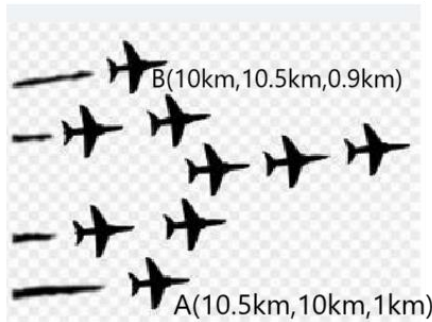
(v) **Section C** has 6 short answer(SA) type questions of **3 marks** each.

(vi) **Section D** has 4 long answer(LA) type questions of **5 marks** each.

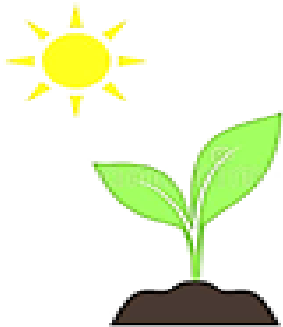
(vii) **Section E** has 3 case study based questions of **4 marks** each.

SECTION - A Multiple Choice Questions (Each question carries one mark)	
1	The domain of the function $y = \sin^{-1}(-x^2)$ is (a) $[0, 1]$ (b) $(0, 1)$ (c) $[-1, 1]$ (d) $[-1, 0]$
2	The order and degree of the differential equation $\left(1 + 3 \frac{dy}{dx}\right)^{2/3} = 4 \frac{d^3y}{dx^3}$ are: (a) 1,2/3 (b) 3,1 (c) 3,3 (d) 1,2
3	Total number of possible matrices of order 3×3 with diagonal entries are ± 2 and non-diagonal entries are $-1, 0$ and 1 is (a) 2^9 (b) 3^9 (c) $2^3 3^6$ (d) $2^6 3^3$
4	If A and B are matrices of order 3 and $A = 5$, and $B = 3$, then $3AB$ is equal to (a) 45 (b) 405 (c) 135 (d) None of these
5	If A is a square matrix of order 3×3 such that $A = 4$, then the value of $A(adjA)$ is (a) 4 (b) 16 (c) 12 (d) 64
6	In the following function $f(x)$ is continuous at $x=0$, then write the value of k. $f(x) = \begin{cases} \frac{\sin\left(\frac{3x}{2}\right)}{x} & , x \neq 0 \\ k, & x = 0 \end{cases}$ (a) $-3/2$ (b) $-2/3$ (c) $3/2$ (d) $2/3$

7	For the curve $\sqrt{x} + \sqrt{y} = 1$, $\frac{dy}{dx}$ at $(\frac{1}{4}, \frac{1}{4})$ is (a) -1 (b) $\frac{1}{2}$ (c) 1 (d) $-\frac{1}{2}$
8	If $x = t^2$ and $y = t^3$ then $\frac{d^2y}{dx^2}$ (a) $\frac{3}{2}$ (b) $\frac{3t}{2}$ (c) $\frac{3}{4t}$ (d) $\frac{3}{2t}$
9	The value of integration $\int e^x \sec x (1 + \tan x) dx$ is (a) $e^x \cos x + c$ (b) $e^x \sec x + c$ (c) $e^x \sin x + c$ (d) $e^x \tan x + c$
10	If $\int_0^a f(2a - x) dx = m$ and $\int_0^a f(x) dx = n$, then $\int_0^{2a} f(x) dx$ is equal to (a) $2m + n$ (b) $m + 2n$ (c) $m - n$ (d) $m + n$
11	If $y = \tan^{-1}\left(\frac{1 - \cos x}{\sin x}\right)$, then $\frac{dy}{dx}$ is (a) 1 (b) $\frac{1}{2}$ (c) -1 (d) $-\frac{1}{2}$
12	$\int \frac{1}{\sin^2 x \cos^2 x} dx$ is equal to (a) $\sin^2 x - \cos^2 x + C$ (b) -1 (c) $\tan x + \cot x + C$ (d) $\tan x - \cot x + C$
13	If $\cos \alpha, \cos \beta, \cos \gamma$ are the direction cosines of $\vec{a}$, then $\cos 2\alpha + \cos 2\beta + \cos 2\gamma$ is equal to: (a) 3 (b) 0 (c) 2 (d) -1
14	The unit vector perpendicular to both the vectors $\hat{i} + 2\hat{j} - 2\hat{k}$ and $-\hat{i} + 2\hat{j} + 2\hat{k}$ (a) $\frac{1}{\sqrt{5}}(2\hat{i} + \hat{k})$ (b) $\frac{1}{\sqrt{5}}(-2\hat{i} - \hat{j})$ (c) $\frac{1}{\sqrt{5}}(2\hat{i} + \hat{j} + \hat{k})$ (d) $\frac{1}{\sqrt{5}}(2\hat{i} + \hat{j})$
15	Find the vector equation of the line which is passing through the point $(2, -3, 5)$ and parallel to the vector $3\hat{i} + 4\hat{j} - 2\hat{k}$. (a) $(2 + 3\lambda)\hat{i} + (4\lambda + 3)\hat{j} + (5 - \lambda)\hat{k}$ (b) $(9 + 3\lambda)\hat{i} + (\lambda - 3)\hat{j} + (5 - 2\lambda)\hat{k}$ (c) $(2 + 3\lambda)\hat{i} + (4\lambda - 3)\hat{j} + (5 - 2\lambda)\hat{k}$ (d) $(7 + \lambda)\hat{i} + (4\lambda + 3)\hat{j} + (5 - 2\lambda)\hat{k}$
16	An objective function of a linear programming problem is (a) a constraint (b) a function to be optimized (c) a relation between the variables (d) none of these
17	The objective function of a linear programming problem, $Z = 4x + 3y$, has to be minimized. The feasible region of this LPP, along with its constraints, is shown in following graph.

	Which constraint , if removed, will not affect the feasible region? (a) $x + 2y \geq 120$ (b) $2x + y \geq 150$ (c) $3x + 4y \geq 200$ (d) any of the given constraints, if removed, will affect the feasible region.
18	A flashlight has 8 batteries out of which 3 are dead. If two batteries are selected without replacement and tested, the probability that both are dead is (a) $\frac{33}{56}$ (b) $\frac{9}{64}$ (c) $\frac{1}{14}$ (d) $\frac{3}{28}$
	ASSERTION-REASON BASED QUESTIONS In Questions number 19 and 20 , 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 and (R) is false (d) (A) is false and (R) is true
19	Assertion (A): Let $A = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 4 & 7 \end{bmatrix}$ and $B = \begin{bmatrix} 4 & 3 & 6 \\ 7 & 8 & 9 \\ 5 & 1 & 2 \end{bmatrix}$, then the product AB is not defined. Reason (R): The number of rows in A is equal to number of columns in B.
20	Assertion (A): The area of parallelogram with the diagonals $\vec{a}$ and $\vec{b}$ is $\frac{1}{2} \vec{a} \times \vec{b} $. Reason (R): If $\vec{a}$ and $\vec{b}$ represent the adjacent sides of a triangle, then the area of triangle can be obtained by evaluating $\frac{1}{2} \vec{a} \times \vec{b} $
	SECTION - B (This section comprises of very short answer type questions(SA) of 2 marks each)
21	Express $\tan^{-1}\left(\frac{\cos x}{1 - \sin x}\right)$, $\frac{\pi}{2} < x < \frac{3\pi}{2}$ in the simplest form.
22	If $\begin{pmatrix} x+y & 2 \\ 5 & xy \end{pmatrix} = \begin{pmatrix} 6 & 2 \\ 5 & 8 \end{pmatrix}$, find the value of $\frac{24}{x} + \frac{24}{y}$
23	Find the interval in which the function $f(x) = 2x^3 + 9x^2 + 12x - 1$ is decreasing (OR) Find the maximum and minimum values (if any) of the function given by $f(x) = 9x^2 + 12x + 2$.
24	Evaluate: $\int \frac{3x + 2}{(x - 1)(2x + 3)} dx$
25	Fighter jets are flying in a formation for an aero show as shown in figure. Taking their control tower as the reference point and the reference point as origin, the coordinates of two fighters in their flight path are A(10.5km, 10km, 1km) and B(10km, 10.5km, 0.9km). They are moving along the straight line . 

	What are the vector equation and cartesian equation of the line passing through A and B (OR) The equation of motion of a rocket is $x=2t, y=-4t, z=4t$, where the time t is given in seconds and the coordinates of the point in km. Write the path of the rocket in cartesian form. Also find the position of rocket in 10 seconds.
SECTION - C (This section comprises of short answer type questions(SA) of 3 marks each)	
26	Determine a so that $f(x)$ is continuous at $x = 0$ $f(x) = \begin{cases} \frac{1-\cos 4x}{x^2} & \text{if } x < 0 \\ a & \text{if } x = 0 \\ \frac{\sqrt{x}}{\sqrt{16+\sqrt{x}}-4} & \text{if } x > 0 \end{cases}$
27	Solve: $\frac{dy}{dx} = \frac{y}{x} + \operatorname{cosec}\left(\frac{y}{x}\right)$, given $y=0$, when $x=1$ (OR) Solve: $\frac{dy}{dx} + y \cot x = 4x \operatorname{cosec} x, (x \neq 0)$, given that $y\left(\frac{\pi}{2}\right) = 0$.
28	Evaluate: $\int_0^{\frac{\pi}{2}} \frac{dx}{1+\sqrt{\cot x}}$ (OR) Evaluate: $\int_1^4 x-1 + x-2 + x-3 dx$
29	Ginni purchased an air plant holder which is in the shape of a tetrahedron. Let A, B, C and D are the coordinates of the air plant holder where $A=(1,1,1)$, $B=(2,1,3)$, $C=(3,2,2)$ and $D=(3,3,4)$. Find the area of ΔABC.  (OR) Rohan is walking around a triangular park. The vertices of the park are given by the position vectors $(-\hat{j}-2\hat{k})$, $(3\hat{i}+\hat{j}+4\hat{k})$ and $(5\hat{i}+7\hat{j}+\hat{k})$. Show that the park is in right triangular shape
30	Solve the following linear programming problem graphically: Minimize : $Z = 3x + 9y$ subject to the constraints: $x + 3y \leq 60$, $x + y \geq 10$, $x \leq y$, $x \geq 0$, $y \geq 0$
31	A black and a red die are rolled together. Find the conditional probability of obtaining the sum 8, given that the red die resulted in a number less than 4. (OR) A problem is given to A, B and C. The probabilities that they solve the problem correctly are $\frac{1}{3}$, $\frac{2}{7}$ and $\frac{3}{8}$ respectively. If they try to solve the problem independently, find the probability that (i) exactly one of them solve the problem. (ii) at least one of them solve the problem.
SECTION- D	

(This section comprises of long answer type questions(LA) of 5 marks each)	
32	Let the relation R in the set $A = \{x \in \mathbb{Z} : 0 \leq x \leq 12\}$, given by $R = \{(a, b) : a - b \text{ is a multiple of } 4\}$. Show that the relation R is an equivalence relation ? Write the equivalence class [1].
33	Find the area of the region bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$. (OR) Find the smaller area enclosed by the circle $x^2 + y^2 = 4$ and the line $x + y = 2$.
34	An Apache helicopter of enemy is flying along the curve given by $y = x^2 + 7$. A soldier, placed at (3, 7), wants to shoot down the helicopter when it is nearest to him. Find the nearest distance.
35	Show that the lines $\vec{r} = (\hat{i} + \hat{j} - \hat{k}) + \lambda(\hat{3i} - \hat{j})$ and $\vec{r} = (4\hat{i} - \hat{k}) + \mu(\hat{2i} + 3\hat{k})$ intersect. Also find their point of intersection and angle between them. (OR) Find the coordinates of the foot of perpendicular and the length of the perpendicular drawn from the point $P(5, 4, 2)$ to the line $\frac{x+1}{2} = \frac{y-3}{3} = \frac{z-1}{-1}$. Also, find the image of P in this line.
SECTION– E CASE BASED QUESTIONS – 4 marks each	
36	A school wants to award its students for the values of Honesty, Regularity and Hardwork with a total cash award of ₹ 6,000. Three times the award money for Hardwork added to that given for Honesty amounts to ₹ 11,000. The award money given for Honesty and Hardwork together is double the one given for Regularity. Represent the above situation algebraically and find the award money for each value, using matrix method. Apart from these values, namely Honesty, Regularity and Hardwork, suggest one more value which the school must include for awards If x, y and z respectively denotes the award for the values of Honesty, Regularity and Hardwork (a) Express the above information in matrix form $AX = B$ (1m) (b) Find inverse of matrix A (1m) (c) Find x:y:z (2m) (OR) Find $A(\text{adj}A)$
37	The relation between the height of the plant (y in cm) with respect to exposure to sunlight is governed by the following equation $y = 4x - \frac{x^2}{2}$ where x is the number of days exposed to sunlight.  (a) Find the rate of growth of the plant with respect to sunlight. (1m) (b) What is the number of days it will take for the plant to grow to the maximum height. (1m)

	(c) Verify that height of the plant is maximum after four days by second derivative test and find the maximum height of plant. (2m) (OR) What will be the height of the plant after 2 days.?
38	Excessive use of screens can result in vision problems, obesity, sleep disorders, anxiety, low retention problems and can impede social and emotional comprehension and expression. It is essential to be mindful of the amount of time we spend on screens and to reduce our screen-time by taking regular breaks, setting time limits, and engaging in non-screen-based activities.  In a class of students of the age group 14 to 17, the students were categorized into three groups according to a feedback form filled by them. The first group consisted of the students who spent more than 4 hours per day on the mobile screen or the gaming screens, while the second group spent 2 to 4 hours per day on the same activities. The third group spent less than 2 hours per day on the same activities. The first group with the high screen time is 60% of all the students, whereas the second group with moderate screen time is 30% and the third group with low screen time is only 10% of the total number of students. It was observed that 80% students of first group faced severe anxiety and low retention issues, with 70% of second group, and 30% of third group having the same symptoms. (i) What is the total percentage of students who suffer from anxiety and low retention issues in the class? (2m) (ii) A student is selected at random, and he is found to suffer from anxiety and low retention issues. What is the probability that he/she spends screen time more than 4 hours per day? (2m)

END OF THE PAPER