WINTER – 2017 EXAMINATION

Model Answer Subject Code: 22103

Important Instructions to Examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance (Not applicable for subject English and Communication Skills).
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answer and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.		Attempt any **five** of the following:	**10**
	a)	Evaluate $\log_3 81$	**02**
	Ans	$\log_3 81$	
		$= \log_3 3^4$	½
		$= 4\log_3 3$	½
		$= 4(1)$	½
		$= 4$	½
		OR	
		$\log_3 81$	
		$= \dfrac{\log 81}{\log 3}$	½
		$= \dfrac{\log 3^4}{\log 3}$	½
		$= \dfrac{4\log 3}{\log 3}$	½
		$= 4$	½
		--	
	b)	Show that the points $(8,1)$ $(3,-4)$ and $(2,-5)$ are collinear using determinant.	**02**
	Ans	Consider $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	b)	$= \begin{vmatrix} 8 & 1 & 1 \\ 3 & -4 & 1 \\ 2 & -5 & 1 \end{vmatrix}$	½
		$= 8(-4+5) - 1(3-2) + 1(-15+8)$	½
		$= 0$	½
		$\therefore$ Points are collinear	½
	c)	--	
	Ans	Without using calculator find the value of $\sin\left(105^0\right)$	**02**
		$\sin\left(105^0\right)$	
		$= \sin\left(60^0 + 45^0\right)$	½
		$= \sin 60^0 \cos 45^0 + \cos 60^0 \sin 45^0$	½
		$= \frac{\sqrt{3}}{2}\frac{1}{\sqrt{2}} + \frac{1}{2}\frac{1}{\sqrt{2}}$	½
		$= \frac{\sqrt{3}+1}{2\sqrt{2}}$ OR 0.9659	½
		--	
	d)	Find area of rhombus whose diagonals are of length 10 cm and 8.2 cm	**02**
	Ans	Area of rhombus $= \frac{1}{2} \times d_1 \times d_2$	
		$= \frac{1}{2} \times 10 \times 8.2$	1
		$= 41$ sq.cm	1
		--	
	e)	If the volume of a sphere is $\frac{4\pi}{3}$ cm^3.Find its surface area	**02**
	Ans	Volume of sphere $= \frac{4}{3}\pi r^3$	
		$\therefore \frac{4\pi}{3} = \frac{4}{3}\pi r^3$	½
		$1 = r^3$	
		$\therefore r = 1$	½
		Surface area of sphere $= 4\pi r^2$	
		$= 4\pi(1)^2$	½
		$= 4\pi$ OR 12.56 cm^2	½
		--	

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1.	f)	Find the range and coefficient of range of the data: 50 , 90 , 120 , 40 , 180 , 200 , 80.	**02**
	Ans	Range $= L - S = 200 - 40$	
		$= 160$	1
		Coefficient of range $= \frac{L-S}{L+S}$	
		$= \frac{200-40}{200+40}$	½
		$= \frac{2}{3}$ OR 0.667	½
	g)	If the coefficient of variation of certain data is 5 and mean is 60.Find the standard deviation.	**02**
	Ans	Coefficient of variation $= \frac{S.D.}{Mean} \times 100$	
		$\therefore 5 = \frac{S.D.}{60} \times 100$	1
		$\therefore \frac{5 \times 60}{100} = S.D.$	
		$\therefore S.D. = 3$	1
2.		Attempt any **three** of the following:	**12**
	a)	If $A = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix}, B = \begin{bmatrix} 1 & 2 \\ 3 & -2 \end{bmatrix}$ whether AB is singular or non-singular matrix?	**04**
	Ans	$AB = \begin{bmatrix} 2 & 1 \\ 0 & 3 \end{bmatrix} \begin{bmatrix} 1 & 2 \\ 3 & -2 \end{bmatrix}$	
		$\therefore AB = \begin{bmatrix} 2+3 & 4-2 \\ 0+9 & 0-6 \end{bmatrix}$	1
		$\therefore AB = \begin{bmatrix} 5 & 2 \\ 9 & -6 \end{bmatrix}$	1
		$\therefore \lvert AB \rvert = \begin{vmatrix} 5 & 2 \\ 9 & -6 \end{vmatrix} = -30 - 18 = -48$	1
		$\therefore \lvert AB \rvert \neq 0$	½
		$\therefore AB$ is non-singular matrix	½
	b)	Resolve into partial fractions : $\frac{x+3}{(x-1)(x+1)(x+5)}$	**04**

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2.	b) Ans	$\frac{x+3}{(x-1)(x+1)(x+5)} = \frac{A}{x-1}+\frac{B}{x+1}+\frac{C}{x+5}$	½
		$\therefore\ x+3 = A(x+1)(x+5)+B(x-1)(x+5)+C(x-1)(x+1)$	
		Put $x=1$	
		$4 = A(2)(6)$	
		$4 = 12A$	
		$\therefore A = \frac{1}{3}$	1
		Put $x=-1$	
		$-1+3 = B(-2)(4)$	
		$2 = -8B$	
		$\therefore B = -\frac{1}{4}$	1
		Put $x=-5$	
		$-5+3 = C(-6)(-4)$	
		$-2 = 24C$	
		$\therefore C = \frac{-1}{12}$	1
		$\frac{x+3}{(x-1)(x+1)(x+5)} = \frac{\frac{1}{3}}{x-1}+\frac{-\frac{1}{4}}{x+1}+\frac{-\frac{1}{12}}{x+5}$	½
		--	
	c)	Using Cramers rule solve $x-y-2z=1$; $2x+3y+4z=4$; $3x-2y-6z=5$	**04**
	Ans	D = $\begin{vmatrix} 1 & -1 & -2 \\ 2 & 3 & 4 \\ 3 & -2 & -6 \end{vmatrix}$	
		$=1(-18+8)+1(-12-12)-2(-4-9)$	1
		$=-8$	
		$D_x = \begin{vmatrix} 1 & -1 & -2 \\ 4 & 3 & 4 \\ 5 & -2 & -6 \end{vmatrix}$	
		$=1(-18+8)+1(-24-20)-2(-8-15)$	
		$=-8$	
		$\therefore x = \frac{D_x}{D} = \frac{-8}{-8} = 1$	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	c)	$D_y = \begin{vmatrix} 1 & 1 & -2 \\ 2 & 4 & 4 \\ 3 & 5 & -6 \end{vmatrix}$	
		$= 1(-24-20) - 1(-12-12) - 2(10-12)$	
		$= -16$	
		$\therefore y = \dfrac{D_y}{D} = \dfrac{-16}{-8} = 2$	1
		$\mathrm{D}_z = \begin{vmatrix} 1 & -1 & 1 \\ 2 & 3 & 4 \\ 3 & -2 & 5 \end{vmatrix}$	
		$= 1(15+8) + 1(10-12) + 1(-4-9)$	
		$\mathrm{D}_z = 8$	
		$z = \dfrac{D_z}{D} = \dfrac{8}{-8} = -1$	1
		--	
	d)	Compute the standard deviation for 15 , 22 , 27 , 11 , 9 , 21 , 14 , 9.	**04**
	Ans	(see table below)	2

x_i	$d_i = x_i - \bar{x}$	d_i^2
15	-1	1
22	6	36
27	11	121
11	-5	25
9	-7	49
21	5	25
14	-2	4
9	-7	49
$\sum x_i =$ 128		$\sum d_i^2 =$ 310

Mean $\bar{x} = \dfrac{\sum x_i}{n}$

Q. No.	Sub Q. N.	Answer	Marking Scheme
2.	d)	Mean $\bar{x} = \frac{128}{8} = 16$	1
		Standard deviation $\sigma = \sqrt{\frac{\sum d_i^2}{n}}$ $= \sqrt{\frac{310}{8}}$ $= 6.22$	1
		OR	
		(table below)	2
		Mean $\bar{x} = \frac{\sum x_i}{n}$ $\bar{x} = \frac{128}{8} = 16$	1
		Standard deviation $\sigma = \sqrt{\frac{\sum x_i^2}{N} - \left(\bar{x}\right)^2}$ $= \sqrt{\frac{2358}{8} - (16)^2}$ $= 6.22$	1

x_i	x_i^2
15	225
22	484
27	729
11	121
9	81
21	441
14	196
9	81
$\sum x_i =$ 128	$\sum x_i^2 =$ 2358

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.		Attempt any **three** of the following:	**12**
	a)	If $\tan(x+y)=3/4$ and $\tan(x-y)=8/15$. Prove that $\tan 2x = 77/36$	**04**
	Ans	Consider	
		$2x = x+y+x-y$	
		$\tan 2x = \tan(x+y+x-y)$	1
		$= \dfrac{\tan(x+y)+\tan(x-y)}{1-\tan(x+y)\tan(x-y)}$	1
		$= \dfrac{\frac{3}{4}+\frac{8}{15}}{1-\frac{3}{4}\frac{8}{15}}$	1
		$= \dfrac{77}{36}$	1
		$\therefore \tan 2x = 77/36$	
		OR	
		Let $x+y=A$	
		$x-y=B$	
		$\therefore \tan A = \dfrac{3}{4}$, $\tan B = \dfrac{8}{15}$	
		$\because 2x = A+B = x+y+x-y$	1
		$\tan 2x = \tan(A+B)$	
		$= \dfrac{\tan A + \tan B}{1-\tan A \tan B}$	1
		$= \dfrac{\frac{3}{4}+\frac{8}{15}}{1-\frac{3}{4}\frac{8}{15}}$	1
		$= \dfrac{77}{36}$	1
		$\therefore \tan 2x = 77/36$	
		--	
	b)	If $A = 30^0$, verify that	**04**
		$i)\ \sin 2A = 2\sin A\cos A$	
		$ii)\ \cos 2A = \dfrac{1-\tan^2 A}{1+\tan^2 A}$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	b) Ans	$i) L.H.S. = \sin 2A$ $= \sin 2(30^0)$ $= \sin 60^0$ $= \frac{\sqrt{3}}{2}$	1
		$R.H.S. = 2\sin A \cos A$ $= 2\sin 30^0 \cos 30^0$ $= 2\left(\frac{1}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$ $= \frac{\sqrt{3}}{2}$	1
		$\therefore \sin 2A = 2\sin A \cos A$ $ii) L.H.S. = \cos 2A = \cos 2\left(30^0\right)$ $= \cos 60^0$ $= \frac{1}{2}$	1
		$R.H.S. = \frac{1-\tan^2 A}{1+\tan^2 A}$ $= \frac{1-\tan^2 30^0}{1+\tan^2 30^0}$ $= \frac{1-\left(\frac{1}{\sqrt{3}}\right)^2}{1+\left(\frac{1}{\sqrt{3}}\right)^2}$ $= \frac{1}{2}$	1
		$\therefore \cos 2A = \frac{1-\tan^2 A}{1+\tan^2 A}$ ---	
	c)	Prove that $\cos 20 \cos 40 \cos 60 \cos 80 = \frac{1}{16}$	**04**
	Ans	$L.H.S. = \cos 20 \cos 40 \cos 60 \cos 80$	
		$= \cos 20 \cos 40 \frac{1}{2} \cos 80$	½
		$= \frac{1}{4}\left(2\cos 20 \cos 40\right)\cos 80$	½

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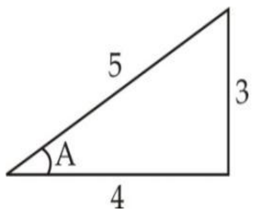
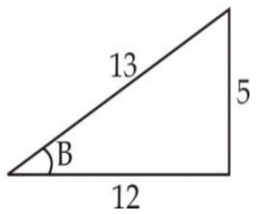
Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	c)	L.H.S. $=\frac{1}{4}(\cos 60+\cos 20)\cos 80$	1
		$=\frac{1}{4}\left(\frac{1}{2}+\cos 20\right)\cos 80$	
		$=\frac{1}{4}\left(\frac{1}{2}\cos 80+\cos 20\cos 80\right)$	
		$=\frac{1}{8}(\cos 80+2\cos 20\cos 80)$	
		$=\frac{1}{8}(\cos 80+\cos 100+\cos 60)$	½
		$=\frac{1}{8}\left(\cos 80+\cos 100+\frac{1}{2}\right)$	
		$=\frac{1}{8}\left(\cos 80+\cos(\pi-80)+\frac{1}{2}\right)$	½
		$=\frac{1}{8}\left(\cos 80-\cos 80+\frac{1}{2}\right)$	½
		$=\frac{1}{16}$	
		$=R.H.S.$	½
		---	
	d)	Prove that $\cos^{-1}\left(4/5\right)+\cos^{-1}\left(12/13\right)=\cos^{-1}\left(33/65\right)$	**04**
	Ans	Put $\cos^{-1}\left(4/5\right)=A$	
		$\because \cos A=\frac{4}{5}$	
		$\therefore \sin A=\sqrt{1-\cos^2 A}$	
		$=\sqrt{1-\frac{16}{25}}$	
		$=\frac{3}{5}$	1
		Put $\cos^{-1}\left(\frac{12}{13}\right)=B$	
		$\therefore \cos B=\frac{12}{13}$	
		$\therefore \sin B=\sqrt{1-\cos^2 B}$	
		$=\sqrt{1-\frac{144}{169}}$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	d)	$\therefore \sin B = \frac{5}{13}$	1
		Consider,	
		$\cos(A+B) = \cos A.\cos B - \sin A.\sin B$	
		$\cos(A+B) = \left(\frac{4}{5}\right)\left(\frac{12}{13}\right) - \left(\frac{3}{5}\right)\left(\frac{5}{13}\right)$	1
		$\therefore \cos(A+B) = \frac{33}{65}$	½
		$\therefore A+B = \cos^{-1}\left(\frac{33}{65}\right)$	½
		$\therefore \cos^{-1}\left(\frac{4}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \cos^{-1}\left(\frac{33}{65}\right)$	
		OR	
		Let $\cos^{-1}\left(\frac{4}{5}\right) = A$  	
		$\therefore \cos A = \frac{4}{5}$	
		$\therefore \tan A = \frac{3}{4}$	
		$A = \tan^{-1}\left(\frac{3}{4}\right)$	
		$\therefore \cos^{-1}\left(\frac{4}{5}\right) = \tan^{-1}\left(\frac{3}{4}\right)$	1
		Let $\cos^{-1}\left(\frac{12}{13}\right) = B$	
		$\therefore \cos B = \frac{12}{13}$	
		$\therefore \tan B = \frac{5}{12}$	
		$\therefore B = \tan^{-1}\left(\frac{5}{12}\right)$	
		$\cos^{-1}\left(\frac{12}{13}\right) = \tan^{-1}\left(\frac{5}{12}\right)$	1
		$L.H.S. = \cos^{-1}\left(4/5\right) + \cos^{-1}\left(12/13\right)$	

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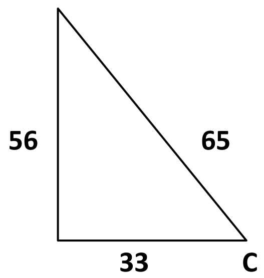
Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	d)	$\text{L.H.S.} = \tan^{-1}\left(\frac{3}{4}\right) + \tan^{-1}\left(\frac{5}{12}\right)$	
		$= \tan^{-1}\left(\dfrac{\frac{3}{4}+\frac{5}{12}}{1-\frac{3}{4}\frac{5}{12}}\right)$	½
		$= \tan^{-1}\left(\frac{56}{33}\right)$	½
		Let $\tan^{-1}\left(\frac{56}{33}\right) = C$	
		$\therefore \tan C = \frac{56}{33}$	
		$\therefore \cos C = \frac{33}{65}$	
		$\therefore C = \cos^{-1}\left(\frac{33}{65}\right)$ 	
		$\therefore \tan^{-1}\left(\frac{56}{33}\right) = \cos^{-1}\left(\frac{33}{65}\right) = R.H.S.$	1
		--	
4.		Attempt any **three** of the following:	**12**
	a)	If $A = \begin{bmatrix} 2 & 5 & 6 \\ 0 & 1 & 2 \end{bmatrix}, B = \begin{bmatrix} 6 & 1 \\ 0 & 4 \\ 5 & 7 \end{bmatrix}$. Verify that $(AB)^T = B^T A^T$	**04**
	Ans	$AB = \begin{bmatrix} 2 & 5 & 6 \\ 0 & 1 & 2 \end{bmatrix} \begin{bmatrix} 6 & 1 \\ 0 & 4 \\ 5 & 7 \end{bmatrix}$	
		$AB = \begin{bmatrix} 12+0+30 & 2+20+42 \\ 0+0+10 & 0+4+14 \end{bmatrix}$	1
		$AB = \begin{bmatrix} 42 & 64 \\ 10 & 18 \end{bmatrix}$	½
		$(AB)^T = \begin{bmatrix} 42 & 10 \\ 64 & 18 \end{bmatrix}$	½
		$B^T A^T = \begin{bmatrix} 6 & 0 & 5 \\ 1 & 4 & 7 \end{bmatrix} \begin{bmatrix} 2 & 0 \\ 5 & 1 \\ 6 & 2 \end{bmatrix}$	½

Q. No.	Sub Q. N.	Answer	Marking Scheme
4.	a)	$B^T A^T = \begin{bmatrix} 12+0+30 & 0+0+10 \\ 2+20+42 & 0+4+14 \end{bmatrix}$	1
		$B^T A^T = \begin{bmatrix} 42 & 10 \\ 64 & 18 \end{bmatrix}$	½
		$\therefore (AB)^T = B^T A^T$	
		--	
	b)	Resolve into partial fraction $\dfrac{x^2-x+3}{(x-2)(x^2+1)}$	**04**
	Ans	$\dfrac{x^2-x+3}{(x-2)(x^2+1)} = \dfrac{A}{x-2} + \dfrac{Bx+C}{x^2+1}$	½
		$\therefore x^2-x+3 = (x^2+1)A + (x-2)(Bx+C)$	
		Put $x=2$	
		$5=5A$	
		$A=1$	1
		Put $x=0$	
		$3=A-2C$	
		$\therefore C=-1$	1
		Put $x=1$	
		$3=2A+(-1)(B+C)$	
		$3=2-B+1$	
		$\therefore B=0$	1
		$\dfrac{x^2-x+3}{(x-2)(x^2+1)} = \dfrac{1}{x-2} + \dfrac{(0)x-1}{x^2+1}$	½
		$\dfrac{x^2-x+3}{(x-2)(x^2+1)} = \dfrac{1}{x-2} - \dfrac{1}{x^2+1}$	
		--	
	c)	Prove that : $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B$	**04**
	Ans	$\sin(A+B)\sin(A-B)$	
		$=(\sin A\cos B + \cos A\sin B)(\sin A\cos B - \cos A\sin B)$	1
		$=\sin^2 A\cos^2 B - \cos^2 A\sin^2 B$	1
		$=\sin^2 A(1-\sin^2 B) - (1-\sin^2 A)\sin^2 B$	1
		$=\sin^2 A - \sin^2 A\sin^2 B - \sin^2 B + \sin^2 A\sin^2 B$	
		$=\sin^2 A - \sin^2 B$	1

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4.	d)	If sin A = $\frac{1}{2}$ find the value of sin3A.	**04**
	Ans	$\sin 3A = 3\sin A - 4\sin^3 A$	1
		$= 3\left(\frac{1}{2}\right) - 4\left(\frac{1}{2}\right)^3$	1
		$= 1$	2
		--	
	e)	Prove that $\frac{\sin 4A+\sin 5A+\sin 6A}{\cos 4A+\cos 5A+\cos 6A} = \tan 5A$	**04**
	Ans	$L.H.S. = \frac{\sin 4A+\sin 5A+\sin 6A}{\cos 4A+\cos 5A+\cos 6A}$	
		$= \frac{\sin 4A+\sin 6A+\sin 5A}{\cos 4A+\cos 6A+\cos 5A}$	
		$= \frac{2\sin\left(\frac{4A+6A}{2}\right)\cos\left(\frac{4A-6A}{2}\right)+\sin 5A}{2\cos\left(\frac{4A+6A}{2}\right)\cos\left(\frac{4A-6A}{2}\right)+\cos 5A}$	1
		$= \frac{2\sin 5A\cos(-A)+\sin 5A}{2\cos 5A\cos(-A)+\cos 5A}$	1
		$= \frac{\sin 5A(2\cos(-A)+1)}{\cos 5A(2\cos(-A)+1)}$	1
		$= \tan 5A$	1
		$= R.H.S.$	
		--	
5.		Attempt any **two** of the following:	**12**
	a) (i)	Find the equation of straight line passes through the points $(3,5)$ and $(4,6)$.	**03**
	Ans	Equation of line is	
		$\frac{y-y_1}{y_1-y_2} = \frac{x-x_1}{x_1-x_2}$	
		$\frac{y-5}{5-6} = \frac{x-3}{3-4}$	2
		$\frac{y-5}{-1} = \frac{x-3}{-1}$	
		$x-y+2=0$	1
		--	
	(ii)	Find the distance between the parallel lines $3x-y+7=0$ and $3x-y+16=0$	**03**
	Ans	For $3x-y+7=0$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
5.	a) (ii)	$a=3,\ b=-1,\ c_1=7$	
		For $3x-y+16=0$	
		$a=3,\ b=-1,\ c_2=16$	
		$\therefore$ distance between two parallel lines is	
		$=\left\|\dfrac{c_2-c_1}{\sqrt{a^2+b^2}}\right\|=\left\|\dfrac{16-7}{\sqrt{3^2+(-1)^2}}\right\|$	2
		$=\left\|\dfrac{9}{\sqrt{10}}\right\|$	
		$=\dfrac{9}{\sqrt{10}}$ OR 2.846	1
		--	
	b) (i)	Find the acute angle between the lines $2x+3y+5=0$ and $x-2y-4=0$	**03**
	Ans	For $2x+3y+5=0$	
		slope $m_1=-\dfrac{a}{b}=-\dfrac{2}{3}$	½
		For $x-2y-4=0,$	
		slope $m_2=-\dfrac{a}{b}=-\dfrac{1}{-2}=\dfrac{1}{2}$	½
		$\therefore \tan\theta=\left\|\dfrac{m_1-m_2}{1+m_1m_2}\right\|$	
		$=\left\|\dfrac{-\frac{2}{3}-\frac{1}{2}}{1+\left(-\frac{2}{3}\right)\cdot\left(\frac{1}{2}\right)}\right\|$	1
		$=\dfrac{7}{4}$	
		$\therefore \theta=\tan^{-1}\left(\dfrac{7}{4}\right)$ *OR* 60.26^0	1
		--	
	(ii)	Find the equation of the line through the point of intersection of lines,	**03**
		$4x+3y=8$; and $x+y=1$ and parallel to the line $5x-7y=3$	
	Ans	$\because 4x+3y=8$	
		$\underline{x+y=1}$	
		$\therefore \quad 4x+3y=8$	
		$\underline{-\ \ 4x+4y=4}$	

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5.	b) (ii)	$-y=4$	
		$y=-4$	
		$\therefore \quad x-4=1$	
		$\therefore x=5$	
		$\therefore$ Point of intersection $=(5,-4)$	1
		Slope of the line $5x-7y=3$ is,	
		$m=-\frac{a}{b}=-\frac{5}{-7}=\frac{5}{7}$	½
		$\therefore$ Slope of the required line is,	
		$m=\frac{5}{7}$	½
		$\therefore$ equation required line is,	
		$y-y_1=m(x-x_1)$	
		$\therefore\ y+4=\frac{5}{7}(x-5)$	½
		$\therefore 5x-7y-53=0$	½
		---	
	c) (i)	The area of a rectangular courtyard is 3000 sq.m. Its sides are in the ratio 6:5.Find the perimeter of courtyard.	**03**
	Ans	Area of rectangular courtyard is $=$ length $\times$ breadth	
		Given $l:b=6:5$	
		i.e. $\frac{l}{b}=\frac{6}{5}$	
		$\therefore l=\frac{6}{5}b$	
		$\because\ A=l\times b$	
		$3000=\frac{6}{5}b\times b$	
		$\frac{15000}{6}=b^2$	
		$2500=b^2$	1
		$\therefore b=50$	
		$\therefore l=\frac{6}{5}b=\frac{6}{5}\times 50$	1
		$\therefore l=60$	
		Perimeter of rectangular courtyard is $=2(l+b)$	
		$=2(60+50)$	
		$=220\ m.$	1

Q. No.	Sub Q. N.	Answer	Marking Scheme
5.	c) (i)	**OR** Sides are in the ratio $6:5$ Let x be the common multiple $\therefore$ Sides are $6x$ *and* $5x$ $\therefore A = 3000$ $\therefore 6x \times 5x = 3000$ $\therefore 30x^2 = 3000$ $\therefore x^2 = 100$ $\therefore x = 10$ $\therefore$ Sides are $6x = 60 = l$ *and* $5x = 50 = b$ Perimeter of rectangular courtyard is $= 2(l+b)$ $= 2(60+50)$ $= 220\ m.$	 1 1 1
	c) (ii)	A circus tent is cylindrical to height 3 m and conical above it . If its diameter is 105 m and slant height of cone is 5 m,calculate the area of total canvas required.	**03**
	Ans	Given $h = 3m$, $d = 105m$ $\therefore r = \frac{105}{2} = 52.5m$, $l = 5\ m$ curved surface area of cylinder $= 2\pi r$h $= 2 \times 3.14 \times 52.5 \times 3 = 989.1\ sq.m.$ curved surface area of cone $= \pi rl$ $= 3.14 \times 52.5 \times 5 = 824.25\ sq.m.$ $\therefore$ Area of total canvas required $= 989.1 + 824.25$ $= 1813.35\ sq.m.$	 1 1 1
6.		Attempt any **two:**	**12**
	a)	Using matrix inversion method , solve $x + y + z = 3$; $x + 2y + 3z = 4$; $x + 4y + 9z = 6$	**06**
	Ans	Let $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 4 & 9 \end{bmatrix}$ $\|A\| = \begin{vmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 4 & 9 \end{vmatrix}$ $\|A\| = 1(18-12) - 1(9-3) + 1(4-2)$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
6.	a)	$\therefore \|A\| = 2 \neq 0$	1
		$\therefore A^{-1}$ exists	
		Matrix of minors $= \begin{bmatrix} \begin{vmatrix} 2 & 3 \\ 4 & 9 \end{vmatrix} & \begin{vmatrix} 1 & 3 \\ 1 & 9 \end{vmatrix} & \begin{vmatrix} 1 & 2 \\ 1 & 4 \end{vmatrix} \\ \begin{vmatrix} 1 & 1 \\ 4 & 9 \end{vmatrix} & \begin{vmatrix} 1 & 1 \\ 1 & 9 \end{vmatrix} & \begin{vmatrix} 1 & 1 \\ 1 & 4 \end{vmatrix} \\ \begin{vmatrix} 1 & 1 \\ 2 & 3 \end{vmatrix} & \begin{vmatrix} 1 & 1 \\ 1 & 3 \end{vmatrix} & \begin{vmatrix} 1 & 1 \\ 1 & 2 \end{vmatrix} \end{bmatrix}$	
		$= \begin{bmatrix} 6 & 6 & 2 \\ 5 & 8 & 3 \\ 1 & 2 & 1 \end{bmatrix}$	1
		Matrix of cofactors $= \begin{bmatrix} 6 & -6 & 2 \\ -5 & 8 & -3 \\ 1 & -2 & 1 \end{bmatrix}$	½
		OR	
		$c_{11} = (-1)^{1+1}\begin{vmatrix} 2 & 3 \\ 4 & 9 \end{vmatrix} = 6,\ c_{12} = (-1)^{1+2}\begin{vmatrix} 1 & 3 \\ 1 & 9 \end{vmatrix} = -6,\ c_{13} = (-1)^{1+3}\begin{vmatrix} 1 & 2 \\ 1 & 4 \end{vmatrix} = 2,$	
		$c_{21} = (-1)^{2+1}\begin{vmatrix} 1 & 1 \\ 4 & 9 \end{vmatrix} = -5,\ c_{22} = (-1)^{2+2}\begin{vmatrix} 1 & 1 \\ 1 & 9 \end{vmatrix} = 8,\ c_{23} = (-1)^{2+3}\begin{vmatrix} 1 & 1 \\ 1 & 4 \end{vmatrix} = -3,$	1
		$c_{31} = (-1)^{3+1}\begin{vmatrix} 1 & 1 \\ 2 & 3 \end{vmatrix} = 1,\ c_{32} = (-1)^{3+2}\begin{vmatrix} 1 & 1 \\ 1 & 3 \end{vmatrix} = -2,\ c_{33} = (-1)^{3+3}\begin{vmatrix} 1 & 1 \\ 1 & 2 \end{vmatrix} = 1,$	
		Matrix of cofactors $= \begin{bmatrix} 6 & -6 & 2 \\ -5 & 8 & -3 \\ 1 & -2 & 1 \end{bmatrix}$	½
		$\therefore AdjA = \begin{bmatrix} 6 & -5 & 1 \\ -6 & 8 & -2 \\ 2 & -3 & 1 \end{bmatrix}$	½
		$A^{-1} = \frac{1}{\|A\|}\text{Adj}.A = \frac{1}{2}\begin{bmatrix} 6 & -5 & 1 \\ -6 & 8 & -2 \\ 2 & -3 & 1 \end{bmatrix}$	1
		$X = A^{-1}B$	
		$\therefore \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 6 & -5 & 1 \\ -6 & 8 & -2 \\ 2 & -3 & 1 \end{bmatrix}\begin{bmatrix} 3 \\ 4 \\ 6 \end{bmatrix}$	

Q. No.	Sub Q. N.	Answer	Marking Scheme
6.	a)	$\therefore \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 18-20+6 \\ -18+32-12 \\ 6-12+6 \end{bmatrix}$	1
		$\therefore \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 4 \\ 2 \\ 0 \end{bmatrix}$	
		$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \\ 0 \end{bmatrix}$	1
		$\therefore\ x=2,\ y=1,\ z=0$	
	b)	Find mean, standard deviation and coefficient of variance of the following:	**06**

Class:	0-10	10-20	20-30	30-40	40-50
Frequency:	3	5	8	3	1

Ans

C.I.	x_i	f_i	$f_i x_i$	x_i^2	$f_i x_i^2$
0-10	5	3	15	25	75
10-20	15	5	75	225	1125
20-30	25	8	200	625	5000
30-40	35	3	105	1225	3675
40-50	45	1	45	2025	2025
		N=20	$\sum f_i x_i =$ 440		$\sum f_i x_i^2 =$ 11900

2

Mean, $\bar{x} = \frac{\sum f_i x_i}{N} = \frac{440}{20} = 22$ 1

$$S.D. = \sqrt{\frac{\sum f_i x_i^2}{N} - \left(\bar{x}\right)^2}$$

$$S.D. = \sqrt{\frac{11900}{20} - (22)^2}$$ 1

$S.D. = 10.54$ 1

Q. No.	Sub Q. N.	Answer	Marking Scheme
6.	b)	Coefficient of variance $= \frac{S.D.}{Mean} \times 100 = \frac{10.54}{22} \times 100 = 47.91\%$	1

OR

Class	x_i	f_i	d_i	$f_i d_i$	d^2_i	$f_i d^2_i$
0-10	5	3	-2	-6	4	12
10-20	15	5	-1	-5	1	5
20-30	25	8	0	0	0	0
30-40	35	3	1	3	1	3
40-50	45	1	2	2	4	4
		N=20		-6		24

2

Mean, $\bar{x} = A + \left(\frac{\sum f_i d_i}{N}\right) \times h = 25 + \left(\frac{-6}{20}\right) \times 10 = 22$ 1

$$S.D. = \sigma = \sqrt{\frac{\sum f_i d_i^2}{N} - \left(\frac{\sum f_i d_i}{N}\right)^2} \times h$$

$$= \sqrt{\frac{24}{20} - \left(\frac{-6}{20}\right)^2} \times 10$$ 1

$$= 10.54$$ 1

Coefficient of variance $= \frac{S.D.}{Mean} \times 100$

$= \frac{10.54}{22} \times 100$

$= 47.91\%$ 1

OR

C.I.	x_i	f_i	$f_i x_i$	$\left(x_i - \bar{x}\right)^2$	$f_i\left(x_i - \bar{x}\right)^2$
0-10	5	3	15	289	867
10-20	15	5	75	49	245
20-30	25	8	200	9	72
30-40	35	3	105	169	507
40-50	45	1	45	529	529
		$\sum f_i = 20$	$\sum f_i x_i = 440$		$\sum f_i\left(x_i - \bar{x}\right)^2 = 2220$

2

Q. No.	Sub Q. N.	Answer	Marking Scheme
6.	b)	Mean, $\bar{x} = \frac{\sum f_i x_i}{N} = \frac{440}{20} = 22$	1
		$S.D. = \sqrt{\frac{\sum f_i \left(x_i - \bar{x}\right)^2}{\sum f_i}}$	
		$S.D. = \sqrt{\frac{2220}{20}}$	1
		$S.D. = 10.54$	1
		Coefficient of variance $= \frac{S.D.}{Mean} \times 100$ $= \frac{10.54}{22} \times 100$ $= 47.91\%$	1
	c) (i)	Calculate the range and coefficient of range for the following data:	**03**

Class:	21-25	26-30	31-35	36-40	41-45
Frequency:	4	16	38	12	10

Ans

C.I.	20.5-25.5	25.5-30.5	30.5-35.5	35.5-40.5	40.5-45.5
f_i	4	16	38	12	10

Range $= L - S = 45.5 - 20.5$ $= 25$ — 1

Coefficient of range $= \frac{L-S}{L+S}$

$= \frac{45.5 - 20.5}{45.5 + 20.5}$ — 1

$= \frac{25}{66}$ OR 0.379 — 1

c) (ii) The two sets of observations are given below. Which of them is more consistent? — **03**

Set I Set II

$\bar{x} = 82.5$ $\bar{x} = 48.75$

$\sigma = 7.3$ $\sigma = 8.35$

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Q. No.	Sub Q. N.	Answer	Marking Scheme
6.	c) (ii)	Set-I Coefficient of variation $V_1 = \frac{S.D.}{Mean} \times 100$ $V_1 = \frac{7.3}{82.5} \times 100$ $V_1 = 8.848$ Set-II Coefficient of variation $V_2 = \frac{S.D.}{Mean} \times 100$ $V_2 = \frac{8.35}{48.75} \times 100$ $V_2 = 17.128$ $\because V_1 < V_2$ $\therefore$ Set I is more consistent	 1 1 1

Important Note

In the solution of the question paper, wherever possible all the possible alternative methods of solution are given for the sake of convenience. Still student may follow a method other than the given herein. In such case, first see whether the method falls within the scope of the curriculum, and then only give appropriate marks in accordance with the scheme of marking.
