UNIT WISE PRACTICE QUESTIONS PAPER
(UNITS: RELATION-FUNCTION, MATRICES, DETERMINANTS)

Marking Scheme

Q.No.	Ans.	Hints/Solution
1.	(D)	$f(x) = 2 + x^2$ For one-one; let $f(x) = f(y) \Rightarrow 2 + x^2 = 2 + y^2 \Rightarrow x = \pm y$ So not one-one. For onto; there are so many elements in co-domain like -3, -4 etc. which are not mapped with any element of domain so not onto.
2.	(C)	$\Delta = \frac{1}{2}\begin{vmatrix} 3 & 8 & 1 \\ -4 & 2 & 1 \\ 5 & 1 & 1 \end{vmatrix} = \frac{61}{2}$ sq units
3.	(A)	For all the 4 elements of the matrix there are three choices so 3^4.
4.	(B)	Reflexive: $(1,1) \notin R$ so not reflexive. Symmetric: $(1,2) \in R$ but $(2,1) \notin R$ so not symmetric. Transitive: It is not violating the rule of being transitive so transitive.
5.	(A)	$\begin{vmatrix} x & x+1 \\ x-1 & x \end{vmatrix} = x^2 - (x^2 - 1) = 1$
6.	(A)	Since A is a skew matrix so $A' = -A \Rightarrow \lvert A' \rvert = \lvert -A \rvert \Rightarrow \lvert A' \rvert = (-1)^n \lvert A \rvert$ $\lvert A \rvert = (-1)^n \lvert A \rvert \Rightarrow$ Since n is odd so $\lvert A \rvert = -\lvert A \rvert \Rightarrow 2\lvert A \rvert = 0 \Rightarrow \lvert A \rvert = 0$
7.	(C)	Only $(a, b) \in R$ If $a = b - 2$ and $b > 6$ so $(6,8) \in R$.
8.	(B)	If all the diagonal elements of a diagonal matrix are equal then it is called scalar matrix.
9.	(D)	Since the given matrix is not a square matrix so det(A) doesn't exist.
10.	(C)	Let $f^{-1}(x) = y \Rightarrow x = f(y) \Rightarrow x = y^3 + 3 \Rightarrow x - 3 = y^3 \Rightarrow y = (x-3)^{1/3}$
11.	(A)	$(A - I)^3 + (A + I)^3 - 7A$ $A^3 - I^3 - 3A^2I + 3AI^2 + A^3 + I^3 + 3A^2I + 3AI^2 - 7A$ $2A^3 + 6AI^2 - 7A$ $2A + 6A - 7A$ A
12.	(B)	$f(x) = 8x^3$ and $g(x) = x^{1/3}$ $fog(x) = f\left(g(x)\right) = 8x$
13.	(D)	Two matrices are inverse of each other iff$AB = BA = I$.
14.	(B)	$\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$ $x^2 - 36 = 36 - 36$ $x = \pm 6$
15.	(B)	$A = \{a, b, c, d\}$ $f = \{(a,b)(b,d)(c,a)(d,c)\}$ $f^{-1} = \{(b,a)(d,b)(a,c)(c,d)\}$

16.	(D)	Reflexive: Since each line parallel to itself i.e. $(L, L) \in R$ so reflexive. Symmetric: Let $(L_1, L_2) \in R \Rightarrow L_1 is$ parallel to $L_2 \Rightarrow L_2\ is$ parallel to $L_1 \Rightarrow (L_2, L_1) \in R$ So symmetric. Transitive: Let $(L_1, L_2)\&(L_2, L_3) \in R \Rightarrow L_1 \parallel L_2 \& L_2 \parallel L_3 \Rightarrow L_1 \parallel L_3 \Rightarrow (L_1, L_3) \in R$ So transitive So R is an equivalence relation.
17.	(B)	Minor of an element of a determinant of order $n(n \geq 2)$ is a determinant of order $n - 1$.
18.	(B)	$AB = 3I$ $A^{-1}\, AB = 3A^{-1}I$ $B = 3A^{-1}$ $A^{-1} = \frac{B}{3}$
19.	(C)	(A) is incorrect and (R) is correct.
20.	(D)	(A) is false, but (R) is true.

SECTION – B

21.	$A = \{1, 2, 3, 4, 5, 6\}$ $R = \{(x, y) : y\ is\ divisible\ by\ x\}$ <u>Symmetric</u>: $(1,2) \in R$ but $(2,1) \notin R$ because 1 is not divisible by 2. So not symmetric. <u>Transitive</u>: let $(x, y) \in R \Rightarrow y$ is divisible by $x \Rightarrow y = \lambda x$ let $(y, z) \in R \Rightarrow z$ is divisible by $y \Rightarrow z = \mu y \Rightarrow z = \mu.\lambda.x \Rightarrow z$ is divisible by x $\Rightarrow (x, z) \in R \Rightarrow$ So transitive.	1 1
22.	Given A and B are Symmetric matrices so $A' = A$ and $B' = B$ Now $(AB - BA)' \Rightarrow (AB)' - (BA)'$ $\Rightarrow B'A' - A'B'$ $\Rightarrow BA - AB$ $\Rightarrow -(AB - BA)$ So $AB - BA$ is a skew symmetric matrix.	½ ½ ½ ½
23.	$A = \begin{vmatrix} 6 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 0 & 4 \end{vmatrix}$ $\lvert A \rvert = 6(4) - 0 + 0 = 24$ $\lvert 2A \rvert = \begin{vmatrix} 12 & 0 & 2 \\ 0 & 2 & 4 \\ 0 & 0 & 8 \end{vmatrix}$ $\lvert 2A \rvert = 12(16) - 0 + 0 = 192 = 8 \times 24 = 8\lvert A \rvert$	½ 1 ½
24.	Given that $f(x) = \frac{1}{x} \forall\, x \in \mathbb{R}$ But $0 \in \mathbb{R}$ for which $f(0)$ is not defined Hence $f(x)$ is not a function.	2

25.	$2\begin{bmatrix}1 & 3\\0 & x\end{bmatrix}+\begin{bmatrix}y & 0\\1 & 2\end{bmatrix}=\begin{bmatrix}5 & 6\\1 & 8\end{bmatrix}$ $\begin{bmatrix}2+y & 6\\1 & 2x+2\end{bmatrix}=\begin{bmatrix}5 & 6\\1 & 8\end{bmatrix}$ $2+y=5\ \&\ 2x+2=8$ $y=3\ \&\ x=3$ $x-y=0$	1 1/2 1/2

SECTION – C

26.	Clearly $a \le a\ \forall\ a \in \mathbb{R} \Rightarrow (a,a) \in\ \mathbb{R} \Rightarrow$ So reflexive. Let $(a,b)\&(b,c) \in\ \mathbb{R} \Rightarrow a \le b\&\ b \le c \Rightarrow a \le c \Rightarrow (a,c) \in\ \mathbb{R} \Rightarrow$ So transitive But not symmetric because $(1,2) \in \mathbb{R}$ but $(2,1) \notin \mathbb{R}$	1 1 1
27.	$A(x,4)\ B(-2,4)$and $C(2,-6)$ $\Delta=\frac{1}{2}\begin{vmatrix}x & 4 & 1\\-2 & 4 & 1\\2 & -6 & 1\end{vmatrix}=5x+10$ $5x+10=\pm 35$ $x=5$ or -9	2 1
28.	$AB=\begin{bmatrix}2 & 3\\1 & -4\end{bmatrix}\begin{bmatrix}1 & -2\\-1 & 3\end{bmatrix}=\begin{bmatrix}-1 & 5\\5 & -14\end{bmatrix}$ $(AB)^{-1}=\begin{bmatrix}-1 & 5\\5 & -14\end{bmatrix}^{-1}=\frac{1}{11}\begin{bmatrix}-14 & -5\\-5 & -1\end{bmatrix}$ Further $\lvert A\rvert=-11$ and $\lvert B\rvert=1$ $A^{-1}=-\frac{1}{11}\begin{bmatrix}-4 & -3\\-1 & 2\end{bmatrix}$ and $B^{-1}=\begin{bmatrix}3 & 2\\1 & 1\end{bmatrix}$ $B^{-1}A^{-1}=-\frac{1}{11}\begin{bmatrix}3 & 2\\1 & 1\end{bmatrix}\times\begin{bmatrix}-4 & -3\\-1 & 2\end{bmatrix}=-\frac{1}{11}\begin{bmatrix}14 & 5\\5 & 1\end{bmatrix}$ $(AB)^{-1}=B^{-1}A^{-1}$	1 1 1
29.	$f:\mathbb{R}\to\mathbb{R}$ $f(x)=[x]$ $\exists\ 1{,}1.6\ \in\ \mathbb{R}$(domain) For which $f(1)=(1.6)=1$ So not one-one There are so many elements in co-domain (like 2.5,7.3 etc.) which are not image of any element of domain so it is not onto	1½ 1½
30.	$\Delta=\begin{vmatrix}1 & x & yz\\1 & y & zx\\1 & z & xy\end{vmatrix}$ Co-factors of elements of 3rd column are: $A_{13}=z-y\ ;\ \ A_{23}=-(z-x)\ \ ;\ A_{33}=-(x-y)$ $\Delta=a_{13}A_{13}+a_{23}A_{23}+a_{33}A_{33}$ $\Delta=yz(z-y)-zx(z-x)-xy(x-y)$ $\Delta=\ (x-y)(y-z)(z-x)$	1 2
31.	$a_{ij}=e^{ix}\sin jx$	3

	$A = \begin{bmatrix} e^x \sin x & e^x \sin 2x \\ e^{2x} \sin x & e^{2x} \sin 2x \\ e^{3x} \sin x & e^{3x} \sin 2x \end{bmatrix}$	

SECTION – D

32.	Let $A \in P(X)$ then $A \subset A \Rightarrow (A, A) \in R \Rightarrow$ So R is reflexive. Let $(P, X) \in P(X)$ such that $P \subset X$ Hence $(P, X) \in R$ but $X \not\subset P \Rightarrow (P, X) \notin R$ So R is not Symmetric. Let $A, B, C \in P(X)$ such that $(A, B)(B, C) \in R \Rightarrow A \subset B,\ B \subset C \Rightarrow A \subset C \Rightarrow (A, C) \in R$ Hence R is transitive.	1 2 2
33.	$A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix}$ $A^2 = A \times A = \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 9 & 7 & 5 \\ 1 & 4 & 1 \\ 8 & 9 & 9 \end{bmatrix}$ $A^3 = \begin{bmatrix} 9 & 7 & 5 \\ 1 & 4 & 1 \\ 8 & 9 & 9 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix} = \begin{bmatrix} 28 & 37 & 26 \\ 10 & 5 & 1 \\ 35 & 42 & 34 \end{bmatrix}$ Now $A^3 - 4A^2 - 3A + 11I$ $\begin{bmatrix} 28 & 37 & 26 \\ 10 & 5 & 1 \\ 35 & 42 & 34 \end{bmatrix} - 4 \begin{bmatrix} 9 & 7 & 5 \\ 1 & 4 & 1 \\ 8 & 9 & 9 \end{bmatrix} - 3 \begin{bmatrix} 1 & 3 & 2 \\ 2 & 0 & -1 \\ 1 & 2 & 3 \end{bmatrix} + 11 \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	 2 2 1
34.	$A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ $\lvert A \rvert = 1$ $Adj\ A = \begin{bmatrix} -3 & -2 & -4 \\ 2 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}$ $A^{-1} = \begin{bmatrix} -3 & -2 & -4 \\ 2 & 1 & 2 \\ 2 & 1 & 3 \end{bmatrix}$ The given system can be written as $\begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 10 \\ 8 \\ 7 \end{bmatrix}$ $A'X = B$ $X = (A')^{-1}B = (A^{-1})'B$ $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 & 2 & 2 \\ -2 & 1 & 1 \\ -4 & 2 & 3 \end{bmatrix} \begin{bmatrix} 10 \\ 8 \\ 7 \end{bmatrix} = \begin{bmatrix} 0 \\ -5 \\ -3 \end{bmatrix}$ $x = 0, y = -5\ \&\ z = -3$	½ 1½ ½ 1 1½

35.	$$f(x)=\frac{4x+3}{6x-4}$$ Let $f(x)=f(y)\Rightarrow\frac{4x+3}{6x-4}=\frac{4y+3}{6y-4}\Rightarrow(4x+3)(6y-4)=(4y+3)(6x-4)$ $$24xy+18y-16x-12=24xy+18x-16y-12$$ $$34x=34y$$ $$x=y$$ So f is One-one function.	2 2 1

SECTION – E

36.	(i) Required Area= $\left\lvert\frac{1}{2}\begin{vmatrix}0&0&1\\3&\sqrt{3}&1\\3&-\sqrt{3}&1\end{vmatrix}\right\rvert=\frac{6\sqrt{3}}{2}=3\sqrt{3}$ sq. units (ii) Since, a face of the Pyramid consists of 25 smaller equilateral triangles. ∴ Area of a face of the Pyramid $=25\times3\sqrt{3}=75\sqrt{3}$ sq. units (iii) Area of equilateral triangle $=\frac{\sqrt{3}}{4}(side)^2$ $3\sqrt{3}=\frac{\sqrt{3}}{4}(side)^2\Rightarrow$ side $=2\sqrt{3}$ units Let h be the length of the altitude of a smaller equilateral triangle $$\frac{1}{2}\times base\times h=3\sqrt{3}$$ $$\frac{1}{2}\times2\sqrt{3}\times h=3\sqrt{3}$$ $h=3$ units	1 1 1 1
37.	(A) Rs A, Rs B and Rs C are the cost incurred by the organization for villages X, Y, Z respectively, therefore matrix equation will be $$\begin{bmatrix}400&300&100\\300&250&75\\500&400&150\end{bmatrix}\begin{bmatrix}50\\20\\40\end{bmatrix}=\begin{bmatrix}A\\B\\C\end{bmatrix}$$ (B) Let number of toilets expected in villagers X,Y,Z be x,y,z respectively Therefore required matrix is $$\begin{bmatrix}x\\y\\z\end{bmatrix}=\begin{bmatrix}400&300&100\\300&250&75\\500&400&150\end{bmatrix}\begin{bmatrix}2\\4\\20\end{bmatrix}$$ (C) $$\begin{bmatrix}A\\B\\C\end{bmatrix}=\begin{bmatrix}400&300&100\\300&250&75\\500&400&150\end{bmatrix}\begin{bmatrix}50\\20\\40\end{bmatrix}=\begin{bmatrix}30000\\23000\\39000\end{bmatrix}$$ Total money spent = 30000 + 23000 + 39000 = 92000 Rs	1 1 2
38.	(i) We know that, two ordered pairs are equal, if their corresponding elements are equal. $(a-3,b+7)=(3,7)$ $\Rightarrow a-3=3$ and $b+7=7$ [equatingcorresponding elements] ⇒ a = 3 + 3 and b = 7 – 7 $\Rightarrow a=6$ and $b=0$ (ii) $(x+6,y-2)=(0,6)$	1

	$\Rightarrow x + 6 = 0$ $\Rightarrow x = -6$ and $y - 2 = 6$ $\Rightarrow y = 6 + 2 = 8$ (iii) $(x + 2, 4) = (5, 2x + y)$ $\Rightarrow x + 2 = 5$ $\Rightarrow x = 5 - 2 = 3$ *and* $4 = 2x + y$ $\Rightarrow 4 = 2 \times 3 + y$ $\Rightarrow y = 4 - 6 = -2$ (iv) $x + 3 = 6,$ $2x + y = 5$ $\Rightarrow x = 3, y = 1$	1 1 1