THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

GRADE: XII **Date:**	**SAMPLE QUESTION PAPER** **FIRST TERM EXAMINATION (2023-24)** **APPLIED MATHEMATICS (241)**	**Marks: 80** **Time: 3 HOURS**

General Instructions :

1. This Question paper contains - **five sections** A,B,C,D and E. Each section iscompulsory. However, there is some internal choice 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)** questions of 2 marks each.
4. **Section C** has 6 **Short Answer(SA)** questions of 3 marks each.
5. **Section D** has 4 **Long Answer(LA)** questions of 5 marks each.
6. **Section E** has 3 **source based/case based/passage based/integrated units ofassessment (**04 marks each**)** with sub parts.
7. Internal Choice is provided **in 2 questions in Section-B, 2 questions in Section-C, 2 Questions in Section-D.** You have to attempt only one alternatives in all such questions.

SECTION A

(All Questions are compulsory. No internal choice is provided in this section)

Q -1 The value of -70 mod 13 is

(a) 5 (b) -5 (c) 8 (d)-8

Q -2 If $\frac{x+1}{x+2} \geq 1$, then

(a) $x \in [-\infty, 2]$ (b) $x \in (-\infty, -2)$ (c) $x \in (-\infty, 2]$ (d) $x \in (-\infty, 2)$

Q-3 If $x \leq 8$ then,

(a) $-x \leq -8$ (b) $-x \geq -8$ (c) $-x < -8$ (d) $-x > -8$

Q-4 If $|x-2| \geq 7, x \in R$, *then*

(a) (-5 , 9] (b)[-5 , 9] (c)(-∞ , -5]∪ [9 , ∞) (d)(- ∞,-5)∪(9,∞)

Q-5 A man can row 6 km/h in still water. It takes him twice as long to row up as to row down the river. Then the rate of the stream is

(a) 2 km/h (b) 4 km/h (c) 6 km/h (d) 8 km/h

Q-6 If $x\begin{bmatrix}2\\3\end{bmatrix} + y\begin{bmatrix}-1\\1\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$, then the value of x and y are :

(a) -4 , 3 (b) 3 ,-4 (c) 3, -3 (d) 4 , -4

Q-7 The least non-negative remainder when 3^{50} is divided by 7 is

(a) 4 (b) 3 c) 2 d) 1

Q-8 .If $A = \begin{bmatrix}2 & x+7\\ 2x-3 & x+8\end{bmatrix}$ is symmetric , then x is equal to

(a) 9 (b) 10 (c) 5 (d) 4

Q-9 $\int \frac{logx}{x} dx$ equals

(a) $\frac{logx}{2} + C$ (b) $\frac{(logx)^2}{2}$ +C (c) $logx + C$ (d)) $log\ (log\ x) + C$

Q-10 If $A = \begin{bmatrix}2 & -1 & 3\\ 4 & 6 & -6\end{bmatrix}$ and $\begin{bmatrix}1 & 2\\ 3 & 4\\ 5 & -6\end{bmatrix}$, then

(a) Only AB is defined (b) only BA is defined

(c)AB and BA are both defined (d) AB and BA both are not defined

Q-11 The function $f(x) = x^3$

(a)decreasing on R (b) increasing on R

(c) Both (a) and (b) (d) neither increasing nor decreasing

Q-12 If Let A be a square matrix of order 2 × 2, then |KA| is equal to

(a) K|A| (b) K²|A| (c) K3|A| (d) 2K|A|

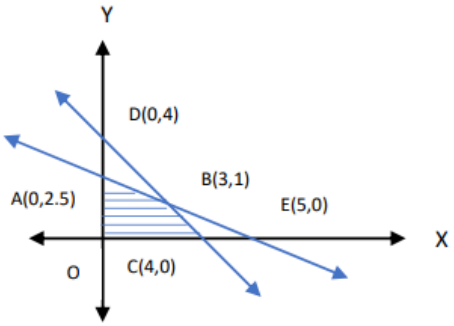
Q-13 If $\begin{bmatrix}1 & 3 & 9\\ 1 & x & x^2\\ 4 & 6 & 9\end{bmatrix}$ is singular matrix, then x =

(a)3 (b) 3 0r 6 (c)3 or$\frac{3}{2}$ (d)-3 or$-\frac{3}{2}$

Q-14 If A = $\begin{bmatrix}2x & 0\\ x & x\end{bmatrix}$ and $A^{-1} = \begin{bmatrix}1 & 0\\ -1 & 2\end{bmatrix}$, then the value of x is:

(a)2 (b)$-\frac{1}{2}$ (c)1 (d) $\frac{1}{2}$

Q-15 Besides non negativity constraint the figure given below is subject to which of the following constraints



(a) $x + 2y \leq 5 ; x + y \leq 4$ (b) $x + 2y \geq 5 ; x + y \leq 4$
(c) $x + 2y \geq 5 ; x + y \geq 4$ (d) $x + 2y \leq 5 ; x + y \geq 4$

Q-16 If $x = at^2 , y = 2at, then \frac{d^2y}{dx^2} =$

(a) $-\frac{1}{2at^3}$ **(b)** $-\frac{1}{2at^2}$ **(c)** $\frac{1}{t^2}$ **(d)**$-\frac{2a}{t}$

Q-17 The equation of the normal to the curve $y = x^2 - x$ at (1,0) is :

(a) $x + y = 0$ (b) $x - y = 0$ (c) $x + y = 1$ (d) $x - y = 1$

Q-18 If the marginal revenue fnction of a commodity is MR $=2x - 9x^2$, then the revenue function is

(a) $2x^2 - 9x^3$ (b)$2 - 18x$ (c) $x^2 - 3x^3$ (d) $18 + x^2 - 3x^3$

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.

Q-19 Assertion (A): The maximum profit that a company makes if profit function is given by $P(x) = 41 + 24x - 8x^2$; where 'x' is the number of units and P is the profit is ₹59

Reason (R) : The profit is maximum at x = a if $P'(a) = 0$ *and* $P''(a) > 0$

20. Assertion(A): If an LPP attains its maximum value at two corner points of the feasible region then it attains maximum value at infinitely many points
Reasoning (R): If the value of the objective function of a LPP is same at two corners then it is same at every point on the line joining two corner points.

SECTION B

(All Questions are compulsory. In case of internal Choice, attempt any one question only)

Q-21 Solve :$5x - 7 < 3(x + 3), 1 - \frac{3x}{2} \geq x - 4$

Q-22 If A is a square matrix $\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$ such that$A^2 = pA$, then find the value of p.

OR

If $\begin{bmatrix} 0 & a & 3 \\ 2 & b & -1 \\ c & 1 & 0 \end{bmatrix}$ is skew -symmetric matrix, then find value of $a+b+c$

Q-23 A Cooperative Society of farmers has 10 hectares of land to grow two crops A and B. To control weeds, pesticide has to be used for crops A and B at the rate of 30 grams per hectare and 15 grams per hectare respectively. Further, not more than 750 grams of pesticide should be used. The profit from crops A and B per hectare are estimated as ₹8000 and ₹9500. Formulate the above problem as LPP, in order to allocate land to each crop for maximum total profit.

Q-24 A man rows 15km upstream and 25km downstream each in 5 hours. Find he speed of the stream.

OR

'A' can run 40 meters while 'B' runs 50 meters in the same time. In a 1000 m race, find by how much distance 'B' beats 'A'.

Q-25 Find the rate of change of volume of a sphere with respect to its surface area when radius is 5m.

SECTION C

All Questions are compulsory. In case of internal Choice, attempt any one question only

Q-26 Find: $\int \frac{x^3}{(x+2)} dx$

OR

Find: $\int (x^2 + 1) \log x \ dx$

Q-27 Cost of two toys A and B are ₹50 and ₹75. On a particular Sunday shopkeeper P sells 7 toys of type A and 10 toys of type B whereas shopkeeper Q sells 8 toys of type A and 6 toys of type B. Find income of both shopkeepers using matrix Algebra.

Q-28 Find the intervals in which the function f(x) = $2x^3 - 9x^2 + 12x - 5$ is increasing or decreasing.

Q-29 The demand and supply functions under the pure market competition are $p_d = 16 - x^2$ and $p_s = 2x^2 + 4$ respectively, where p is the price and x is the quantity of the commodity. Using integrals find **Consumer's surplus**.

OR

The demand and supply functions under the pure market competition are $p_d = 56 - x^2$ and $p_s = 8 + \frac{x^2}{3}$ respectively, where p is the price and x is the quantity of the commodity. Using integrals find **Producer's surplus.**

A runs 3 times as fast as B.If A gives B a start of 50m, then find the distance of the finish point on the race course so that A and B reach the goal at the same time.

Q-31 Find the number of pairs of consecutive even positive integers,both of which are larger than 8 and their sum is less than 25.

SECTION D

(This section comprises of long answer type questions (LA) of 5 mark each)

Find the adjoint of the matrix

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

and hence show that $A(adjA) = |A|I_3$

Q-33 A manufacturer has three machines I,II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours whereas machine III must be operated for at least 5 hours a day. He produces only two items M and N , each requiring the use of all the three machines. The number of hours required for producing 1 unit of M and N on three machines are given in the following table:

Items	**Number of hours required on machines**		
	I	II	III
M	1	2	1
N	2	1	1.25

He makes a profit of ₹600 and ₹400 on one unit of items M and N respectively. Formulate the above problem as LPP and solve it graphically to find how many units of each item be produced to maximize profit. Also find the maximum profit.

Q-34 A company produces a certain commodity with ₹2400 fixed cost. The variable cost is estimated to be 25% of the total revenue received on selling the product at a rate of ₹8 per unit. Find the following

(i) Cost Function. (ii) Revenue Function

(iii) Breakeven Point (iv) Profit Function

OR

The production manager of a company plans to include 180 sq cm of actual printed matter in each page of a book under production. Each page should have a 2.5 cm wide margin along the top and bottom and 2 cm wide margin along the sides. What are the most economical dimensions of each printed page?

35. Solve the following system of equation using matrix method

$3x+y+z=10,$

$2x-y-z=0,$

$x-y+2z=1$

OR

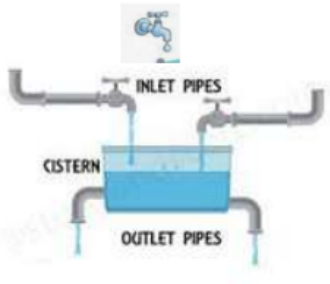
Find the value of k if M $=\begin{bmatrix}1 & 2\\ 2 & 3\end{bmatrix}$ and $M^2 - kM - I_2 = 0$

SECTION E

(This section comprises of 3 source based questions (Case Studies) of 4 mark each)

Q-36 Case Study 1 : Pipes and Cisterns (Mark 2+1+1) (Internal choice is in the iii part)

A, B and C are three pipes connected to a tank. A and B together fill the tank in 6 hours. B and C together fill the tank in 10 hours. A and C together fill the tank in $7\frac{1}{2}$ $hours$. Based on above information answer the following questions.



(i) In how much time will A, B and C fill the tank?
(ii) In how much time will A separately fill the tank?
(iii) In how much time will B separately fill the tank?

OR

In how much time will C separately fill the tank?

Q-37 The marginal revenue of a product is given by $M = 7 - 4X + 3x^2$, where x is the number Of units produced and sold.Based on the above information answer the following:

(a) Find the revenue function

OR

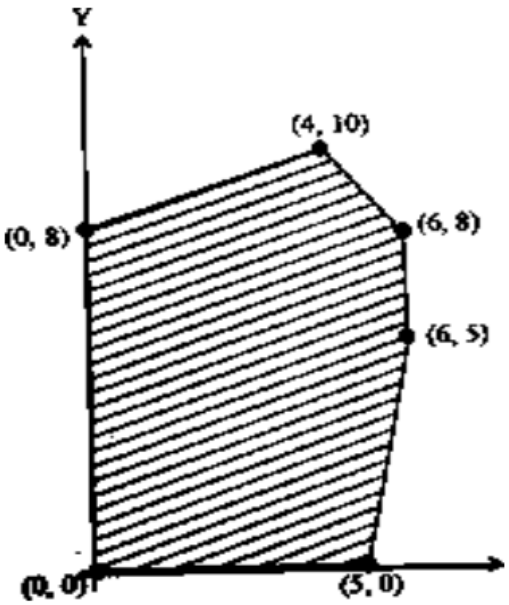
If at x=4 revenue generated id Rs 20 , then ffind the revenue function.

(b) Find the demand function

(c) Find the average revenue

Q-38

The feasible solution for a LPP is shown in fig. Let Z=3x-4y be the objective function.



(i) At what point , Z attains min value.
(ii) Find the minimum value of Z.
(iii) At what point , Z attains max. value.

OR

(iii) Find the maximum value of Z.