THE VILLAGE
INTERNATIONAL SCHOOL
"We Nurture Dreams"

AIM HIGH, TOGETHER WE FLY

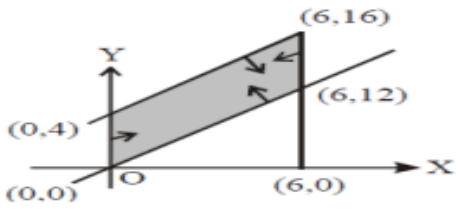
GRADE: XII Date:13-09-2023	FIRST TERM EXAMINATION 2023 APPLIED MATHEMATICS (241)	MARKS: 80 TIME: 3 HOURS

General Instructions :

1. This Question paper contains - **five sections** A,B,C,D and E. Each section is compulsory. 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.

Q.No.	Questions	Mark
	SECTION A (Multiple Choice question) **Each question carries 1 mark**	
1	If $100 \equiv x(mod7)$, then the least value of x is : (a)2 (b)3 (c)6 (d)4	**1**
2	The remainder when 5^{61} is divided by 7 is: (a)2 (b)1 (c)5 (d)4	**1**
3	The value of $20-_{12}12$ is (a)9 (b)12 (c)8 (d)0	**1**
4	The solution of $\|x+2\| \leq 5$ is: (a)(-7,5) (b)[-7,3] (c)[-5,5] (d)(-7,3)	**1**
5	For two distinct positive numbers x and y (a)$x + y > 2\sqrt{xy}$ (b)$\frac{x+y}{2} > xy$ (c)$\sqrt{xy} > \frac{x+y}{2}$	**1**

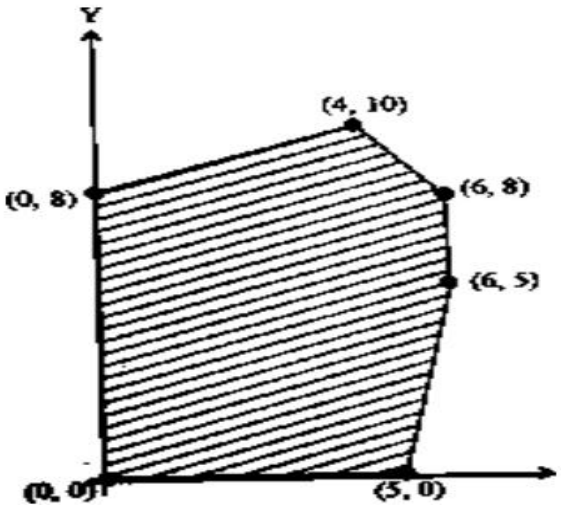
	(d)$\frac{2xy}{x+y} > \sqrt{xy}$	
6	Let p>0 and q<0 and p,q$\in Z$, then choose the correct inequality from thr given below options to complete the statement: $p + q - - - - p - q$ (a)> (b)< (c)≤ (d)≤	**1**
7	If $x\begin{bmatrix}2\\3\end{bmatrix} + y\begin{bmatrix}-1\\1\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$, then the value of x and y are : (a) -4 , 3 (b) 3 ,-4 (c) 3, -3 (d) 4 , -4	**1**
8	If matrix A is given by A = $[a_{ij}]_{2\times2}$ where $a_{ij} = i + j$ (a)$\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$ (b) $\begin{bmatrix}2 & 3\\3 & 4\end{bmatrix}$ (c) $\begin{bmatrix}1 & 1\\2 & 2\end{bmatrix}$ (d) $\begin{bmatrix}1 & 2\\1 & 2\end{bmatrix}$	**1**
9	If A is a square matrix of order 3×3 such that $\lvert A\rvert = 4$, then $\lvert 3A\rvert$ is equal to: (a)27 (b)81 (c)108 (d)256	**1**
10	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$-\frac{3}{2}$	**1**
11.	If A =$\begin{bmatrix}7 & -3\\-5 & 2\end{bmatrix}$ then $\lvert A\rvert$ is: (a)-2 (b)2 (c)-1 (d)1	**1**
12.	If A =$\begin{bmatrix}3 & 2 & -4\\6 & -1 & -2\\-7 & 1 & 2\end{bmatrix}$ then the cofactor of a_{23} is: (a)-16 (b)-20 (c)-18 (d)-17	**1**
13	If the total revenue received from the sale of x units of product is given by $R(x) = 3x^2 + 36x + 5$ then the marginal revenue when x=15 is: (a) 116 (b)96 (c)90 (d)126	**1**
14	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) $x - y = 1$	**1**
15.	Let f have second derivative at c such that $f'(c) = 0$ and $f''(c) > 0$, then c is a point of _____ (a)local maxima (b)$point\ of\ inflection$ (c)$local\ minima$	**1**

	(d)$extremum\ point$	
16.	Demand curve shows the relationship between: (a) Quantity demand and quantity supply of a commodity (b)Income and quantity demand of a commodity (c)Price and quantity of a commodity (d) Income and price of a commodity	**1**
17.	If the marginal revenue fnction of a commodity is MR $=2x - x^2$, then the revenue function is (a) $2x^2 - 9x^3$ (b) $2 - 18x$ (c) $x^2 - 3x^3$ (d) $18 + x^2 - 3x^3$	**1**
18	The feasible region for LPP is shown shaded in the figure. Let $Z = 3x - 4y$ be the objective function, then the maximum value  of Z is : (a) 1 (b)-2 (c)-1 (d)0	**1**
	ASSERTION-REASON BASED QUESTIONS In the following questions(19&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 but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.	
19	Assertion : It is given that at x=1 , the function $x^4 - 62x^2 + ax + 9$ attains its maximum value, on the interval [0,2]. Then value of a is 120. Reason: To find the value of a put $f'(1) = 0$.	**1**
20	Assertion: If an LPP attains its maximum value at two corner points of the feasible region then it attains maximum value at infinitely many points	**1**

	Reason: If the value of the objective function of an lpp is same at two corners then it is same at every point on the line joining two corner points.	
	SECTION B **(This section comprises of very short answer type-questions (VSA) of 2 marks each)**	
21	Solve the following inequality and graph the solution on the number line: $2x - 5 \leq x + 2 \leq 3x + 8$	**2**
22	If $A = \begin{bmatrix} 4 & 1 \\ 5 & 8 \end{bmatrix}$, show that $A + A^T$ is a symmetric matrix. OR If the matrix A= $\begin{bmatrix} 1 & 1 & 0 \\ 0 & -1 & 2 \\ 3 & 0 & 1 \end{bmatrix}$ and B = $\begin{bmatrix} 1 \\ 0 \\ 3 \end{bmatrix}$ find AB	**2**
23	A manufacturer produces nuts and bolts. It takes 1 hours of work on machine A and 3 hours on machine B to product a package of nuts. It takes 3 hours on machine A and 1 hour on machine B to produce a package of bolts. He earns a profit of Rs 17.50 per package on nuts and Rs 7 per package of bolts. How many packages of each should be produced each day so as to maximize his profits if he operates his machines for at the most 12 hours a day? From the above as a linear programming problem and solve it graphically.	**2**
24	A man rows 15 km upstream and 25 km downstream each in 5 hours. Find the speed of the stream . OR A can run 40 m while B runs 50 m in the same time. In a 1000 m race find by how much distance B beats A.	**2**
25	Find $\frac{dy}{dx}$ when $x = 4t \; and \; y = \frac{4}{t}$	**2**
	SECTION C **(This section comprises of short answer type questions (SA) of 3 marks each)**	
26	Evaluate: $\int \frac{2x+1}{(x+1)(x-2)}$ OR Evaluate: $\int (1 + x) log x \; dx$	**3**
27	Find the value of 2a+3b-c if $A = \begin{bmatrix} 0 & -1 & 28 \\ a-8 & 0 & 3b \\ -c+2 & 2 & 0 \end{bmatrix}$ is a skew symmetric matrix.	**3**
28	Find the intervals in which the function $f(x) = \frac{x^4}{4} - 2x^3 + \frac{11x^2}{2} 6x$ is strictly increasing and strictly decreasing. OR	**3**

	The surface area of a spherical balloon is increasing at the rate of 2 cm^2/sec.Find the rate of change of its volume and its radius is 6cm.	
29	Demand and supply functions are p= 50 – 8x and p=5+x respectively .Find the consumer surplus and producer surplus at equilibrium price.	**3**
30	Two pipes A and B running together can fill a tank in 6 minutes .If pipes A takes 5 minutes less than B to fill the tank, find the time taken by pipe B to fill the tank alone.	**3**
31	Solve : $\frac{3}{x-2} < 1$	**3**
	SECTION D **(This section comprises of long answer-type questions (LA) of 5 marks each)**	
32	The demand of a certain product is represented by the function $p = 200 + 20x - x^2$ where x is the number of units demanded and p is the price per unit. (1) find the marginal revenue (2) obtain the marginal revenue when 10 units are sold (3) calculate R(11) – R(10)	**5**
33	Using matrix method solve the following system of equations: $3x + 2y - 2z = 3$ $x + 2y + 3z = 6$ $2x - y + z = 2$ OR Using Cramer's method solve the following system of equations: $6x + y - 3z = 5$ $x + 3y - 2z = 5$ $2x + y + 4z = 8$	**5**
34	Minimise Z = $-3\boldsymbol{x} + 4\boldsymbol{y}$ subject to $x+2y \leq 8,\ 3x+2y \leq 12,\ x \geq 0,\ y \geq 0$.	**5**

35	If $A=\begin{bmatrix}-1\\2\\3\end{bmatrix}$ and $B=[-2 \quad -1 \quad -4]$, verify that (AB)'=B'A' OR Find the values of x, y ,z if the matrix $A=\begin{bmatrix}0 & 2y & z\\x & y & -z\\z & -y & z\end{bmatrix}$satisfies the equation A'A=I_3	**5**
	SECTION E **(This section comprises of 3 case study/passage – based questions of 4 marks each with two sub parts. First two case study questions have 3 sub – parts (i), (ii), (iii) of marks 1,1,2 respectively)**	
36	To enhance the reading skills of class XII students, the school nominates you and your friends to set a class library.There are three section A,B and C of class XII.There are 32 students in Section A, 36 students in Section B, and 40 students in Section C. Based on the above information , answer the following question. (a) Find the reminder when total number of students is divided by 7. (b)Find the unit digit of 3^{108} (c) Find the value in the set {1,2,3,4} such that number of students in section A and C≡ $x(mod\ 7)$	**4**
37	The relation between the height of the plant with respect to exposure to sunlight is given by the following equation $y=4x-\frac{1}{2}x^2$where x is the number of days exposed to sunlight.	**4**

	 Based on the above information answer the following questions: (a) find the rate of growth of the plant with respect to number of days exposed to sunlight. (b) What will be the height of the plan after 2 days. (c) What is the number of days it will take for the plant to grow to the maximum height? what is the maximum height of the plant	
38	The feasible solution for an LPP is shown in figure. Let $Z = 3x - 4y$ be the objective function.  Based on the above information answer the following: (a) At what point Z attains minimum value. (b) Find the minimum value of Z. (c) At what point it is said attains maximum value and find the maximum value of Z.	**4**
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