2731

Code : 20SC01T

Register Number | | | | | | | | | | |

I Semester Diploma Examination, March/April-2022

ENGINEERING MATHEMATICS

Time : 3 Hours] **[Max. Marks : 100**

Instructions: (i) Answer **one** full question from each section.
(ii) Each section carries **20** marks.
(iii) Answer **all** sections.

SECTION – I

1. (a) If the determinant value of the matrix $\begin{bmatrix} 2 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & x \end{bmatrix} = 8$, then find the value of 'x'. **4**

OR

For the matrix $A = \begin{bmatrix} 4 & -3 \\ -5 & 2 \end{bmatrix}$, find adj (A).

(b) In a mesh-analysis formulation, the following equations are obtained
$4i_1 + 2i_2 = 4; i_1 + i_2 = 2$
obtain the currents i_1 and i_2 using Cramer's rule. **6**

OR

If $A = \begin{bmatrix} 1 & 2 \\ 1 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$, find the product matrix AB and hence find its inverse matrix, if it exists.

(c) Find the characteristics roots of the matrix $A = \begin{bmatrix} 2 & 3 \\ 0 & 4 \end{bmatrix}$. **5**

OR

A manufacturer produces 100 units of Product 'X', 200 units of Product 'Y', 800 units of Product 'Z' and sells in an open market. If the unit sale price of Product 'X' is ₹ 2, Product 'Y' is ₹ 4 and Product 'Z' is ₹ 10, find the total revenue earned by the seller with the help of product of two matrices.

(d) If $A = \begin{bmatrix} 2 & 1 & 4 \\ 4 & 1 & 5 \end{bmatrix}$, $B = \begin{bmatrix} 3 & -1 \\ 2 & 2 \\ 1 & 3 \end{bmatrix}$, then can we perform AB and BA ? If so, write the order of AB and BA. **5**

OR

If for a matrix A, A + I = 0, where I is identity matrix of order 3 × 3 and 0 is Null matrix of order corresponding to matrix A, then find A.

SECTION – II

2. (a) Observe the following tabulations : **4**

P		Q	
PI	Equation of a straight line in intercept form with x-intercept 2 units, y-intercept 3 units.	Ql	$2x + y = 1$
P2	The equation of a line whose inclination is 45° with positive x-axis and passing through origin.	Q2	$\frac{x}{2} + \frac{y}{3} = 1$
		Q3	$y = x$

Giving all relevant steps and solution, fill up the relevant answer in the below tabular column.

	P1	P2
Ans. →		

OR

What are the conditions for the lines, $y = m_1x + c_1$ and $y = m_2x + c_2$ to be

(i) Parallel

(ii) Perpendicular

Also, check whether, the lines $x - 2y = 4$ and $2x + y = 3$ are parallel or perpendicular.

(b) If a straight line is inclined at an angle of 135° with the positive direction of x-axis, then what is its slope ? Further, if the same line passes through the point (1, 2), find its equation. **6**

OR

Find the equation of the straight line passing through two points (6, 2) and (8, 4).

(c) Find the equation of the lines parallel to the line joining the points A(–2, 5) and B(2, –5). **5**

OR

Find the equation of the line passing through the point (1, 3) and perpendicular to the line $2x + y = 1$.

(d) If the x-intercept of a line is 2 units and y-intercept of the line is twice the x-intercept, find the equation of a line. **5**

OR

Find the tangent of the angle between the lines $x + 3y = 1$ and $3x - 5y = 2$.

SECTION – III

3. (a) Express 225° as a allied angle and hence find the value of sin 225°. **4**

OR

Find the value of cos 15° using relevant compound angle.

(b) If $\tan A = \frac{1}{3}$ and $\tan B = \frac{1}{2}$, find $\tan (A + B)$. **6**

OR

Show that $\sin 40° + \sin 20° - \cos 10° = 0$.

(c) Simplify : $\dfrac{\cos (360° - A) \tan (360° + A)}{\cot (270° - A) \sin (90° + A)}$ **5**

OR

Find the value of 'θ' lying between 0 and 2π which satisfy the equation $2 \cos \theta - 1 = 0$.

(d) Prove that : $\sin 20° \cdot \sin 40° \cdot \sin 80° = \frac{\sqrt{3}}{8}$. **5**

OR

Show that $\cos 2\theta = 2 \cos^2 \theta - 1$.

SECTION – IV

4. (a) If $y = \frac{x+1}{x-1}$, then find the first derivative of 'y' with respect to 'x' at $x = 2$. **4**

OR

If $y = x^4 + 4x^3$, find $\frac{dy}{dx}$ at $x = 1$.

[Turn over

(b) If $y = \log(\sin(x^3))$, obtain $\frac{dy}{dx}$ using Chain rule of differentiation. 6

OR

If $y = t^3 + 3t^2 + 6t + 1$ represents the chemical disintegration equation with respect to time 't', then calculate the rate of change of 'y' with respect to time 't', when $t = 2$ units.

(c) When brakes are applied to a moving car, the car travels a distance of 'S' feet in 't' seconds given by, $S = 10t - 20t^2$. When does the car stop ? Also, find the acceleration of the car. 5

OR

If $S = at^3 + bt$, find 'a' and 'b' given that at $t = 3$, the velocity is zero and acceleration is 14 units.

(d) Obtain the maximum and minimum values of the function $f(x) = 2x^3 - 21x^2 + 36x - 20$. 5

OR

A moving particle traces the path given by the curve $y = x^3 + x^2$. What could be the equation of the tangent to the curve at a point (1, 2) ?

SECTION – V

5. (a) Find the integration of $x^3 + \sin x + e^x + 2$ w.r.t. x. 4

OR

Using the rule of integration by parts, evaluate $\int x \cdot \sin x \cdot dx$

(b) Evaluate : $\int \cos 7x \cdot \cos 3x \cdot dx$ 6

OR

Evaluate : $\int \sin^3 x \cdot dx$

(c) If the area bounded by the curve $y = x$ between the ordinates $x = 2$ and $x = k$ is 6 sq. units, then find the value of 'k'. 5

OR

As a definite integral, find the value of $\int_0^1 \frac{(\tan^{-1} x)^2}{1+x^2} \cdot dx$.

(d) Calculate the area converging due to radioactive decay of an element governed by the equation $y = x^3 + 1$ in between the ordinates $x = 0$ to $x = 1$, bounded by X-axis. 5

OR

Find the volume of the solid generated by the revolution of the curve $y^2 = x^3 + 5x$ between the ordinates $x = 2$ & $x = 4$ about X-axis.

I SEMESTER DIPLOMA EXAMINATION – APRIL / MAY 2022

Sub : Engineering Mathematics

Sub Code : 20SC01T

SCHEME OF VALUATION

Q no	Scheme	Marks	Q no	Scheme	Marks
	SECTION – I		1)b)	Writing $\Delta, \Delta i_1, \Delta i_2$	1 m each
1)a)	Writing as det	1 M		Finding i_1 *and* i_2 (OR)	1½m each
	Expansion	1 M		Finding AB	2 M
	Rest	2 M		Showing non- singular	1 M
	(OR)			Formula for inverse of matrix	1 M
	Writing cofactors of elements of A or interchange of P.d elements	2 M		Result	2 M
	adj A or changing sign of S.d. elements	2 M	1)d)	0(A) – 2 x 3	½ M
	(* Alternate method award full marks)			0(B) – 3x 2	½ M
1)c)	Writing $\lvert A-\lambda I\rvert$ =0 and Substituting	1 M		Writing 0(AB)	2 M
	Ch. Equation	2 M		Writing 0(BA)	2 M
	Ch. Roots (OR)	2 M		(OR) A+I=0 $\Rightarrow A+\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}=\begin{pmatrix}0&0&0\\0&0&0\\0&0&0\end{pmatrix}$	$2\frac{1}{2}$ m
	Writing A=[100 200 800] B= $\begin{bmatrix}2\\4\\10\end{bmatrix}$	1 M 1 M		A = -I=- $\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$	$2\frac{1}{2}$ m
	Writing AB	1 M		(* please award full marks for alternate method*)	
	Matrix multiplication and arriving at final Ans	2 M			
2)a)	Writing $\frac{x}{a}+\frac{y}{b}=1$	1M	2) b)	Writing m=-1	2 M
	(P1) $\frac{x}{2}+\frac{y}{3}=1$	1M		substituting in $y-y_1=m(x-x_1)$	2 M
	(P2) $m=1$	1M		Final answer (OR)	2 M
	Final ans $y=x$ { award full marks for any alternate way of answering even if steps are not shown} (OR)	1M		Writing $\frac{y-y_1}{y_2-y_1}=\frac{x-x_1}{x_2-x_1}$	2 M
	Writing $m_1 = m_2$ $m_1.m_2$ =-1	1M 1M		Substituting (x_1y_1) and (x_2y_2)	2 M
	writing $m_1=+\frac{1}{2}$ m_2 = -2	½ + ½		Final answer	2 M
	Condition for *perpendicularity* : $m_1m_2=-1$ checking	1M			

Q no	Scheme	Marks
2)(c)	Calculation of slope of AB (OR)	5M
	Slope of $2x + y - 1 = 0$ $m_1 = -2$	1M
	Req line slope, $m_2 = \frac{1}{2}$	1M
	Writing, $y - y_1 = m_2(x - x_1)$	1M
	Substitution and final answer	2M
2)(d)	Writing a=2, b=4	2M
	Formula Arriving at $2x + y - 4 = 0$	1M 2M
	(OR)	
	Writing values of m_1 *and* m_2	½ + ½
	Formula	1M
	Substitution	1M
	Final answer	2M
3)(a)	Writing 225^0 as an allied angle	1 M
	Rest	3M
	(OR) Splitting $15^0 = 45^0$-30^0or $15^0 = 60^0$-45^0	1M
	Formula and substitution	1M
	Rest	2M
3)(b)	Formula tan (A + B)	2M
	Substitution of tan A & tan B	2M
	Final answer	2M
	(OR)	
	Transformation Formula	1M
	Substitution and Simplification	1+1+1
	Rest	2M

Q no	Scheme	Marks
3)(c)	Each allied Angle simplification	1 m each . (4m)
	Final answer (OR)	1M
	Writing cos $\theta = \frac{1}{2}$	1m
	Writing, $\theta = 60^0$	2m
	Writing, $\theta = 300^0$	2m
3)(d)	Transformation Formula	1M
	Simplification	3m
	Final answer (OR)	1m
	Spiltting and applying compound angle formula	1m
	Rest	4M
4)(a)	Writing quotient rule of differentiation for the given problem	1m
	Differentiation of terms in numerator	1m
	Simplifications and final answer	2m
	(OR) Each term differentiation	1+1
	Sub, $x = 1$ & arriving at final answer	2m
4)(b)	Each chain Rule derivative	2+2+2
	[single step answer, award full marks]	
	(OR)	
	First derivative	3m
	Sub, t = 2 and obtaining final answer	3m
4)(c)	$\frac{ds}{dt}, \frac{d^2s}{dt^2}$	1+1
	Equation $\frac{ds}{dt} = 0$	1m
	Obtaining 't' $= \frac{1}{4}$	1+1
	(OR)	
	Obtaining $\frac{ds}{dt}, \frac{d^2s}{dt^2}$	1+1
	Arriving at $27\,a + b = 0$ and Obtaining $a = \frac{7}{9}$	1 m
	Obtaining $b = -21$	2m

Q no	Scheme	Marks	Q no	Scheme	Marks
4)(d)	Finding $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$	(½ + ½) m	5)(c)	Formulating as $\int_2^k x.dx = 6$ Using area formula	2m
	Obtaining critical values of $x = 1$ & $x = 6$	2m		Integrating and applying limits	2m
	Local max values	1 M		Final answer	1m
	Local min values	1 M		(OR)	
	(OR)			Showing substitution &changing limit	2m
	Finding $\frac{d}{dx}(x^3)$, $\frac{d}{dx}(x^2)$	½ + ½		Integrating	1m
	$\left(\frac{dy}{dx}\right)_{(1,2)} = 5 = m$	1m		Final answer	2m
	Writing $y - y_1 = m(x - x_1)$	1m	5)(d)	Formulating as $\int_0^1 (x^3 + 1).dx$	1m
	Rest	2M		Each integral	(1+1)m
5)(a)	Each integral (OR)	1+1+1+1		Substituting limits	1m
	Applying integration by parts	2m		Final answer $\left(\frac{5}{4}\right)$ sq units	1m
	Simplification	1m		(OR)	
	Final answer	1M		formula $V = \int_a^b \pi y^2 .dx$	1m
5)(b)	Writing $cosA.cosB$ formula	1m		Sub, y^2 and limits	1m
	Applying formula	1m		Each integral	(1+1)m
	Integration of each term	(1+1)m		Final answer	1m
	Final answer	2m		**Note**	
	(OR)			Kindly award marks for any alternate method in any problem solving.	
	Formula for sin 3x Arriving at, $\frac{3}{4}\int \sin x.dx - \frac{1}{4}\int \sin 3x.dx$	1m 2m		.	
	Rest	3m			
	* (substitution method)	award full marks			

I certify that the scheme of valuation is prepared by me for Q.P code : 20SC01T is correct to the best of my knowledge.

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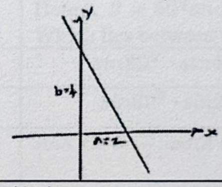
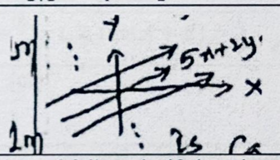
Model answers

Q no	Scheme	Marks
1)(a)	$\begin{vmatrix}2&0&0\\0&4&0\\0&0&x\end{vmatrix}=8$	1m
	On expansion, $8x=8\rightarrow x=1$ or	(1+1+1)m
	$A=\begin{bmatrix}4&-3\\-5&2\end{bmatrix}$	
	Interchange of p.d. elts	2m
	Changing sign of secondary diagonal elts	2m
	i.e. Adj $A=\begin{bmatrix}2&3\\5&4\end{bmatrix}$	4m
1)(b)	$4i_1+2i_2=4$ $i_1+i_2=2$	
	$\Delta=\begin{vmatrix}4&2\\1&1\end{vmatrix}=4-2=2$	1m
	$\Delta i_1=\begin{vmatrix}4&2\\2&1\end{vmatrix}=4-4=0$	1m
	$\Delta i_2=\begin{vmatrix}4&4\\1&2\end{vmatrix}=8-4=4$	1m
	$\left.\begin{array}{l}\therefore i_1=\frac{\Delta i_1}{\Delta}=\frac{0}{2}=0;\\ i_2=\frac{\Delta i_2}{\Delta}=\frac{4}{2}=2\end{array}\right\}$ $\left\{\begin{array}{l}\frac{1}{2}m+\frac{1}{2}m\ for\ \frac{\Delta i_1}{\Delta},\frac{\Delta i_2}{\Delta},\\ 1\,\text{m}\ each\ for\ final\ i_1,\ i_2\end{array}\right\}$	3m
	(OR) A.B= $\begin{bmatrix}1&2\\1&4\end{bmatrix}\begin{bmatrix}3&1\\2&1\end{bmatrix}$ $=\begin{bmatrix}3+4&1+2\\3+8&1+4\end{bmatrix}=\begin{bmatrix}7&3\\11&5\end{bmatrix}$	2m
	Let $C=\begin{bmatrix}7&3\\11&5\end{bmatrix}$, $\lvert C\rvert=35-33$ $=2$ $\neq 0$ $\therefore$ 'C' is non-singular	1m

Q no	Scheme	Marks
1)(b)	C^{-1} exists, i.e., $(AB)^{-1}$ exists	
	$C^{-1}=\frac{1}{\lvert C\rvert}\cdot adj\ C$ $=\frac{1}{2}\begin{bmatrix}5&-3\\-11&7\end{bmatrix}$	3m
1)(c)	A = $\begin{bmatrix}2&3\\0&4\end{bmatrix}$ $A-\lambda I=\begin{bmatrix}2&3\\0&4\end{bmatrix}-\lambda\begin{bmatrix}1&0\\0&1\end{bmatrix}$	
	$=\begin{bmatrix}2-\lambda&3\\0&4-\lambda\end{bmatrix}$	1 m
	Ch. Equation $\lvert A-\lambda I\rvert=0$	
	$\begin{bmatrix}2-\lambda&3\\0&4-\lambda\end{bmatrix}=0$	
	$(2-\lambda)(4-\lambda)-0=0$	
	$8-2\lambda-4\lambda+\lambda^2=0$ $\lambda^2-6\lambda+8=0$	2m
	$\lambda^2-4\lambda-2\lambda+8=0$ $\lambda(\lambda-4)-2(\lambda-4)=0$ $(\lambda-4)(\lambda-2)=0$ $\lambda=4,\quad \lambda=2$	2m
	(OR)	
	{ Formulate, row matrix as 'matrix of products' and coln matrix as selling price matrix}	
	Let, $A=[100\ \ 200\ \ 800]$	1m
	B= $\begin{bmatrix}2\\4\\10\end{bmatrix}$ Total revenue is given by A.B	1m
	A.B = $\overrightarrow{[100\ 200\ 800]}\begin{bmatrix}2\\4\\10\end{bmatrix}\downarrow$	1m
	=[200+800+8000] =[9000]	2m
	Total revenue earned = Rs 9,000	

Q no	Scheme	Marks	Q no	Scheme	Marks
1)(d)	Order (A) $\rightarrow 2x3$ Order (B) $\rightarrow 3x2$	1m	2)(a)	$y = m_1x + c_1$ $y = m_2x + c_2$	
	$A.B \rightarrow \left.\begin{matrix}(2\,x\,3)\\(3\,x\,2)\end{matrix}\right\} \Rightarrow 2x2$	2m		i) For parallel, $m_1 = m_2$ ii) For perpendicular, $m_1.m_2 = -1$	1m 1m
	(No of col of A= No of rows of B)			Consider, $x - 2y - 4 = 0,$ $\left(m = -\frac{a}{b}\right)$	
	$A.B$ B.A $\rightarrow \left.\begin{matrix}(3\,x\,2)\\(2\,x\,3)\end{matrix}\right\} \Rightarrow 3x3$	2m		$m_1 = \frac{-1}{-2} = \frac{1}{2}$ *and* $2x + y - 3 = 0$	
	((No of col of B= No of rows of A)∴ order (AB) $\rightarrow 2x2$ order (BA) $\rightarrow 3x3$			$m_2 = \frac{-2}{1} = -2$	1m
	$A + I = 0$ $A + \begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix} = \begin{pmatrix}0&0&0\\0&0&0\\0&0&0\end{pmatrix}$	2m		$\therefore m_1.m_2 = \left(\frac{1}{2}\right)(-2) = -1$ **Lines are perpendicular**	1m
	$A = \begin{pmatrix}0&0&0\\0&0&0\\0&0&0\end{pmatrix} - \begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$	2m			
	$A = \begin{pmatrix}-1&0&0\\0&-1&0\\0&0&-1\end{pmatrix}$	1m	2)(b)	$\theta = 135^0$	
	$A = -I$ Alternate method : $A + I = 0$ $A = 0 - I = -I = -\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$ ***Note :*** ***(Suitable marks can be awarded for the above alternate method)***			Slope, $m = \tan 135^0$ $m = \tan(90^0 - 45^0)$ $m = -\tan 45^0 = -1$ Line passes through (1, 2) $\therefore y - y_1 = m(x - x_1)$ $y - 2 = -1(x - 1)$	2m 2m
2)(a)	P1 | P2 Q2 | Q3			$y - 2 = -x + 1$ $x + y - 3 = 0$ (OR)	2m
	P1 : $\frac{x}{a} + \frac{y}{b} = 1$ $\frac{x}{2} + \frac{y}{3} = 1$ (Q2)	1m 1m		Line passes through (6, 2)and (8, 4)	
	P2 : $\theta = 45^0, m = \tan\theta$ $\boldsymbol{m = \tan 45^0 = 1}$	1m		Equation : $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$	2m
	$y - y_1 = m(x - x_1)$ y – 0 = 1 (x-0) y = x (Q3)	1m		$\frac{y-2}{4-2} = \frac{x-6}{8-6}$	1m
	{ award full marks for any alternate way of answering even if steps are not completely shown}			$\frac{y-2}{2} = \frac{x-6}{2}$	1m
	[or]			$y - 2 = x - 6$ $x - y - 4 = 0$	1m 1m

Q no	Scheme	Marks	Q no	Scheme	Marks
2)(c)	A = (-2, 5), b= (2, 5) Equation of line passing through two pts is of the form:		2)(c)	Equation of the line passing through (1, 3) and slope $\frac{1}{2}$ is	
	$\frac{y-y_1}{y_2-y_1}=\frac{x-x_1}{x_2-x_1}$	2m		$y-y_1=m\,(x-x_1)$ $y-3=\frac{1}{2}(x-1)$	1m
	$\frac{y-5}{-5-5}=\frac{x-2}{2+2}$			$2y-6=x-1$ $x-2y+5=0$	2m
	$\Rightarrow \frac{y-5}{-10}=\frac{x+2}{4}$		2(d)	$a=2\,;\,b=4$	2m
	$\Rightarrow \frac{y-5}{-5}=\frac{x+2}{2}$			Equation : $\frac{x}{a}+\frac{y}{b}=1$	1m
	$\Rightarrow 2y-10=-5x-10$	2m		$\frac{x}{2}+\frac{y}{4}=1$	
	$\Rightarrow 5x+2y=0$			$\frac{2x+y}{4}=1 \Rightarrow 2x+y=4$	
	All lines parallel to the above will be of the form $5x+2y+c=0$ Aliter:			$2x+y-4=0$ 	2m
	Slope of AB = $\frac{y_2-y_1}{x_2-x_1}$ $=\frac{-5-5}{2+2}=\frac{-10}{4}=\frac{-5}{2}$				
				(OR) $x+3y=1 \Rightarrow m_1=\frac{-a}{b}=\frac{-1}{3}$ $3x-5y=2 \Rightarrow m_2=\frac{-3}{-5}=\frac{3}{5}$	1m
	(award full marks if slope is calculated) Any alternate answers with slope as $\frac{-5}{2}$, award full marks (OR)			$\tan\theta=\left\|\frac{m_1-m_2}{1+m_1m_2}\right\|$ $\tan\theta=\left\|\frac{\frac{-1}{3}-\frac{3}{5}}{1+\left(\frac{-1}{3}\right)\left(\frac{3}{5}\right)}\right\|$	1m 1m
	$(x_1,y_1)=(1,3)$ and the required line is $\perp^r$ to $2x+y-1=0$			$=\left\|\frac{-5-9/15}{15-3/15}\right\|$	
	Slope $m_1=\frac{-2}{1}=-2$	1m		$=\left\|\frac{-14}{12}\right\|=\left\|\frac{-7}{6}\right\|$	
	$\therefore$ slope of required line is $\frac{1}{2}$ (since, perpendicular, $m_1m_2=-1$)	1m		$\tan\theta=\left\|\frac{-7}{6}\right\|$ OR $\tan\theta=\frac{7}{6}$	2m

Q no	Scheme	Marks	Qn o	Scheme	Ma rks
3)(a)	$225^0 = 2.90^0 + 45^0$	1m		Substituting,	
	$\sin 225^0 = \sin(2.90^0 + 45^0)$	1m		$\frac{\cos A \cdot \tan A}{\tan A \cdot \cos A} = 1$	1m
	$=-\sin\ 45^0 = -\frac{1}{\sqrt{2}}$	1m		(Award full marks for alternate methods)	
	(225^0 −third quadrant 'sin' is negative in III quadrant)			S | A T | C	
	$\Rightarrow \sin\ 225^0 = -\frac{1}{\sqrt{2}}$	1m		(OR) $2\cos\theta - 1 = 0$	
	(OR)			$\cos\theta = \frac{1}{2}$	1m
	$\cos 15^0 = \cos(45^0 - 30^0)$			Here, $\cos\theta$ is positive if θ lies in either first quadrant or fourth quadrant	
	[cos (A-B)=cos A cos B+sin A.sin B]	1m		i.e. $\cos 60^0 = \frac{1}{2} \Rightarrow \theta = 60^0$	2m
	$= \cos 45^0 \cdot \cos 30^0 + \sin 45^0 \sin 30^0$	1m		$\Rightarrow \theta$ *can* also be, $\theta = 360^0 - 60^0 = 300^0$	2m
	$=\frac{1}{\sqrt{2}} \cdot \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \cdot \frac{1}{2} = \frac{\sqrt{3}+1}{2\sqrt{2}}$	2m		Hence, $\theta = 60^0 \text{ and } 300^0$, Which lies between 0 and 2π	
3)(b)	$\tan A = \frac{1}{3}$, $\tan B = \frac{1}{2}$		3d)	$\sin 20^0 \cdot \sin 40^0 \cdot \sin 80^0$	
	$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \cdot \tan B}$	2m		$\sin 80^0 \cdot \sin 20^0 \cdot \sin 40^0$	
	$= \frac{\frac{1}{3}+\frac{1}{2}}{1-\frac{1}{3}\cdot\frac{1}{2}} = \frac{3+2/6}{6-1/6}$	2m		$\sin A . \sin B = \frac{-1}{2}[\cos(A+B) - \cos(A-B)]$	
	$= \frac{5}{5} = 1 \ \therefore \tan(A+B) = 1$	2m		$\frac{-1}{2}[\cos 100^0 - \cos 60^0] \cdot \sin 40^0$	1m
	[or]			$\frac{-1}{2}[\cos 100^0 . \sin 40^0] + \frac{1}{2} \cdot \frac{1}{2} \cdot \sin 40^0$	1m
	$\sin 40^0 + \sin 20^0 - \cos 10^0$			$\frac{-1}{2}\left[\frac{1}{2}(\sin 140^0 - \sin 60^0)\right] + \frac{1}{4}\sin 40^0$	
	$\left[\sin C + \sin D = 2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)\right]$	1m		$= \frac{-1}{4}\sin 40^0 + \frac{1}{4}\left(\frac{\sqrt{3}}{2}\right) + \frac{1}{4}\sin 40^0$	1m
	$=2\sin\left(\frac{40^0+20^0}{2}\right) \cdot \cos\left(\frac{40^0-20^0}{2}\right) - \cos 10^0$	1m		$\Rightarrow \frac{\sqrt{3}}{8} = RHS$	1m
	$=2\sin\left(\frac{60^0}{2}\right) \cdot \cos\left(\frac{20^0}{2}\right) - \cos 10^0$	1m			1m
	$=2\sin 30^0 \cdot \cos 10^0 - \cos 10^0$	1m		(OR)	
	$=2\left(\frac{1}{2}\right) \cdot \cos 10^0 - \cos 10^0 = 0$	2m		$\cos 2\theta = \cos(\theta + \theta)$ $[\cos(A+B) = \cos A . \cos B - \sin A . \sin B)$	1m
3)(c)	$\frac{\cos(360^0 - A) \cdot \tan(360^0 + A)}{\cot(270^0 - A) \cdot \sin(90^0 + A)}$			$=\cos\theta . \cos\theta - \sin\theta . \sin\theta$	1m
	$\cos(360^0 - A) = \cos(4.90^0 - A) = \cos A$	1m		$= \cos^2\theta - \sin^2\theta$	1m
	$\tan(360^0 + A) = \tan(4.90^0 + A) = \tan A$	1m		$= \cos^2\theta - (1 - \cos^2\theta)$	1m
	$\cot(270^0 - A) = \cot(3.90^0 - A) = +\tan A$	1m		$= 2\cos^2\theta - 1$	1m
	$\sin(90^0 + A) = \sin(1.90^0 + A) = +\cos A$	1m			

Q no	Scheme	Marks	Qno	Scheme	Marks
	SECTION – 4		4)(c)		
4)(a)	$y = \frac{x+1}{x-1}$ Diff w.r.t 'x'			$\frac{d^2s}{dt^2} = \vec{a} = -40$	1m
	$\frac{dy}{dx} = \frac{(x-1)\frac{d}{dx}(x+1) - (x+1)\frac{d}{dx}(x-1)}{(x-1)^2}$	1m		Car stops, if velocity is zero i.e., $\frac{ds}{dt} = 0$	1m
	$= \frac{(x-1)(1+0) - (x+1)(1-0)}{(x-1)^2}$ $= \frac{x-1-x-1}{(x-1)^2} = \frac{-2}{(x-1)^2}$ $\left(\frac{dy}{dx}\right)_{x=2} = \frac{-2}{(2-1)^2} = \frac{-2}{1^2} = -2$ (OR)	1m 1m 1m		$\Rightarrow 10 - 40t = 0 \Rightarrow t = \frac{1}{4}$ *secs* Also, acceleration is -40 $^{ft}/_{s^2}$ So, car stops after $\frac{1}{4}$ *secs* (OR)	2m
	$y = x^4 + 4x^3$ Diff w.r.t 'x'			$S = at^3 + bt$	
	$\frac{dy}{dx} = 4x^3 + 12x^2$	(1+1)m		$\frac{ds}{dt} = 3at^2 + b$	1m
	$\left(\frac{dy}{dx}\right)_{x=1} = 4(1)^3 + 12(1)^2$ $= 4 + 12 = 16$	2m		$\frac{d^2s}{dt^2} = 6at$	1m
4)(b)	$y = log(sin(x^3))$ Diff w.r.t 'x' $\frac{dy}{dx} = \frac{1}{sin(x^3)} \text{ x } \frac{d}{dx}(sin(x^3))$ $= \frac{1}{sin(x^3)} \text{ x } (cos(x^3)) \text{x} \frac{d}{dx}(x^3)$ $= \frac{1}{sin(x^3)} \text{ x } cos(x^3) \text{x } (3x^2)$ (Award full marks for alternate method) (OR)	2m 2m 2m		*At* $t = 3$, — *At* $t = 3$ $\left(\frac{ds}{dt}\right)_{t=3} = 0$ — $\left(\frac{d^s s}{dt^2}\right)_{t=3} = 14$ $3a(3)^2+b=0$ — $6a(3)=14$ $27a+b=0$ — $18a=14$ $a = \frac{7}{9}$	1m
	$y = t^3 + 3t^2 + 6t + 1$ Diff w.r.t 'x'			Sub $a = \frac{7}{9}$,	
	$\frac{dy}{dt} = 3t^2 + 6t + 6$	3m		$27\left(\frac{7}{9}\right) + b = 0$	
	$\left(\frac{dy}{dt}\right)_{t=2} = 3(2)^2 + 6(2) + 6$			$21 + b = 0 \Rightarrow b = -21$	2m
	$= 3(4) + 12 + 6$		4)(d)	$f(x) = 2x^3 - 21x^2 + 36x - 20$ $f^1(x) = 6x^2 - 42x + 36$	
	$= 12 + 12 + 6$			$f^{11}(x) = 12x - 42$	1m
	$= 30$	3m		For max OR min	
4)(c)	$s = 10t - 20t^2$			$f^1(x) = 0$	
	$\frac{ds}{dt} = \vec{v} = 10 - 40t$	1m		$6x^2 - 42x + 36 = 0 \; (\div 6)$	

Q no	Scheme	Marks	Qno	Scheme	Marks
4)(d)	$x^2-7x+6=0$			SECTION - 5	
	$x^2-6x-x+6=0$ $x(x-6)-(x-6)=0$ $x=1,\ x=6$	2m	5)(a)	$\int(x^3+sinx+e^x+2).dx$ $=\frac{x^4}{4}-cosx+e^x+2x+c$ (Note : Award 1 mark for each integral)	1+1+1+1
	At $x=1$, $f^{11}(1)=12(1)-42$			(OR)	
	$=12-42$ $=-30<0$			$\int x.\,sin\,x.dx$	
	$\therefore f(x)$ attains local max at $x=1$ and local max value is, $f(1)=2(1)^3-21(1)^3+36(1)-20$			$x\int sin\,x.dx-\iint sinx\frac{d}{dx}(x).dx+c$ $x(-cosx)-\int(-cosx).1.dx+c$	1m 1m
	$f(1)=2-21+36-20$			$-x\cos x+\int cosx.dx+c$	1m
	$f(1)=38-41=-3$ Also,	1m		$-x\cos x+\sin x+c$	1m
	At $x=6$, $f^{11}(6)=12(6)-42$			$I=\int cos7x.\cos 3x.dx$	
	$=72-42$ $=30>0$		5)(b)	$\left\{cosA.cosB=\frac{1}{2}(cos(A+B)+cos(A-B)\right\}$	
	$\therefore f(x)$ attains local min at $x=6$ and local min value is,			$I=\frac{1}{2}\int cos(7x+3x)+cos(7x-3x)dx$	2m
	$f(6)=2(6)^3-21(6)^2+36(6)-20$			$I=\frac{1}{2}\int cos10x+cos4x)dx$	1m
	$=2(216)-21(36)+36(6)-20$			$I=\frac{1}{2}\left\{\frac{sin\,10x}{10}+\frac{sin\,4x}{4}\right\}+c$	2m
	$=648-756-20$			$I=\frac{1}{2}\left\{\frac{sin\,10x}{10}+\frac{sin\,4x}{4}\right\}+c$	1m
	$=-128$	1m		$I=\frac{sin\,10x}{20}+\frac{sin\,4x}{8}+c$	
	(OR)			(OR)	
	$y=x^3+x^2$			$I=\int sin^3x.dx$	
	Diff w.r.t 'x'			WKT	
	$\frac{dy}{dx}=3x^2+2x$	1m		$sin\,3x=3sinx-4\,sin^3x$	
	Slope, $\left(\frac{dy}{dx}\right)_{(1,2)}=3(1)^2+2(1)=5=m$			$\Rightarrow sin^3x=\frac{3\,sinx-sin3x}{4}$	
	Equation of the tangent :			$\therefore I=\frac{1}{4}\int(3sinx-sin3x)dx$	2m
	$y-y_1=m(x-x_1)$	1m		$=\frac{3}{4}\int sinx.dx-\frac{1}{4}\int sin3x.dx$	1m
	$y-2=5(x-1)$	1m		$=\frac{3}{4}(-cosx)-\frac{1}{4}\left(\frac{-cos3x}{3}\right)+c$	2m
	$y-2=5x-5$			$=-\frac{3\cos x}{4}+\frac{cos3x}{12}+c$	1m
	$5x-y-3=0$	1m			

Q no	Scheme	Marks	Qno	Scheme	Marks
5)(c)	Given, $\int_2^k f(x).dx = 6$		5)(d)	$A = \int_0^1 (x^3+1).dx$	1m
	$\int_2^k x.dx = 6$	1m		$= \left[\frac{x^4}{4}+x\right]_0^1$	2m
	$\left[\frac{x^2}{2}\right]_2^k = 6$	1m		$= \left(\frac{1}{4}+1\right)-(0+0)$	
	$\frac{1}{2}[k^2-2^2] = 6$	1m		$= \frac{5}{4}$ sq limits (OR)	2m
	$k^2-2^2 = 12$			$V = \int_a^b \pi y^2.dx$	1m
	$k^2 = 12+4 = 16$	1m		$= \pi\int_2^4 (x^3+5x).dx$	1m
	$\therefore k = \pm 4$	1m		$= \pi\left\{\frac{x^4}{4}+5.\frac{x^2}{2}\right\}_2^4$	1m
	(OR)			$= \pi\left\{\left[\frac{4^4}{4}+\frac{5}{2}(4^2)\right]-\left[\frac{2^4}{4}+\frac{5}{2}(2^2)\right]\right\}$	1m
	Let, I = $\int_0^1 \frac{(tan^{-1}x)^2}{1+x^2}.dx$			$= \pi\{64+40-4-10\}$	
	Put $tan^{-1}x = t$, $x=0, t=0$ $x=1, t=\frac{\pi}{4}$			$= \pi\{50+40\} = 90\pi$ Cubic units	1m
	Diff w.r.t 'x' $\frac{1}{1+x^2}.dx = dt$	2m			
	I = $\int_0^{\pi/4} t^2\ dt$ $= \left[\frac{t^3}{3}\right]_0^{\pi/4}$	1m		**Remarks :** **Award marks for any alternate methods in solving problems.**	
	$= \frac{1}{3}\left[\left(\frac{\pi}{4}\right)^3 - 0\right]$			**Marks to be awarded based on answering the problem than length of the solution.**	
	$= \frac{\pi^3}{3 x 4^3} = \frac{\pi^3}{192}$	2m			

I certify the answers written is correct to the best of my knowledge.

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