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

OR

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

(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	Q no	Scheme	Marks
2)(c)	Calculation of slope of AB (OR)	5M	3)(c)	Each allied Angle simplification	1 m each . (4m)
	Slope of $2x + y - 1 = 0$ $m_1 = -2$	1M		Final answer (OR)	1M
	Req line slope, $m_2 = \frac{1}{2}$	1M		Writing $\cos\theta = \frac{1}{2}$	1m
	Writing, $y - y_1 = m_2(x - x_1)$	1M		Writing, $\theta = 60^0$	2m
	Substitution and final answer	2M		Writing, $\theta = 300^0$	2m
2)(d)	Writing a=2, b=4	2M			
	Formula Arriving at $2x + y - 4 = 0$	1M 2M	3)(d)	Transformation Formula	1M
	(OR)			Simplification	3m
	Writing values of m_1 *and* m_2	½ + ½		Final answer (OR)	1m
	Formula	1M		Spiltting and applying compound angle formula	1m
	Substitution	1M		Rest	4M
	Final answer	2M	4)(a)	Writing quotient rule of differentiation for the given problem	1m
3)(a)	Writing 225^0 as an allied angle	1 M		Differentiation of terms in numerator	1m
	Rest	3M		Simplifications and final answer	2m
	(OR) Splitting $15^0 = 45^0$-30^0or $15^0 = 60^0$-45^0	1M		(OR) Each term differentiation	1+1
	Formula and substitution	1M		Sub, $x = 1$ & arriving at final answer	2m
	Rest	2M	4)(b)	Each chain Rule derivative	2+2+2
3)(b)	Formula tan (A + B)	2M		[single step answer, award full marks]	
	Substitution of tan A & tan B	2M		(OR)	
	Final answer	2M		First derivative	3m
	(OR)			Sub, t = 2 and obtaining final answer	3m
	Transformation Formula	1M	4)(c)	$\frac{ds}{dt}, \frac{d^2s}{dt^2}$	1+1
	Substitution and Simplification	1+1+1		Equation $\frac{ds}{dt} = 0$	1m
	Rest	2M		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

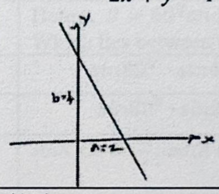
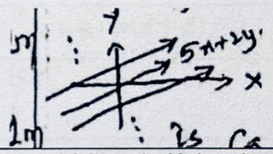
Q no	Scheme	Marks
4)(d)	Finding $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$	(½ + ½) m
	Obtaining critical values of $x = 1$ & $x = 6$	2m
	Local max values	1 M
	Local min values	1 M
	(OR)	
	Finding $\frac{d}{dx}(x^3)$, $\frac{d}{dx}(x^2)$	½ + ½
	$\left(\frac{dy}{dx}\right)_{(1,2)} = 5 = m$	1m
	Writing $y - y_1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

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, $x - 2y - 4 = 0,$ $\left(m = -\frac{a}{b}\right)$	
	$A.B \rightarrow \left.\begin{matrix}(3\,x\,2)\\(2\,x\,3)\end{matrix}\right\} \Rightarrow 3x3$ B.A	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 $A \cancel{=} 0 - I = -I = -\begin{pmatrix}1&0&0\\0&1&0\\0&0&1\end{pmatrix}$ *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 Q1 2 | Q2 3			$y - 2 = -x + 1$ $x + y - 3 = 0$ (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)			$\tan\theta = \left\lvert \frac{m_1 - m_2}{1 + m_1 m_2} \right\rvert$ $\tan\theta = \left\lvert \frac{\frac{-1}{3} - \frac{3}{5}}{1 + \left(\frac{-1}{3}\right)\left(\frac{3}{5}\right)} \right\rvert$	1m 1m
	$(x_1, y_1) = (1, 3)$ and the required line is $\perp^r$ to $2x + y - 1 = 0$			$= \left\lvert \frac{-5 - 9/15}{15 - 3/15} \right\rvert$	
	Slope $m_1 = \frac{-2}{1} = -2$	1m		$= \left\lvert \frac{-14}{12} \right\rvert = \left\lvert \frac{-7}{6} \right\rvert$	
	$\therefore$ slope of required line is $\frac{1}{2}$ (since, perpendicular, $m_1 m_2 = -1$)	1m		$\tan\theta = \left\lvert \frac{-7}{6} \right\rvert$ OR $\tan\theta = \frac{7}{6}$	2m

Q no	Scheme	Marks	Qno	Scheme	Marks
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, $\theta = 60^0$ 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
	$\sin 40^0 + \sin 20^0 - \cos 10^0$			$\frac{-1}{2}\left[\frac{1}{2}(\sin 140^0 - \sin 60^0)\right] + \frac{1}{4}\sin 40^0$	
	$[\sin C + \sin D = 2\sin\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)]$	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' $\frac{dy}{dx} = \frac{1}{sin(x^3)}$ x $\frac{d}{dx}(sin(x^3))$ $= \frac{1}{sin(x^3)}$ x $(cos(x^3))$x$\frac{d}{dx}(x^3)$ $= \frac{1}{sin(x^3)}$ x $cos(x^3)$x $(3x^2)$ (Award full marks for alternate method) (OR)	2m 2m 2m		*At* $t = 3$, $\left(\frac{ds}{dt}\right)_{t=3} = 0$ $3a(3)^2+b=0$ $27a+b=0$ *At* $t = 3$ $\left(\frac{d^ss}{dt^2}\right)_{t=3} = 14$ $6a(3) = 14$ $18a=14$ $a = \frac{7}{9}$	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			

1343 **Code : 20SC01T**

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

I & II Semester Diploma Examination, June/July-2023

ENGINEERING MATHEMATICS

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

Instructions : (i) Answer **one** full question from each section.
(ii) One full question carries **20** marks.

SECTION – I

1. (a) Solve for x, $\begin{vmatrix} 1 & 2 & 3 \\ 2 & x & 3 \\ 3 & 4 & 3 \end{vmatrix} = 0$ **4**

OR

If $A = \begin{bmatrix} 1 & 5 \\ 2 & 3 \end{bmatrix}$, Find $A + A^T$.

(b) Using Cramer's rule, find the solution of the system of equations $2y - z = 0$, and $x + 3y = -4$, $3x + 4y = 4$ **6**

OR

Which of the matrix has no inverse ?

$A = \begin{bmatrix} 1 & 5 \\ 0 & -1 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 6 \\ -1 & -3 \end{bmatrix}$ $C = \begin{bmatrix} 3 & 2 \\ 12 & 8 \end{bmatrix}$

(c) Find the characteristic equation and characteristic roots value for the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$ **5**

OR

If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 0 \\ 4 & 3 \end{bmatrix}$, then verify that $(A + B)^T = A^T + B^T$

(d) Consider the matrix **5**

If $A = \begin{bmatrix} 2 & 1 \\ 3 & 5 \end{bmatrix}$, find A^{-1}.

OR

If $A = \begin{bmatrix} 2 & 1 \\ -3 & 5 \end{bmatrix}$ & $B = \begin{bmatrix} 9 & 2 \\ -3 & 5 \end{bmatrix}$, find AB.

SECTION – II
(Match the following)

P

2. (a) (A) Equation of a straight line passing through a given point (x, y) and having slope m is
(B) Equation of a straight line passing through two points (x_1, y_1) and (x_2, y_2) is
(C) The equation of a straight line whose x and y-intercepts are a, b respectively is
(D) If two lines are perpendicular then product of their slopes is equal to

Q

(1) $\frac{x}{a}+\frac{y}{b}=1$
(2) $y-y_1=m(x-x_1)$
(3) -1
(4) $\frac{y-y_1}{x-x_1}=\frac{y_2-y_1}{x_2-x_1}$ 4

Answers :

P	Q
A	
B	
C	
D	

OR

(Match the following)

P

(A) If two lines with slopes m_1 and m_2 are parallel then 'θ' is
(B) Equation of a straight line whose slope is m and y intercept is C.
(C) Slope of line $ax + by + c = 0$
(D) Slope of a line joining two points (x_1 y_1) and (x_2 y_2).

Q

(1) $y = mx + c$
(2) 0 (zero)
(3) $\frac{y_2-y_1}{x_2-x_1}$
(4) $-\frac{a}{b}$

Answers :

P	Q
A	
B	
C	
D	

(b) Find the equation to the perpendicular to the line $6x - 5y - 2 = 0$ and passing through $(2, -3)$. **6**

OR

Are the lines $4x + 6y + 7 = 0$ and $2x + 3y - 1 = 0$ parallel to each other ? Justify.

(c) Find the equation of straight line parallel to $5x + 6y - 10 = 0$ and passing through the point $(-3, 3)$. **5**

OR

Are the lines $3x + 4y + 7 = 0$ and $28x - 21y + 50 = 0$ are perpendicular to each other ? Justify.

(d) Find the angle between the lines $x + 3y + 5 = 0$ and $4x + 2y - 7 = 0$ **5**

OR

Find the equation of straight line which passes through the points $(-2, 3)$ and $(-5, 6)$.

SECTION – III

3. (a) Determine the value of $\cos(570°)$ and $\sin(330°)$. **4**

OR

Convert 45 degree into radian and $\frac{11\pi}{5}$ radian into degree.

(b) If $A + B = \frac{\pi}{4}$ prove that $(1 + \tan A)(1 + \tan B) = 2$ **6**

OR

Prove that $\sin 3A = 3\sin A - 4\sin^3 A$

(c) Given $\tan A = \frac{18}{17}$ and $\tan B = \frac{1}{35}$ show that $A - B = \frac{\pi}{4}$ **5**

OR

Show that : $\frac{\cos(360° - A) \cdot \tan(360° + A)}{\cot(270° - A) \cdot \sin(90° + A)} = 1$

(d) Prove that $\cos 55° + \cos 65° + \cos 175° = 0$ **5**

OR

Show that $\frac{\sin 40° + \sin 20°}{\cos 40° + \cos 20°} = \frac{1}{\sqrt{3}}$

SECTION – IV

4. (a) If $y = \sin x + \log x + e^x + \tan x$, then find $\frac{dy}{dx} = ?$ **4**

OR

If $\frac{dy}{dx} = 4x^3 + 3x^2$, then find $\frac{d^2y}{dx^2}$ at $(1, 2)$

(b) Using chain rule of differentiation, find the derivative of the function $y = (3x + 8)^5$ 6

OR

Using composite rule find the derivative of the function $y = \log(\sin(\log x))$

(c) The distance covered by a body in t seconds is given by $S = 4t - 5t^2 + 2t^3$, find the velocity and acceleration when t = 2 sec. 5

OR

Distance travelled by a car is given by $S = 160t - 16t^2$ metre and time in seconds. When does the car stop ?

(d) Find the maximum and minimum values of the function $x^3 - x^2 - x = 0$. 5

OR

Find the equation of the tangent to the curve $y = 2 - 3x + x^2$ at (1, 2)

SECTION – V

5. (a) Integrate : $\cos x + e^x + \frac{1}{x} + x^2$, w.r. to x. 4

OR

The area under the curve $y = x^2$ between $x = 1$, and $x = 2$ is equal to ...

(b) Using the rule of integration by parts evaluate the integral $\int x \sin 2x . dx$ 6

OR

Evaluate $\int \sin 2x \cos 3x \, dx$

(c) Find $\int_0^{\pi/2} \sin^2 x . dx$ 5

OR

Evaluate $\int \sin^5 x \cos x \, dx$

(d) The area enclosed by the curve $y = x^2 + 1$, x-axis between $x = 1$, $x = 3$, calculate the area enclosed. 5

OR

Find the volume generated by rotating the curve $y = \sqrt{x + 2}$ about x-axis between $x = 0$ and $x = 2$.

SCHEME OF VALUATION

I & II SEMESTER DIPLOMA EXAMINATION

Sub: Engg Mathematics June/ July 2023 Code: 20SCOIT

Q.NO	Matter	Marks
1 (a)	Expansion of determinant Simplifying and result **OR** Finding A^T Finding $A+A^T$ Result	**2** **2** **1** **2** **1**
1 (b)	Find Δ_x , Δ_y , Δ_z Finding x , y, z **OR** Find $\lvert A\rvert = -1$, A^{-1} exists Find $\lvert B\rvert = \cancel{-1}\ 0$, B^{-1} Does not ~~exists~~ Find $\lvert C\rvert = \cancel{-1}\ 0$, C^{-1} exists	 **3** **3** 2 2 2
1.c	$\lvert A-\lambda I\rvert = 0$ Finding characteristic equation Finding roots **OR** (A+B) $(A+B)^T$ A^T , B^T A^T+B^T	1 2 2 1 1 2 1
1.d	$\lvert A\rvert=7 \neq 0$ Formula $A^{-1} = \frac{adj\ A}{\lvert A\rvert}$ Find adj A Answer **OR** AB=$\begin{bmatrix} 2 & 1 \\ -3 & 5 \end{bmatrix} \begin{bmatrix} 9 & 2 \\ -3 & 5 \end{bmatrix}$ Performing AB Answer	1 1 2 1 1 3 1

Q.NO	Matter	Marks
2(a)	Matching A-2 Award 1 to all for attending. B-4 C-1 D-3 **OR** Matching A-2 B-1 C-4 D-3	1 **1** 1 1 1 **1** 1 1
2 (b)	Finding $m = \frac{6}{5}$ Formula $(y-y_1)= m(x-x_1)$ Substitution and calculation Answer **OR** Finding $m_1 = \frac{-2}{3}$ $m_2 = \frac{-2}{3}$ Using condition Answer	1 1 3 1 2 2 1 1
2.c	**Finding** $m = \frac{-5}{6}$ **Formula** $(y-y_1)= m(x-x_1)$ Substitution and calculation Answer **OR** **Finding** $m_1 = \frac{-3}{4}$, $m_2 = \frac{4}{3}$ **Using condition** $m_1 \times m_2 = -1$ Answer	1 1 2 1 2 2 1
2.d	Finding $m_1 = \frac{-1}{3}$, $m_1 = -2$ Formula $\tan\theta = \left\lvert\frac{m_1-m_2}{1+m_1m_2}\right\rvert$ Calculation Answer **OR** $\frac{(y-y_1)}{(x-x_1)} = \frac{(y_2-y_1)}{(x_2-x_1)}$ Substitution and calculation Answer	2 1 1 1 1 3 1

Q.NO	Matter	Marks
3.a	$\cos(570°) = \cos(6 \times 90° + 30°)$ $-\cos 30° = -\frac{\sqrt{3}}{2}$ $\sin(330°) = \sin(4 \times 90° - 30°)$ $-\sin 30° = -\frac{1}{2}$ OR $45° = \frac{\pi}{180} \times 45 = \frac{\pi}{4} = 0.7855\ rad$ $11\frac{\pi}{5} = \frac{180}{\pi} \times 11\frac{\pi}{5} = 36 \times 11 = 396°$	1 1 1 1 2 2
3. b	$\tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$ $\tan(A+B) = 1$ $\tan A + \tan B + \tan A \tan B = 1$ add 1 both the side, and calculations Answer OR $\sin 2A = 2 \sin A \cos A$ $\cos 2A = 1 - 2\sin^2 A$ $\cos^2 A = 1 - \sin^2 A$ $\sin(A+B) = \sin A \cos B + \cos A \sin B$ Calculation and answer	1 1 1 2 1 1 1 1 1 2
3. c	$\tan(A-B)$ Formula substitution and calculation Answer OR $\cos(360 - A) = cosA$ $\tan(360 + A) = tanA$ $Cos(270 - A) = tanA$ $Sin(90 + A) = CosA$ Results	1 3 1 1 1 1 1 1
3. d	Using Formula cosc+cosd Cos120=-sin30 Sin30=1/2 Calculation & answer OR Using formula SinC+SinD CosC+CosD Calculation Answer	1 1 1 2 1 1 2 1

Q.NO	Matter	Marks
4.a	Differentiation of each term OR $\frac{dy}{dx}, \frac{d^2y}{dx^2}$ $\left(\frac{d^2y}{dx^2}\right)_{(1,2)} = 30$	1 mark =4m 2 2
4.b	$5(3x+8)^{5-1} \times \frac{d(3x+8)}{dx}$ $5(3x+8)^4 \times (3\frac{d(x)}{dx} + \frac{d(8)}{dx})$ Calculation & Results OR $\frac{d(\log[\sin(\log x)])}{dx} = \frac{1}{\sin(\log x)} \frac{d(\sin(\log x))}{dx}$ Remaining calculations Answer	2 2 2 1 4 1
4. c	$V = \frac{d(s)}{dt} = 4 - 10t + 6t^2$ V=8m/sec a=-10+12t a=14m/sec^2 OR $\frac{d(s)}{dt} == 160 - 32t$ When the car stop velocity becomes zero. V=0 calculation answer	1 1 2 1 1 1 2 1
4.d	$\frac{dy}{dx} = 3x^2 - 2x - 1$ $x = -\frac{1}{3}$, and $x = 1$ $\frac{d^2y}{dx^2} = 6x - 2$ Maximum value is $y = \left(\frac{5}{27}\right)$ Minimum value is $y = -1$ OR $\frac{dy}{dx} = -3 + 2x$ $m = \left(\frac{dy}{dx}\right)_{(1,2)} = -1$ $y - y_1 = m(x - x_1)$ Calculation and answer	1 1 1 1 1 1 1 1 2

Q.NO	Matter	Marks
5.a	For each integration **OR** $A = \int_a^b y\,dx$ Substitution and calculation Answer	1 marks each=4m 1 2 1
5.b	Integration by part formula Substitution Calculation Answer **OR** Integration by part formula Formula $\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$ Substitution and calculation Answer	1 1 3 1 1 1 3 1
5. c	$\int_0^a f(x)\,dx = \int_0^a f(a-x)\,dx$ And calculation $sin^2x + cos^2x = 1$ $I = \pi/4$ **OR** $t = \sin x$, $dt = \cos x\ dx$ Calculation Answer	1 2 1 1 2 2 1
5.d	$A = \int_a^b y\,dx$ Substitution and calculation Answer A=32/3 **OR** $V = \pi \int_a^b [y]^2\,dx$ Substitution Calculation V=6 π Cubic unit	1 3 1 1 1 2 1

OR
$A = \int_a^b y\,dx$ — 1
$= \int_0^{\pi/2} \sin^2 x\,dx = \int_0^{\pi/2} \frac{1-\cos 2x}{2}\,dx \to 1+1$
$= \frac{1}{2}\left[x - \frac{\sin 2x}{2}\right]_0^{\pi/2}$ — 1 , Sub. & Ans $\to 1+1$

I AND II SEMESTER EXAMINATION JUNE/JULY 2023

ENGINEERING MATHEMATICS **CODE: 20SC01T**

1. (a) $1(3x-12)-2(6-9)+3(8-3x)=0$

$$3x-24+42-9x=0$$

$$18-6x=0 \Rightarrow \quad x=3$$

OR

$$A=\begin{bmatrix}1 & 5\\2 & 3\end{bmatrix} \quad A^T=\begin{bmatrix}1 & 2\\5 & 3\end{bmatrix}$$

$$A+A^T=\begin{bmatrix}1 & 5\\2 & 3\end{bmatrix}+\begin{bmatrix}1 & 2\\5 & 3\end{bmatrix}=+\begin{bmatrix}1+1 & 5+2\\2+5 & 3+3\end{bmatrix}$$

$$A+A^T=\begin{bmatrix}2 & 7\\7 & 6\end{bmatrix}$$

1. (b) 0x+2y-z =0 X+3y+0z =- 4 3x+4y +0z = 4

$$\Delta=\begin{vmatrix}0 & 2 & -1\\1 & 3 & 0\\3 & 4 & 0\end{vmatrix}= 0(0-0) -2(0-0) -1(4-9) =0-0-1(-5) = 5$$

$$\Delta_x=\begin{vmatrix}0 & 2 & -1\\-4 & 3 & 0\\4 & 4 & 0\end{vmatrix}= 0(0-0) -2(0-0) -1(-16-12) =0-0-1(-28) = 28$$

$$\Delta_y=\begin{vmatrix}0 & 0 & -1\\1 & -4 & 0\\3 & 4 & 0\end{vmatrix}= 0(0-0) -0(0-0) -1(4+12) =0-0-1(16) = -16$$

$$\Delta_z=\begin{vmatrix}0 & 2 & 0\\1 & 3 & -4\\3 & 4 & 4\end{vmatrix}= 0(12+16) -2(4+12) +0(4-9) =0-2(16)-0(-5) = - 32$$

$$x=\frac{\Delta x}{\Delta}=\frac{28}{5} \quad y=\frac{\Delta y}{\Delta}=\frac{-16}{5}\quad , \quad z=\frac{\Delta z}{\Delta}=\frac{-32}{5}$$

OR

$$|A|=\begin{vmatrix}1 & 5\\0 & -1\end{vmatrix}=-1-0=-1 \qquad |B|=\begin{vmatrix}2 & 6\\-1 & -3\end{vmatrix}=-6+6=0$$

$$|C|=\begin{vmatrix}3 & 2\\12 & 8\end{vmatrix}=-24-24=0$$

Matrix B and C does not have inverse.

1. (C) Given $\begin{bmatrix}1 & 2\\3 & 1\end{bmatrix}$

Characteristic equation is $|A-\lambda I|=0$

$$\begin{bmatrix}1 & 2\\3 & 1\end{bmatrix}-\lambda\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}=\begin{bmatrix}1-\lambda & 2-0\\3-0 & 1-\lambda\end{bmatrix}=\begin{bmatrix}1-\lambda & 2\\3 & 1-\lambda\end{bmatrix}$$

$$\begin{vmatrix}1-\lambda & 2\\3 & 1-\lambda\end{vmatrix}=0 \Rightarrow (1-\lambda)(1-\lambda)-6=0$$

$$\Rightarrow \lambda^2-2\lambda-5=0$$

$$\lambda=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-(-2)\pm\sqrt{(-2)^2-4\times1(-5)}}{2\times1}$$

$$\Rightarrow \quad \lambda=1+\sqrt{6} \text{ and } \lambda=1-\sqrt{6}$$

OR

A= $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$ B= $\begin{bmatrix}2 & 0\\4 & 3\end{bmatrix}$

(A+ B) = $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}+\begin{bmatrix}2 & 0\\4 & 3\end{bmatrix}=\begin{bmatrix}1+2 & 2+0\\3+4 & 4+3\end{bmatrix}=\begin{bmatrix}3 & 2\\7 & 7\end{bmatrix}$

$(A+B)^T=\begin{bmatrix}3 & 7\\2 & 7\end{bmatrix}$ ....(1)

$A^T=\begin{bmatrix}1 & 3\\2 & 4\end{bmatrix}$ $B^T=\begin{bmatrix}2 & 4\\0 & 3\end{bmatrix}$

$A^T+B^T=\begin{bmatrix}1 & 3\\2 & 4\end{bmatrix}+\begin{bmatrix}2 & 4\\0 & 3\end{bmatrix}=\begin{bmatrix}3 & 7\\2 & 7\end{bmatrix}$ ....(2)

From equation (1) & (2) $(A+B)^T=A^T+B^T$

1. (d) A= $\begin{bmatrix}2 & 1\\3 & 5\end{bmatrix}$ $\Rightarrow |A|=\begin{vmatrix}2 & 1\\3 & 5\end{vmatrix}=10-3=7\neq0$ $\therefore A^{-1}$ exists.

adj A = $\begin{bmatrix}5 & -1\\-3 & 2\end{bmatrix}$ $\Rightarrow A^{-1}=\frac{adj\,A}{|A|}=\frac{1}{7}\begin{bmatrix}5 & -1\\-3 & 2\end{bmatrix}$

OR

A= $\begin{bmatrix}2 & 1\\-3 & 5\end{bmatrix}$ B= $\begin{bmatrix}9 & 2\\-3 & 5\end{bmatrix}$

AB = $\begin{bmatrix}2 & 1\\-3 & 5\end{bmatrix}\begin{bmatrix}9 & 2\\-3 & 5\end{bmatrix}=\begin{bmatrix}18-3 & 4+5\\-27-15 & -6+25\end{bmatrix}=\begin{bmatrix}15 & 9\\-42 & 19\end{bmatrix}$

2. (a)

2a

(A) Equation of Straight line Passing through a given point (x_1, y_1) and having slope m is	(2) $(y - y_1) = m(x - x_1)$
Award one mark for this question for attending, because in question (x, y) is given	
(B) equation of straight line passing through two points (x_1, y_1) and (x_2, y_2) is	(4) $\frac{(y-y_1)}{(x-x_1)} = \frac{(y_2-y_1)}{(x_2-x_1)}$
(C) The equation of straight line whose x and y intercepts are a, b respectively is	(1) $\frac{x}{a} + \frac{y}{b} = 1$
(D) If two lines are perpendicular to each other then Product of their slope is equal to	(3) -1

OR

(A) if two lines with slopes m_1 and m_2 are parallel then θ is	(2) 0 (zero)
(B) equation of straight line whose slope is m and y intercept is C	(1) $y = mx + C$
(C) Slope of line is $ax + by + C = 0$	(4) $\frac{-a}{b}$
(D) slope of line joining two points (x_1, y_1) and (x_2, y_2)	(3) $\frac{(y_2-y_1)}{(x_2-x_1)}$

2. (b)

Given equation $6x - 5y - 2 = 0$

Slope of given line $m = \frac{-a}{b} = \frac{-6}{-5} = \frac{6}{5}$

Therefore slope of required line is $m = \frac{-5}{6}$

Equation of line passing through (2, -3) & having slope $m = \frac{-5}{6}$

$(y - y_1) = m(x - x_1)$, $(x_1, y_1) = (2, -3)$ $m = \frac{-5}{6}$

$[y - (-3)] = \frac{-5}{6}(x - 2) \Rightarrow 5x + 6y + 8 = 0$

OR

Consider $4x + 6y + 7 = 0$ ....(1) $2x + 3y - 1 = 0$ ....(2)

Slope of line (1) $m_1 = \frac{-a}{b}$ $m_1 = \frac{-4}{6} = \frac{-2}{3}$

Slope of line (2) $m_2 = \frac{-a}{b}$, $m_2 = \frac{-2}{3}$

since $m_1 = m_2 = \frac{-2}{3}$ so the lines are parallel to each other.

2. (C) Given line $5x+6y-10=0$

Slope of given line $m=\frac{-a}{b}$ $m=\frac{-5}{6}$

Since required line is parallel to $5x+6y-10=0$

So slope of required line is $m=\frac{-5}{6}$

$(x_1,y_1)=(-3,3)$ $m=\frac{-5}{6}$

$(y-y_1)=m(x-x_1)$

$(y-3)=\frac{-5}{6}(x+3) \Rightarrow 6(y-3)=-5(x+3)$

$6y-18=-5x-15 \Rightarrow 5x+6y-3=0$ required line.

OR

Consider $3x+4y+7=0$ .... (1) $28x-21y+50=0$ ....(2)

Slope of equation (1) $m_1=\frac{-a}{b}=\frac{-3}{4}$ Slope of equation (2) $m_2=\frac{-a}{b}=\frac{-28}{-21}=\frac{4}{3}$

Since product of slope of two perpendicular lines is equal to -1

$$m_1\times m_2=\frac{-3}{4}\times\frac{4}{3}=-1$$

∴ given lines are perpendicular to each other.

2. (d) let $x+3y+5=0$ ....(1) $4x+2y-7=0$ ....(2)

$m_1=\frac{-a}{b}=\frac{-1}{3}$ $m_2=\frac{-a}{b}=\frac{-4}{2}=-2$

$$\tan\theta=\left|\frac{m_1-m_2}{1+m_1m_2}\right|=\left|\frac{\frac{-1}{3}+2}{1+\left(\frac{-1}{3}\right)(-2)}\right|=\left|\frac{\frac{-1+6}{3}}{1+\frac{2}{3}}\right|=\left|\frac{\frac{5}{3}}{\frac{5}{3}}\right|=1$$

$\tan\theta=1 \Rightarrow \theta=\tan^{-1}1=45°$

OR

Equation of straight line which passes through (x_1,y_1) & (x_2,y_2) is

$\frac{(y-y_1)}{(x-x_1)}=\frac{(y_2-y_1)}{(x_2-x_1)}$ and $(x_1,y_1)=(-2,\ 3)$ $(x_2,y_2)=(-5,6)$

$\frac{y-3}{x+2}=\frac{6-3}{-5+2}=-1$ $\frac{y-3}{x+2}=-1$

$y-3=-1(x+2)=-x-2$

$y-3+x+2=0 \Rightarrow x+y-1=0$

3. (a)

$$\cos(570°) = \cos(6 \times 90° + 30°) = -\cos 30° = -\frac{\sqrt{3}}{2}$$

$$\sin(330°) = \sin(4 \times 90° - 30°) = -\sin 30° = -\frac{1}{2}$$

OR

$$45° = \frac{\pi}{180} \times 45 = \frac{\pi}{4} = 0.7855\ rad$$

$$11\frac{\pi}{5} = \frac{180}{\pi} \times 11\frac{\pi}{5} = 36 \times 11 = 396°$$

3. (b)

$$A + B = \frac{\pi}{4} \quad \Rightarrow \tan(A+B) = \tan\frac{\pi}{4} = 1$$

$$\tan(A+B) = 1$$

$$\frac{\tan A + \tan B}{1 - \tan A \tan B} = 1 \ , \quad \tan A + \tan B = 1 - \tan A \tan B$$

$\tan A + \tan B + \tan A \tan B = 1$ add 1 both the side.

$$1 + \tan A + \tan B + \tan A \tan B = 1 + 1$$

$$1 + \tan A + \tan B\,(1 + \tan A) = 2$$

$$(1 + \tan A)(1 + \tan B) = 2$$

OR

$$\sin 3A = 3\sin A - 4sin^3 A$$

$$\sin 3A = \sin(2A + A) = \sin 2A \cos A + \cos 2A \sin A$$

$$= 2\sin A \cos A \cos A + (1 - 2sin^2 A)\sin A$$

$$= 2\sin A\, cos^2 A + \sin A - 2sin^3 A$$

$$= 2\sin A\,(1 - sin^2 A) + \sin A - 2sin^3 A$$

$$= 2\sin A - 2\, sin^3 A + \sin A - 2sin^3 A$$

$$\therefore \quad \sin 3A = 3\sin A - 4sin^3 A$$

3. (c) $\tan A = \frac{18}{17}$ $\qquad \tan B = \frac{1}{35}$

$$\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

$$\tan(A-B)=\frac{\frac{18}{17}-\frac{1}{35}}{1+\frac{18}{17}\times\frac{1}{35}}=\frac{630-17}{595+18}=\frac{613}{613}=1$$

$$\tan(A-B)=1=\tan\frac{\pi}{4}$$

$$\Rightarrow\ (A-B)=\frac{\pi}{4}$$

OR

$$\frac{\cos(360-A)\tan(360+A)}{\cot(270-A)\sin(90+A)}=\frac{\cos(A)\tan(A)}{\tan(A)\cos(A)}=1$$

3. (d)

L.H.S $\cos 55° + \cos 65° + \cos 175° = \cos 55° + 2\cos(\frac{65+175}{2})\ \cos(\frac{65-175°}{2})$

$$= \cos 55° + 2\cos(120°)\ \cos(-55°)$$

$$= \cos 55° + 2\times\cos(90°+30°)\cos(55°)$$

$$= \cos 55° + 2\times(-\sin 30°)\cos(55°)$$

$$= \cos 55° - 2\times\frac{1}{2}\cos(55°)$$

$= \cos 55° - \cos 55° = 0$ R.H.S

OR

$$\frac{\text{Sin } 40°+\sin 20°}{\cos 40°+\cos 20°}=\frac{2\sin\left(\frac{40+20}{2}\right)\cos\left(\frac{40-20}{2}\right)}{2\cos\left(\frac{40+20}{2}\right)\cos\left(\frac{40-20}{2}\right)}$$

$$=\frac{\sin\left(\frac{40+20}{2}\right)}{\cos\left(\frac{40+20}{2}\right)}=\frac{\sin(30)}{\cos(30)}=\tan 30=\frac{1}{\sqrt{3}}$$

4. (a) $y=\sin x+\log x+e^x+\tan x$

$$\frac{dy}{dx}=\frac{d(\sin x)}{dx}+\frac{d\log x}{dx}+\frac{de^x}{dx}+\frac{d\tan x}{dx}$$

$$\frac{dy}{dx}=\cos x+\frac{1}{x}+e^x+sec^2x$$

OR

$y = 4x^3 + 3x^2$, $\frac{dy}{dx} = 4\frac{dx^3}{dx} + 3\frac{dx^2}{dx}$ Given, $\frac{dy}{dx} = 4x^3 + 3x^2$

$\frac{dy}{dx} = 4 \times 3x^2 + 3 \times 2x = 12x^2 + 6x$ ✓ $\therefore \frac{d^2y}{dx^2} = 4(3x^2) + 3(2x)$

$\frac{d^2y}{dx^2} = 12\frac{d(x^2)}{dx} + 6\frac{d(x)}{dx} = 12 \times 2x + 6 \times 1 = 24x + 6$ ✓ $= 12x^2 + 6x$

$\therefore \frac{d^2y}{dx^2}$ at $(1,2)$

$\left(\frac{d^2y}{dx^2}\right)_{(1,2)} = 24(1) + 6 = 30$ ✓ $\frac{d^2y}{dx^2} = 12(1)^2 + 6(1)$

$\frac{d^2y}{dx^2} = 12 + 6 = \underline{\underline{18}}$

4. (b)

$y = (3x+8)^5$

$\frac{dy}{dx} = 5(3x+8)^{5-1} \times \frac{d(3x+8)}{dx}$

$= 5(3x+8)^4 \times (3\frac{d(x)}{dx} + \frac{d(8)}{dx})$

$= 5(3x+8)^4 \times (3 \times 1 + 0)$

$= 15(3x+8)^4$ ✓

OR

$y = \log[\sin(\log x)]$

$\frac{dy}{dx} = \frac{d(\log[\sin(\log x)])}{dx} = \frac{1}{\sin(\log x)} \frac{d(\sin(\log x))}{dx}$

$\frac{dy}{dx} = \frac{1}{\sin(\log x)} (\cos(\log x)) \frac{d(\log x)}{dx}$

$\frac{dy}{dx} = \frac{\cos(\log x)}{\sin(\log x)} \left(\frac{1}{x}\right) = \frac{\cot(\log x)}{x}$

4. (c) $S = 4t - 5t^2 + 2t^3$

$\frac{d(s)}{dt} = \frac{d(4t - 5t^2 + 2t^3)}{dt}$

$\frac{d(s)}{dt} = 4\frac{d(t)}{dt} - 5\frac{d(t^2)}{dt} + 2\frac{d(t^3)}{dt}$

$\frac{d(s)}{dt} = 4 \times 1 - 5 \times 2t + 2 \times 3t^2$ ✓

$V = \frac{d(s)}{dt} = 4 - 10t + 6t^2$ ✓

$$V = \left(\frac{d(s)}{dt}\right)_{t=2} = 4 - 10 \times 2 + 6 \times 2^2 = 4 - 20 + 24 = 8$$

$$a = \frac{d(4-10t+6t^2)}{dt} = 0 - 10\frac{dt}{dt} + 6\frac{dt^2}{dt} = -10 \times 1 + 6 \times 2t = -10 + 12t$$

$$(a)_{t=2} = -10 + 12(2) = -10 + 24 = 14\, ms^{-2}$$

OR

$$S = 160t - 16t^2$$

$$\frac{d(s)}{dt} = V = \frac{d(160t-16t^2)}{dt} = 160\frac{d(t)}{dt} - 16\frac{d(t^2)}{dt}$$

$$\frac{d(s)}{dt} = 160 \times 1 - 16 \times 2t = 160 - 32t$$

When the car stop velocity becomes zero. V=0

V= $0 = 160 - 32t$

$$t = \frac{160}{32} = 5\ sec$$

4. (d) $y = x^3 - x^2 - x$, $\frac{dy}{dx} = 3x^2 - 2x - 1$

y is maximum or minimum, if $\frac{dy}{dx} = 0$

i.e $0 = 3x^2 - 2x - 1$ *or* $(3x+1)(x-1) = 0$

$\therefore x = -\frac{1}{3}$, *and* $x = 1$

$\frac{d^2y}{dx^2} = 6x - 2$, now if $x = -\frac{1}{3}$ $\frac{d^2y}{dx^2} = 6\left(\frac{-1}{3}\right) - 2$

$$\frac{d^2y}{dx^2} = -4$$

$\therefore$ y is maximum at $x = -\frac{1}{3}$

$$y = x^3 - x^2 - x$$

$$y = \left(\frac{-1}{3}\right)^3 - \left(\frac{-1}{3}\right)^2 - \left(\frac{-1}{3}\right) = \left(\frac{-1}{27}\right) - \left(\frac{1}{9}\right) + \left(\frac{1}{3}\right) = \left(\frac{5}{27}\right)$$

Maximum value is $y = \left(\frac{5}{27}\right)$

For $x = 1$ $\frac{d^2y}{dx^2} = 6(1) - 2 = 4 = +ve\ value$

$\therefore$ y is minimum at $x = 1$

$y = x^3 - x^2 - x$, $y = 1^3 - 1^2 - 1 = -1$

Minimum value is $y = -1$

OR

$y = 2 - 3x + x^2$ diff w.r.t x

$\frac{dy}{dx} = -3 + 2x$, $m = \left(\frac{dy}{dx}\right)_{(1,2)} = -3 + 2(1) = -1$

Equation of tangent $y - y_1 = m(x - x_1)$

$y - 2 = -1(x - 1)$ $y - 2 = -x + 1$

$y - 2 + x - 1 = 0$ $x + y - 3 = 0$

5. (a) $y = \cos x + e^x + \frac{1}{x} + x^2$

$\int y dx = \int \cos x \, dx + \int e^x dx + \int \frac{1}{x} dx + \int x^2 \, dx$

$= \sin x + e^x + \log x + \frac{x^3}{3} + C$

OR

Area A $= \int_a^b y \, dx = \int_1^2 x^2 \, dx = \left[\frac{x^3}{3}\right]_1^2 = \left[\frac{2^3}{3} - \frac{1^3}{3}\right] = \frac{8}{3} - \frac{1}{3} = \frac{7}{3}$

$\therefore A = \frac{7}{3}$ square units

5. (b) $\int uv \, dx = u \int v \, dx - \int \left[\frac{du}{dx} \times \int v \; dx\right] dx$

$\int x \sin 2x \, dx = x \int \sin 2x \, dx - \int \left[\frac{dx}{dx} \times \int \sin 2x \; dx\right] dx$

$= x\left(\frac{-\cos 2x}{2}\right) - \int \left(1 \times \left(\frac{-\cos 2x}{2}\right)\right) dx$

$$= x\left(\frac{-\cos 2x}{2}\right) + \frac{1}{2}\int \cos 2x \ dx$$

$$= -\frac{x\cos(2x)}{2} + \frac{\sin 2x}{4} + C$$

OR

$$\int uv\, dx = u\int v\, d \ - \int \left[\frac{du}{dx} \times \int v \ dx\right] dx$$

$$\int \sin 2x \cos 3x \, dx = \int \frac{1}{2}[\sin(2x+3x) + \sin(2x-3x)]dx$$

Here using formula $\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$

$$\int \sin 2x \cos 3x \, dx = \frac{1}{2}\int \sin(5x)\, dx + \frac{1}{2}\int \sin(-x)\, dx$$

$$= \frac{1}{2}\left(-\frac{\cos 5x}{5}\right) + \frac{1}{2}\int (-\sin x)\, dx$$

$$= \frac{-\cos 5x}{10} - \frac{1}{2}(-\cos x) + C$$

$$= \frac{-\cos 5x}{10} + \frac{\cos x}{2} + C$$

5. (C) $\int_0^{\frac{\pi}{2}} sin^2 x \, dx$

$I = \int_0^{\frac{\pi}{2}} sin^2 x \, dx$ ....(1) $\quad \because \int_0^a f(x)\, dx = \int_0^a f(a-x)\, dx$

$I = \int_0^{\frac{\pi}{2}} sin^2(\frac{\pi}{2} - x)\, dx = \int_0^{\frac{\pi}{2}} cos^2 x \, dx$ ....(2)

Adding (1) & (2)

$I + I = \int_0^{\frac{\pi}{2}} sin^2 x \, dx + \int_0^{\frac{\pi}{2}} cos^2 x \, dx$

$2I = \int_0^{\frac{\pi}{2}} (sin^2 x + cos^2 x)\, dx = \int_0^{\frac{\pi}{2}} 1 \, dx = [x]_0^{\frac{\pi}{2}} = \left[\frac{\pi}{2} - 0\right]$

$\Rightarrow \quad 2I = \frac{\pi}{2} \quad \Rightarrow \quad I = \frac{\pi}{4}$

OR

$\int sin^5 x \cos x \, dx = \int t^5 \, dt$ $\quad$ put $t = \sin x$

$= \frac{t^{5+1}}{5+1} + C$ $\quad \frac{dt}{dx} = \cos x$

$= \frac{t^6}{6} + C$ $\quad dt = \cos x \ dx$

$= \frac{(\sin x)^6}{6} + C$

5. (d) Area $= A = \int_a^b y\, dx = \int_1^3 (x^2+1)dx = \left[\frac{x^3}{3} + x\right]_1^3 = \frac{1}{3}[x^3]_1^3 + [x]_1^3$

$$= \frac{1}{3}\left[(3)^3 - (1)^3\right] + [3-1]$$

$$= \frac{1}{3}\,[27-1] + [2]$$

$$= \frac{26}{3} + 2 = \frac{32}{3}$$

OR

$$y = \sqrt{x+2}$$

$$V = \pi \int_a^b [y]^2\, dx = \pi \int_a^b [f(x)]^2\, dx = \pi \int_0^2 \left(\sqrt{x+2}\right)^2 dx$$

$$= \pi \int_0^2 (x+2)\, dx = \pi \int_0^2 (x)\, dx + 2\pi \int_0^2 1\, dx$$

$$= \pi \left[\frac{x^2}{2}\right]_0^2 + 2\pi [x]_0^2$$

$$= \frac{\pi}{2}\left[2^2 - 0^2\right] + 2\pi[2-0]$$

$$= \frac{\pi}{2}[4] + 2\pi[2] = 2\pi + 4\pi = 6\pi$$

$$V = 6\pi \ \ cubic\ unit$$

Note: Give full marks for any other alternate method.

7651

Code : 20SC01T

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

I/II Semester Diploma Examination, February/March-2023

ENGINEERING MATHEMATICS

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

Instructions : (i) Answer **one** full question from each section.

(ii) Each section carries **20** marks.

SECTION – I

1. (a) Define square matrix with an example. **4**

OR

If $A = \begin{bmatrix} 4 & 5 \\ 3 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 4 \\ 2 & 1 \end{bmatrix}$, then find 3A – 2B.

(b) If $A = \begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$, then find the inverse of matrix A if it exists. **6**

OR

Find the characteristic roots of the matrix $A = \begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$.

(c) Solve the system of linear equations by applying Cramer's rule : **5**

$x + y = 1$

$2x + y = 2$

OR

The Maruti Motor Company Ltd. has 2 outlets, one in Delhi and one in Mumbai, among other things, it sells Baleno, Ertiga and Brezza cars. The monthly sales of these cars at the two stores for two months are given in the following tables :

January Sales

	Delhi	Mumbai
Baleno	45	30
Ertiga	35	25
Brezza	20	18

February Sales

	Delhi	Mumbai
Baleno	42	28
Ertiga	36	20
Brezza	22	16

Use matrix subtraction to calculate the change in sales of each product in each store from January to February.

 [Turn over

(d) If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$, find AB matrix and also find $(AB)^T$ matrix. **5**

OR

For the matrix $A = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$, verify $|A| \cdot I = A\cdot(\text{adj } A)$ where $|A|$ stands for determinant of A and I is a unit matrix of order 2×2.

SECTION – II

2. (a) Find slope and x-intercept of the line $3x + 4y + 7 = 0$. **4**

OR

Write the standard form of equation of straight line in (i) general form and (ii) one-point form.

(b) Find the equation of line passing through the point (1, 2) and parallel to the line $2x - 3y + 1 = 0$. **6**

OR

Find the equation of straight line passing through the points (2, 3) and (4, 6).

(c) Find the equation of straight line using intercepts form whose x-intercept is 3 and y-intercept is 2. **5**

OR

Show that the angle between the lines
$x - y + 4 = 0$ and $2x - y + 5 = 0$ is $\tan^{-1}(1/3)$.

(d) If the line inclined at angle of 45° with +ve direction of x-axis and having y-intercept '5' unit, then find its equation using slope-intercept form. **5**

OR

Write the condition of slopes for 2 lines to be parallel and show that the lines $2x + y - 4 = 0$ and $6x + 3y + 10 = 0$ are parallel.

SECTION – III

3. (a) Convert 40° into radians and $\frac{8\pi}{7}$ into degree. **4**

OR

Prove that $\tan(45° - A) = \frac{1 - \tan A}{1 + \tan A}$.

(b) Simplify $\frac{\sin(360° + A) \cdot \tan(180° + A)}{\cos(90° - A) \cdot \cot(270° - A)}$. **6**

OR

If $\tan\theta = \frac{3}{4}$ where θ is in I quadrant, show that the value of $5\sin\theta + 5\cos\theta = 7$.

(c) Write the formula for cos (A + B) then find the value of cos 75°. **5**

OR

Prove that $\frac{\sin 2A}{\sin A} - \frac{\cos 2A}{\cos A} = \sec A$.

(d) Prove that $\frac{\sin 6\theta + \sin 2\theta}{\cos 6\theta + \cos 2\theta} = \tan 4\theta$. **5**

OR

Prove that $\frac{1 - \cos 2\theta + \sin 2\theta}{1 + \cos 2\theta + \sin 2\theta} = \tan \theta$

SECTION – IV

4. (a) If $y = \tan x + 4e^x - 6 + \sqrt{x}$, then find $\frac{dy}{dx}$. **4**

OR

Differentiate $x^2 \cdot e^x$ w.r.t. x.

(b) Find the derivative of $y = \frac{1 + \tan x}{1 - \tan x}$ w.r.t. x. **6**

OR

If $y = 2x^4 - 3x^3 - 2x^2 + x - 1$, find $\frac{d^2y}{dx^2}$ at $x = 0$.

(c) Distance travelled by a particle in 't' second is given by $S = 2t^3 - t^2 + 5t - 6$. Find the velocity and acceleration of particle at t = 2 second. **5**

OR

Find the maximum and minimum values of function $y = 2x^3 - 3x^2 - 36x + 10$.

(d) If $y = x^2$, show that $x\frac{d^2y}{dx^2} - \frac{dy}{dx} = 0$. **5**

OR

Find the equation of tangent to the curve $y = x^2 + x - 1$ at the point (1, 1).

SECTION – V

5. (a) Integrate $e^x + \frac{1}{1 + x^2} - \sin x + x^3$ w.r.t. x. **4**

OR

Evaluate $\int x^2 \cdot (1 + x) \cdot dx$.

(b) Evaluate $\int \cos^2 x \cdot dx$. 6

OR

Show that $\int_0^{\pi/4} \tan^2 x \cdot \sec^2 x \cdot dx = 1/3$.

(c) With the use of definite integrals find the area bounded by the curve $y = x^3 - 2$, x-axis and $x = 0$, $x = 1$. 5

OR

The curve $y^2 = x + 2$ is rotated about x-axis. Find the volume of solid generated by revolving the curve between $x = 2$ and $x = 5$.

(d) Evaluate the indefinite integral $\int x \cdot e^x \cdot dx$ using integration by parts. 5

OR

Evaluate $\int_0^1 \frac{e^x}{1 + e^x} \cdot dx$.

I/II Semester Diploma Examination, February-2023

Course Name: Engineering Mathematics Course Code:20SC01T

SCHEME OF VALUATION

Q. No.	Particular	Marks
1(a)	Definition Example	2 2
	OR	
	Finding 3A & 2B Answer	2 2
1(b)	Formula Det A adjA Answer	1 2 2 1
	OR	
	Formula $\lvert A-\lambda I\rvert=0$ Substitution Finding Characteristic Equation Finding roots	1 1 2 2
1(c)	Finding Δ Finding Δ_x&Δ_y Finding x&y	2 1each 1
	OR	
	Writing in the matrix form subtraction	2each 1
1(d)	Writing AXB Finding AB Finding $[AB]^T$	1 2 2
	OR	
	Finding$\lvert A\rvert$ Finding $\lvert A\rvert.\mathrm{I}$ Finding adjA Finding A.adjA Answer	1 1 1 1 1
2(a)	Slope formula & Answer X-int. formula & Answer	1each 1each
	OR	
	General form One-point form	2 2
2(b)	One-point form Slope of line Parallel slope Substitution Answer	2 1 1 1 1
	OR	
	Two-point form	2

Q. No.	Particular	Marks
2(b)	Substitution Answer	2 2
2(c)	Intercepts form Writing a & b Substitution & Answer	2 1 2
	OR	
	Formula Slopes Answer	2 2 1
2(d)	Slope-Intercept form Finding Slope Substitution & Answer	2 1 2
	OR	
	Parallel condition Finding slopes Rest	2 2 1
3(a)	Converting 40^0 to radian Converting $\frac{8\pi}{7}$ to degree	2 2
	OR	
	tan(A-B) formula Substitution Answer	2 1 1
3(b)	Each allied angle value Simplification & answer	1 2
	OR	

Q. No.	Particular	Marks
3(b)	Finding other side using tanΘ Finding sinΘ & cosΘ Substitution Answer	2 2 1 1
3(c)	cos(A+B) formula $\cos\left(45^0+30^0\right)$ Numerical values of 45^0 & 30^0 Answer	2 1 1 1
	OR	
	LCM Sin(A-B) formula Simplification Answer	1 2 1 1
3(d)	SinC+sinD form cosC+cosD form Rest	2 2 1
	OR	
	Sin2Θformula Cos2Θformula Simplification & Answer	1 2 2
4(a)	Each term differentiation	1
	OR	
	Product rule Applying rule Differentiation	1 1 2
4(b)	Quotient Rule Applying Quotient Rule Differentiation Answer	2 1 2 1
	OR	
	First differentiation Second differentiation Finding $\frac{d^2y}{dx^2}$ at x=0	2 2 2
4(c)	Differentiation for velocity Differentiation for acceleration Finding V & a at t=2	2 1 2
	OR	
	Differentiations Roots Checking for +ve & -ve Answer	2 1 2 1

Q. No.	Particular	Marks
4(d)	First Differentiation Second Differentiation Answer	2 2 1
	OR	
	Differentiation Finding slope at (1,1) One-point form Substitution & Answer	1 1 1 2
5(a)	Integration of each term	1
	OR	
	Multiplication Each term differentiation Rest	1 2 1
5(b)	Formula Integration Answer	2 1+2 1
	OR	
	Substitution Differentiation Integration Limits & Answer	1 1 2 2
5(c)	Area formula Integration Limits substitution Answer	1 2 1 1
	OR	
	Volume formula Integration Limits substitution Answer	1 2 1 1
5(d)	Integration by parts formula Substitution Integration Differentiation	2 1 1 1
	OR	
	Substitution Differentiation Integration Applying limits & answer	1 1 1 2

Note: - Give equal weightage for alternative answers

I/II Semester Diploma Examination, February-2023

Course Name: Engineering Mathematics Course Code: 20SC01T

MODEL ANSWERS

<table>
<tr><th>Q.No.</th><th>Answers</th><th>Q.No.</th><th>Answers</th></tr>
<tr><td rowspan="2">1(a)</td><td rowspan="2">Square matrix: - It is a matrix with equal number of Rows and Columns

Example: $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

OR

Given $A = \begin{bmatrix} 4 & 5 \\ 3 & 2 \end{bmatrix}, B = \begin{bmatrix} 3 & 4 \\ 2 & 1 \end{bmatrix}$

3A-2B=3 $\begin{bmatrix} 4 & 5 \\ 3 & 2 \end{bmatrix} - 2\begin{bmatrix} 3 & 4 \\ 2 & 1 \end{bmatrix}$

$=\begin{bmatrix} 12 & 15 \\ 9 & 6 \end{bmatrix} - \begin{bmatrix} 6 & 8 \\ 4 & 2 \end{bmatrix}$

$=\begin{bmatrix} 6 & 7 \\ 5 & 4 \end{bmatrix}$</td><td>1(b)</td><td>$(1-\lambda)(3-\lambda)-8=0$
$\lambda^2 - 4\lambda - 5 = 0$

$\lambda^2 - 5\lambda + \lambda - 5 = 0$

$\lambda(\lambda - 5) + 1(\lambda - 5) = 0$

$\lambda=5$ & $\lambda=-1$</td></tr>
<tr><td>1(c)</td><td>x+y=1 & 2x+y=2

$\Delta=\begin{vmatrix} 1 & 1 \\ 2 & 1 \end{vmatrix} = 1 - 2 = -1$

$\Delta_x = \begin{vmatrix} 1 & 1 \\ 2 & 1 \end{vmatrix} = -1$

$\Delta_y = \begin{vmatrix} 1 & 1 \\ 2 & 2 \end{vmatrix} = 2 - 2 = 0$

$x = \frac{\Delta_x}{\Delta} = \frac{=1}{-1} = 1 \& y = \frac{\Delta_y}{\Delta} = \frac{0}{-1} = 0$</td></tr>
<tr><td rowspan="2">1(b)</td><td rowspan="2">Given A=$\begin{bmatrix} 3 & 2 \\ 1 & 2 \end{bmatrix}$ $then$ detA=$\begin{vmatrix} 3 & 2 \\ 1 & 2 \end{vmatrix} = 6 - 2 = 4$

adjA=$\begin{bmatrix} 2 & -2 \\ -1 & 3 \end{bmatrix}$

$A^{-I} = \frac{adjA}{detA} = \frac{1}{4}\begin{bmatrix} 2 & -2 \\ -1 & 3 \end{bmatrix}$

OR

A=$\begin{bmatrix} 1 & 2 \\ 4 & 3 \end{bmatrix}$

Characteristic equation is $\lvert A - \lambda I \rvert = 0$

$\left\lvert \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix} - \lambda \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \right\rvert = 0$

$\begin{vmatrix} 1-\lambda & 2 \\ 4 & 3-\lambda \end{vmatrix} = 0$</td><td>1(c)</td><td>OR

$J = \begin{pmatrix} 45 & 30 \\ 35 & 25 \\ 20 & 18 \end{pmatrix}, F = \begin{pmatrix} 42 & 28 \\ 36 & 20 \\ 22 & 16 \end{pmatrix}$

$D = \begin{pmatrix} 3 \\ 1 \\ 2 \end{pmatrix}, M = \begin{pmatrix} 2 \\ 5 \\ 2 \end{pmatrix}$</td></tr>
<tr><td></td><td></td></tr>
</table>

1(d)	$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, B = \begin{bmatrix} 2 & 1 \\ 3 & 4 \end{bmatrix}$ $AB = \begin{bmatrix} 2+6 & 1+8 \\ 6+12 & 3+16 \end{bmatrix} = \begin{bmatrix} 8 & 9 \\ 18 & 19 \end{bmatrix}$ $(AB)^T = \begin{bmatrix} 8 & 18 \\ 9 & 19 \end{bmatrix}$	2(b)	OR Given points are (2,3) & (4,6) Two-point form is $\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$ (or) $\frac{y-3}{x-2} = \frac{3}{2}$ $2y-6 = 3x-6(\,or)\ 3x-2y=0$
1(d)	OR $A = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}$ $\lvert A\rvert = \begin{vmatrix} 3 & 1 \\ 5 & 2 \end{vmatrix} = 6-5 = 1$ $\lvert A\rvert.I = 1.\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = L.H.S$ $A.adjA = \begin{bmatrix} 3 & 1 \\ 5 & 2 \end{bmatrix}\begin{bmatrix} 2 & -1 \\ -5 & 3 \end{bmatrix}$ $= \begin{bmatrix} 6-5 & -3+3 \\ 10-10 & -5+6 \end{bmatrix}$ $= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = R.H.S$	2(c)	Intercepts form is $\frac{x}{a} + \frac{y}{b} = 1$ Given $x-int. = 3$ & $y-int. = 2$ Then $\frac{x}{3} + \frac{y}{2} = 1$ Therefore, the equation is $2x+3y-6=0$ OR Slope of x-y+4=0 is $m_1 = 1$, $Slope$ of 2x-y+5=0 is $m_2 = 2$, Formula Θ=$\tan^{-1}\left(\frac{m_2-m_1}{1+m_2.m_1}\right)$ $= \tan^{-1}\left(\frac{2-1}{1+2.1}\right) = \tan^{-1}\left(\frac{1}{3}\right)$
2(a)	$Equation\ of\ line\ is\ 3x+4y+7=0$ $Slope = \frac{-a}{b} = \frac{-3}{4}$ $X-int. = \frac{-c}{a} = \frac{-7}{3}$ OR General form of straight line is $ax+by+c=0$ One-point form is $(y-y_1) = m(x-x_1)$	2(d)	Θ=45^0, $m = \tan 45^0$, $y-int. = C = 5$ Equation of line is y=mx+c i.e., y=1.x+5 or x-y+5=0 **(OR)** Parallel condition is $m_1 = m_2$ Slope of 2x+y-4=0 is $m_1 = \frac{-2}{1} = -2$ Slope of 6x+3y+10=0 is $m_2 = \frac{-6}{3} = -2$, $There\ fore\ m_1 = m_2$
2(b)	2x-3y+1=0, Slope $m_1 = \frac{-a}{b} = \frac{-2}{-3} = \frac{2}{3}$, $m_2 = \frac{2}{3}$(II) One-point form is $(y-y_1) = m(x-x_1)$ $(y-2) = \frac{2}{3}(x-1)$ & $2x-3y+4=0$	3(a)	40^0=40X1^0 =40X$\frac{\pi^c}{180}$=$\frac{2\pi^c}{9}$ $= 0.6981^c$ and $\frac{8\pi^c}{7}$=$\frac{8\pi}{7}$X$\frac{180^0}{\pi}$ $= (205.42)^0$ $= 205^0 42^I 51^{II}$

3(a)	OR $\tan(45^0 - A) = \frac{\tan 45^0 - \tan A}{1 + \tan 45^0 . \tan A}$ $= \frac{1-\tan A}{1+\tan A}$	3(d)	Given $\frac{\sin 6\theta + \sin 2\theta}{\cos 6\theta + \cos 2\theta} = \frac{2\sin\left(\frac{6\theta+2\theta}{2}\right)\cos\left(\frac{6\theta-2\theta}{2}\right)}{2\cos\left(\frac{6\theta+2\theta}{2}\right)\cos\left(\frac{6\theta-2\theta}{2}\right)}$ $= \frac{\sin 4\theta}{\cos 4\theta} = \tan 4\theta$ OR $\frac{1-\cos 2\theta+\sin 2\theta}{1+\cos 2\theta+\sin 2\theta}$ $= \frac{1-(1-2sin^2\theta)+2\sin\theta\cos\theta}{1+2cos^2\theta-1+2\sin\theta\cos\theta} = \frac{2sin^2\theta+2\sin\theta\cos\theta}{2cos^2\theta+2\sin\theta\cos\theta}$ $= \frac{2\sin\theta(\sin\theta+\cos\theta)}{2cos\theta(\cos\theta+\sin\theta)}$ =tanΘ
3(b)	Simplify $\frac{\sin(360^0+A)\tan(180^0+A)}{\cos(90^0-A)\cot((270^0-A))} = \frac{\sin A.\tan A}{\sin A.\tan A}$=1 OR Given $\tan\theta = \frac{3}{4}$, $Then\ hypotenuse = 5$ Therefore $\sin\theta = \frac{3}{5}$, $\cos\frac{4}{5}$ $5\sin\theta + 5\cos\theta = 5\left(\frac{3}{5}\right) + 5\left(\frac{4}{5}\right)$=7	4(a)	Given $y = \tan x + 4e^x - 6 + \sqrt{x}$ $\frac{dy}{dx} = sec^2x + 4e^x - 0 + \frac{1}{2\sqrt{x}}$ OR $\frac{d(x^2.e^x)}{dx} = x^2e^x + e^x.2x$
3(c)	$\cos(A+B) = \cos A\cos B - \sin A\sin B$ $\cos(75^0) = \cos(45^0 + 30^0)$ $= \cos 45^0\cos 30^0 - \sin 45^0\sin 30^0$ $= \frac{1}{\sqrt{2}}\frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}\frac{1}{2} = \frac{\sqrt{3}}{2\sqrt{2}} - \frac{1}{2\sqrt{2}} = \frac{\sqrt{3}-1}{2\sqrt{2}}$ OR Let$\frac{sin2A}{sinA} - \frac{\cos 2A}{\cos A}$ $= \frac{\sin 2A\cos A - \cos 2A\sin A}{\sin A\cos A}$ $= \frac{\sin(2A-A)}{\sin A\cos A} = \frac{\sin A}{\sin A\cos A} = \frac{1}{\cos A} = \sec A$	4(b)	$y = \frac{(1+\tan x)}{(1-\tan x)}$ $\frac{dy}{dx} = \frac{(1-\tan x)sec^2x - (1+\tan x)(-sec^2x)}{(1-\tan x)^2}$ $= \frac{sec^2x - \tan x sec^2x + sec^2x + \tan x sec^2x}{(1-\tan x)^2} = \frac{2sec^2x}{(1-\tan x)^2}$ OR $y = 2x^4 - 3x^2 - 2x^2 + x - 1$ $\frac{dy}{dx} = 8x^3 - 9x^2 - 4x + 1$ $\frac{d^2y}{dx^2} = 24x^2 - 18x - 4, at\ x = 0, \frac{d^2y}{dx^2} = -4$

4(c)	S=$2t^3 - t^2 + 5t - 6$ V=$\frac{ds}{dt} = 6t^2 - 2t + 5$ a=$\frac{dv}{dt} = 12t - 2$ At t=2 , V=25 At t=2 , a=22 OR $Y = 2x^3 - 3x^2 - 36x + 10$, $\frac{dy}{dx} = 6x^2 - 6x - 36$, $\frac{d^2y}{dx^2} = 12x - 6$ Let $x^2 - x - 6 = 0$, $x^2 - 3x + 2x - 6 = 0$, $(x-3)(x+2) = 0$, x=3 or x= -2 Put x=3 in $\frac{d^2y}{dx^2}$ and its value is 30(+ve) Function has minimum at x=3 Put x=-2 in $\frac{d^2y}{dx^2}$ and its value is -30(-ve) Function has maximum at x=-2 Maximum value is (x=-2 in given eqn.) 54 Minimum value is (x=3 in given eqn.) -71	5(a)	$\int e^x + \frac{1}{1+x^2} - \sin x + x^3$.dx $= e^x + \tan^{-1} x + \cos x + \frac{x^4}{4}$+C OR $\int x^2\,(1+x).\,dx$ $= \int x^2 + x^3.\,dx$ $= \frac{x^3}{3} + \frac{x^4}{4} + c$
4(d)	If $y = x^2$, $\frac{dy}{dx} = 2x$, $\frac{d^2y}{dx^2} = 2$ Let $x\ \frac{d^2y}{dx^2} - \frac{dy}{dx}$ $x(2) - 2x$ =0 OR $y = x^2 + x - 1$, One-point form is $\frac{dy}{dx} = 2x + 1$, $(y - y_1) = m(x - x_1)$ Slope m(at x=1)=3 $(y - y_1) = m(x - x_1)$ $(y-1) = 3(x-1)$ i.e. 3x-y-2=0	5(b)	$\int cos^2x.\,dx = \int \frac{1+\cos 2x}{2}.\,dx$ = $\frac{1}{2}\left(x + \frac{\sin 2x}{2}\right) + c$ OR $\int_0^{\frac{\pi}{4}} tan^2x sec^2x.\,dx$ Put tanx = t $\int_0^{\frac{\pi}{4}} t^2.\,dt = \left[\frac{t^3}{3}\right]$ = $\frac{tan^3x}{3}$ sec^2x .dx=dt where limits are 0 to $\frac{\pi}{4}$ then answer is $\frac{1}{3}$

5(c)	Area=$\int_a^b y.dx = \int_0^1 x^3 - 2.dx = \left[\frac{x^4}{4} - 2x\right]$ $with\ limits\ 0\ to\ 1$ $= \left(\left(\frac{1^4}{4} - 2(1)\right)\right) - 0$ Answer is $\frac{-7}{4}$ OR Volume=$\pi \int_a^b y^2 . dx = \pi \int_2^5 x + 2.dx$ $= \pi \left[\frac{x^2}{2} + 2x\right]$with limits 2 to 5 Answer is $\frac{33\pi}{2}$		
5(d)	$\int x.e^x.dx = x\int e^x.dx - \int \frac{d}{dx}x.\int e^x.dx.dx$ $= x\int e^x.dx - \int 1.e^x.dx$ $= xe^x - e^x + c$ OR $\int_0^1 \frac{e^x}{1+e^x}.dx = \int_0^1 \frac{dt}{t}$=$[logt] = [\log(1+e^x)]$ With limits 0 to 1 Put 1+$e^x = t$ $log(1+e) - \log(1+1)$ $e^x.dx = dt$ $= log\frac{(1+e)}{2}$		
Note: - Give equal weightage for alternate answers			

Register Number :

QP-Code : 20SC01T

Makeup Examination Nov/Dec - 2022

I / II Semester Diploma Examination

ENGINEERING MATHEMATICS (20SC01T)

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

Instruction: i) Answer ONE full question from each section.

ii) One full question carries 20 marks.

SECTION – I

1. (a) Write four type of matrices with one example for each. **(4)**

OR

If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ then Find $3A + 2B$

(b) If $A = \begin{bmatrix} 3 & 1 & 2 \\ 1 & 2 & 1 \\ 2 & 3 & 1 \end{bmatrix}$ then find adjA **(6)**

OR

Find the characteristic roots of the matrix $A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$

(c) Applying Cramer's rule solve the system of linear equations **(5)**

$$3x + y = 4 \; and \; x + 3y = 4$$

OR

The Tata motors company Ltd., has two outlets, one in Bengaluru and one in Belgaum, among other things, it sells Tata Nexon, Tata Tiago, and Tata Punch cars. The monthly sales of these cars at the two stores for two months are Given in the following tables:

October sells

	Bengaluru	**Belgaum**
Tata Nexon	25	35
Tata Tiago	15	20
Tata Punch	18	05

November sells

	Bengaluru	**Belgaum**
Tata Nexon	35	45
Tata Tiago	30	50
Tata Punch	26	25

Use matrix arithmetic to calculate the change in sales of each product in each Store from October to November.

(d) If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ $and\ B = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ then find the value of AB and then find $(AB)^T$ **(5)**

OR

For the given matrix $A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ verify $A\,.\,adjA = |A|I$, where ' I' is the unit matrix of the order 2.

SECTION – II

2. (a) Find the slope and y-intercept of the line 5x - 3y +9 = 0 **(4)**

OR

Find the equation of straight line of slope 3units and y-intercept 4.

(b) Find the equation of straight line passing through the point (3,4) and perpendicular to $4x+2y+3=0$. **(6)**

OR

Find the equation of straight line passing through the point (2,-5) and (3,7)

(c) Using slope point form of straight line find the equation of line passing through the point (1,2) , inclined at 45^0 to the x - axis **(5)**

OR

Find the equation of straight line whose 'x'- intercept and y-intercept are 5and 6respectively. Write the standard form of it.

(d) Find the equation of straight line passing through the point (2,3) and parallel to $5x - 4y +4 =0$ **(5)**

OR

If $\frac{3}{5}$ and $\frac{7}{3}$ are the slopes of two lines, find the angle between the two lines

SECTION – III

3.(a) Convert 30^0 into radians and $\frac{\pi}{12}$ into degree. **(4)**

OR

Prove that $\tan(45^o + A) = \frac{1+\tan A}{1-\tan A}$

(b) Prove that $sin\theta \cos(90-\theta) + cos\theta \sin(90-\theta) = 1$ (6)

OR

Prove that $\frac{\sin(A+B)+\sin(A-B)}{\cos(A+B)+\cos(A-B)} = tanA$

(c) Write the formula for $sin(A+B)$ then find the value of $sin75^0$ (5)

OR

Simplify $\frac{\cos(360^0-A)\tan(360^0+A)}{\cot(270^0-A)\sin(90^0+A)}$

(d) Prove that $sin20^0\ sin40^0\ sin80^0 = \frac{\sqrt{3}}{8}$ (5)

OR

Prove that $cos2\theta = 2\cos^2\theta - 1$

SECTION – IV

4. (a) Differentiate $x^3 + x^2 + 3x + 9$ with respect to x. (4)

OR

If $y = (x+1)(x-1)$ then find $\frac{dy}{dx}$.

(b) Find the maximum and minimum value of a function (6)

$y = x^3 - 12x^2 - 27x + 16$

OR

A ball will throw vertically upwards and reaches maximum height s in feet. The height reached is given by $s = -16t^2 + 64t$. How much time it takes to reach maximum height? Find also the maximum height reached by the ball.

(c) If $y = Ae^{mx} + Be^{-mx}$ then prove that $\frac{d^2y}{dx^2} - m^2y = 0$ **(5)**

OR

Find the derivative of a function $\frac{1+\sin x}{1-\sin x}$ w.r.t.x.

(d) Find the equation of normal to the curve $y = 1 - x^3$ at the point (2, 3) **(5)**

OR

If $y = (1+x^2)\tan^{-1} x$ then find $\frac{dy}{dx}$.

SECTION – V

5. a) Integrate $2x^3 - \frac{3}{x} + 4\cos x + \frac{1}{1+x^2}$ w.r.t. x **(4)**

OR

Integrate $(x-2)(x+3)$ w.r.t x.

b) Evaluate $\int \sin^2 x \, dx$ **(6)**

OR

Evaluate $\int_0^{\frac{\pi}{4}} \tan^2 x \, dx$

c) Using definite integrals,find the area bounded by the curve $y = 4x - x^2 - 3$, x-axis and the ordinates $x = 1$ and $x = 3$. **(5)**

OR

The curve $y^2 = x^2 + 5x$ is rotated about x −axis. Find the volume of the solid generated by revolving the curve between the ordinates $x = 1, x = 2$ about x −axis

d) Using integration by parts evaluate the indefinite integral $\int x \, sinx \, dx$. **(5)**

OR

Evaluate $\int_0^1 \frac{(tan^{-1}x)^3}{1+x^2} dx$

MAKE UP EXAMINATION NOV/DEC 2022

Course Name: Engineering Mathematics **Course Code : 20SC01T**

SCHEME OF VALUATION

Q No	Particulars	Marks
	Section - I	
1 (a)	Types Example (each $\frac{1}{2}$ marks)	1 1 1 1 = 4
	OR	
	Finding 3A and 2B Finding 3A+2B	2 2 = 4
1(b)	Finding minors Writing cofactor Writing adjoint	4 1 1 = 6
	OR	
	Writing $\|A - \lambda I\| = 0$ Finding Characteristic Equation Finding Characteristic roots	1 3 2 = 6
1(c)	Finding $\Delta,\ \Delta_x,\ \Delta_y$ Finding x and y	3 2 = 5
	OR	
	Writing Given Data in Matrix Form Finding difference Answer	2 2 1 = 5
1(d)	Finding AB Finding $(AB)^T$	3 2 = 5
	OR	
	Finding $A.adjA$ Finding $\|A\|I$ Conclusion	2 2 1 = 5

Q.N	PARTICULAR	MARKS
	SECTION - II	
2(a)	Finding slope Finding y-intercept	2 2
	OR	
	Writing m=3 and c =4 Formula	1 1

	Substituting values Final equation	1 1
2(b)	Writing 4x+2y+K=0 Getting value of k result	2 2 2
	OR	
	Formula Substituting values Simplification and result	2 2 2
2(c)	Finding m = 1 Formula Substituting values Final equation	2 1 1 1
	OR	
	Writing standard form Substituting values Simplification Final equation	2 1 1 1
2(d)	Writing 5x-4y+K=0 Getting value of k result	2 2 1
	OR	
	Formula Substituting values Simplification Result	2 1 1 1

Q No	Particulars	Marks
	Section - III	
3 (a)	Converting 30^0 to radian Converting $\frac{\pi}{12}$ to degree	2 2 = 4
	OR	
	$\tan{(A+B)}$ formula substituting 45^0 Result	1 2 1 = 4
(b)	Allied angle change Substitution Trigonometric identity Result	2 2 1 1 = 6
	OR	
	$\sin{(A+B)}$ and $\cos{(A+B)}$ (2 mark each) Simplification Proving RHS	4 1 1 = 6
(c)	$\sin{(A+B)}$ formula each T – value $\frac{1}{2}$ mark result	2 2 1 = 5
	OR	

	Each allied angle (1 mark each) Simplification and result	4 1	= 5
1(d)	Simplifying $sin20^0 sin40^0$ Simplifying $cos20^0\ sin80^0$	2 2 1	= 5
	OR		
	$cos2\theta$ formula $\sin^2\theta$ formula Rest	2 2 1	= 5

Q.N0	Particular	Marks
	SECTION-IV	
4(a)	Differentiation of each term	1+1+1+1 = 4
	OR	
	Applying algebraic formula or multiplication Differentiation and Answer	1 2+1 = 4
4(b)	Finding first and second derivative of a function Getting value of x Finding maximum and Minimum value	1+1 2 1+1 = 6
	OR	
	Finding $\frac{ds}{dt}$ Taking $\frac{ds}{dt} = 0$ Getting time value Finding displacement value	2 1 1 2 = 6
4(c)	Finding $\frac{dy}{dx}$ Finding $\frac{d^2y}{dx^2}$ Simplification and Answer	2 2 1 = 5
	OR	
	Using Quotient rule Derivative of 1+sinx Derivative of 1-sinx Simplification and answer	2 1 1 1 = 5
4(d)	Differentiation and getting slope Equation of normal formula Substitution and simplification	2 1 2 = 5
	OR	
	Using product rule Differentiation each term Answer	2 1+1 1 = 5

Q.N0	Particular	Marks
SECTION V		
5(a)	Integration of each 1 mark (1+1+1+1)	4M
	OR	
	Simplification Integration	1 M 3M
5(b)	Writing sin^2x formula Substitution Integration	2M 1 M 1M
	OR	
	Writing tan^2x formula Integration Substituting limit values Simplification	2M 1M 1M 2M
5(c)	Writing Area Formula Integration Simplification and Result	1M 2M 2M
	OR	
	Writing Volume Formula Integration Simplification and Result	1M 2M 2M
5(d)	Formula for integration by parts Substitution Calculation and Result	1M 1M 3M
	OR	
	Substitution Differentiation Finding new limits Simplification	1M 1M 1M 2M

MODEL ANSWERS

SECTION I

1(a)

1. Row matrix $A = [1 \quad 2 \quad 3]$
2. Column matrix $A = \begin{bmatrix} 3 \\ 2 \\ 1 \end{bmatrix}$
3. Square matrix $S = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
4. Diagonal matrix $D = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$

OR

If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ then Find $3A + 2B$

$3A = 3\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix}$

$2B = 2\begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} = \begin{bmatrix} 6 & 4 \\ 2 & 8 \end{bmatrix}$

$3A + 2B = \begin{bmatrix} 3 & 6 \\ 9 & 12 \end{bmatrix} + \begin{bmatrix} 6 & 4 \\ 2 & 8 \end{bmatrix}$

$= \begin{bmatrix} 9 & 10 \\ 11 & 20 \end{bmatrix}$

1(b) To find the adjoint we need to find the cofactors first

$C_3 = +\begin{vmatrix} 2 & 1 \\ 3 & 1 \end{vmatrix}$ $= +(2-3) = -1$	$C_1 = -\begin{vmatrix} 1 & 2 \\ 3 & 1 \end{vmatrix}$ $= -(1-6) = 5$	$C_2 = +\begin{vmatrix} 1 & 2 \\ 2 & 1 \end{vmatrix}$ $= +(1-4) = -3$
$C_1 = -\begin{vmatrix} 1 & 1 \\ 2 & 1 \end{vmatrix}$ $= -(1-2) = 1$	$C_2 = +\begin{vmatrix} 3 & 2 \\ 2 & 1 \end{vmatrix}$ $= +(3-4) = -1$	$C_3 = -\begin{vmatrix} 3 & 2 \\ 1 & 1 \end{vmatrix}$ $= -(3-2) = -1$
$C_2 = +\begin{vmatrix} 1 & 2 \\ 2 & 3 \end{vmatrix}$ $= +(3-4) = -1$	$C_1 = -\begin{vmatrix} 3 & 1 \\ 2 & 3 \end{vmatrix}$ $= -(9-2) = -7$	$C_1 = +\begin{vmatrix} 3 & 1 \\ 1 & 2 \end{vmatrix}$ $= +(6-1) = +5$

Cofactor matrix C= $\begin{bmatrix} -1 & 1 & -1 \\ 5 & -1 & -7 \\ -3 & -1 & 5 \end{bmatrix}$

AdjA= $[cofactor\ matrix]^T$

$adjA = \begin{bmatrix} -1 & 5 & -3 \\ 1 & -1 & -1 \\ -1 & -7 & 5 \end{bmatrix}$

OR

Given $A = \begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$

Characteristic equation is ‘A’ defined as $|A - \lambda I| = 0$

$\Rightarrow \begin{vmatrix} 3-\lambda & 1 \\ 2 & 4-\lambda \end{vmatrix} = 0$

$\Rightarrow (3-\lambda)(4-\lambda) - 2 = 0$

$\Rightarrow 12 - 3\lambda - 4\lambda + \lambda^2 - 2 = 0$

<table>
<tr><td></td><td>$\Rightarrow 12 - 7\lambda + \lambda^2 - 2 = 0$
$\Rightarrow \lambda^2 - 7\lambda + 10 = 0$
$\Rightarrow \lambda^2 - 5\lambda - 2\lambda + 10 = 0$
$\Rightarrow \lambda(\lambda - 5) - 2(\lambda - 5) = 0$
$\Rightarrow (\lambda - 5)(\lambda - 2) = 0$
$\Rightarrow \lambda - 5 = 0 \;\; or \; \lambda - 2 = 0$
$\Rightarrow \lambda = 5$ or $\lambda = 2$
Therefore the characteristics roots of the given matrix are $\lambda = 5 \; and \; \lambda = 2$</td></tr>
<tr><td>1(c)</td><td>Given system of linear equations
$3x + y = 4$
$x + 3y = 4$

Consider $\Delta = \begin{vmatrix} 3 & 1 \\ 1 & 3 \end{vmatrix} = 9 - 1 = 8$

$\Delta_x = \begin{vmatrix} 4 & 1 \\ 4 & 3 \end{vmatrix} = 12 - 4 = 8$

$\Delta_y = \begin{vmatrix} 3 & 4 \\ 1 & 4 \end{vmatrix} = 12 - 4 = 8$

$x = \frac{\Delta_x}{\Delta} = \frac{8}{8} = 1 y = \frac{\Delta_y}{\Delta} = \frac{8}{8} = 1$

$x = 1$ and $y = 1$</td></tr>
<tr><td></td><td>OR</td></tr>
<tr><td></td><td>By transforming given data to matrix form
Let October sells be Let November sells
$O = \begin{bmatrix} 25 & 35 \\ 15 & 20 \\ 18 & 5 \end{bmatrix} N = \begin{bmatrix} 35 & 45 \\ 30 & 50 \\ 26 & 25 \end{bmatrix}$

Change in sells is given by

$O - N = \begin{bmatrix} 25 & 35 \\ 15 & 20 \\ 18 & 5 \end{bmatrix} - \begin{bmatrix} 35 & 45 \\ 30 & 50 \\ 26 & 25 \end{bmatrix}$

$= \begin{bmatrix} -10 & -10 \\ -15 & -30 \\ -8 & -20 \end{bmatrix}$ or $\begin{bmatrix} 10 & 10 \\ 15 & 30 \\ 8 & 20 \end{bmatrix}$</td></tr>
<tr><td>1(d)</td><td>Given $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$

$AB = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$

$= \begin{bmatrix} (1 \times 3) + (2 \times 1) & (1 \times 2) + (2 \times 4) \\ (3 \times 3) + (4 \times 1) & (3 \times 2) + (4 \times 4) \end{bmatrix}$

$= \begin{bmatrix} 3 + 2 & 2 + 8 \\ 9 + 4 & 6 + 16 \end{bmatrix}$

$= \begin{bmatrix} 5 & 10 \\ 13 & 22 \end{bmatrix}$</td></tr>
</table>

	$(AB)^T = \begin{bmatrix} 5 & 13 \\ 10 & 22 \end{bmatrix}$
	OR
	Given ,$A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ $\Rightarrow adjA = \begin{bmatrix} 4 & -2 \\ -1 & 3 \end{bmatrix}$ Consider $A.adjA = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}\begin{bmatrix} 4 & -2 \\ -1 & 3 \end{bmatrix}$ $= \begin{bmatrix} (3\times 4)+(2\times -1) & (3\times -2)+(2\times 3) \\ (1\times 4)+(4\times -1) & (1\times -2)+(4\times 3) \end{bmatrix}$ $= \begin{bmatrix} 12-2 & -6+6 \\ 4-4 & -2+12 \end{bmatrix}$ $= \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$----------------- (1) Consider $\|A\|I = \begin{vmatrix} 3 & 2 \\ 1 & 4 \end{vmatrix}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $= (12-2)\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $= 10\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$---------------(2) From (1) and (2) $A\,.adjA = \|A\|I$

SECTION - II	
2(a)	Find the slope and y-intercept of the line $5x - 3y + 9 = 0$ Given: $5x - 3y + 9 = 0$ $a = 5 \quad b = -3 \quad c = 9$ $Slope = \frac{-a}{b} = \frac{-5}{-3} = \frac{5}{3}$ $y-\ intercept = \frac{-c}{b} = \frac{-9}{-3} = \frac{9}{3} = 3$

	OR
	Find the equation of straight line of slope 3units and y-intercept 4. Given: $slope\ m = 3 \quad c = 4$ $y = mx + c$ $y = 3x + 4$ $3x - y + 4 = 0$
2(b)	Find the equation of straight line passing through the point (3,4) and perpendicular to $4x + 2y + 3 = 0$ Given: $4x + 2y + 3 = 0$ $4x + 2y + 3 = 0$ $a = 4 \quad b = 2 \quad c = 3$ $2x - 4y + k = 0$ ……….(1) $Slope = \frac{-a}{b} = \frac{-4}{2} = -2$ $2(3) - 4(4) + k = 0$ $(y - y_1) = \frac{-1}{m}(x - x_1)$ OR $6 - 16 + k = 0$ $(y - 4) = \frac{-1}{-2}(x - 3)$ $-10 + k = 0$ $(y - 4) = \frac{1}{2}(x - 3)$ $k = 10$ $(substitute\ in\ equ\ -1)$ $2(y - 4) = 1(x - 3)$ $2x - 4y + 10 = 0$ $2y - 8 = x - 3$ $x - 3 - 2y + 8 = 0$ 0r $x - 2y + 5 = 0$ $x - 2y + 5 = 0$
	OR
	Find the equation of straight line passing through the point $(2,-5)$ and $(3,7)$ Given: $(x_1, y_1) = (2,-5)$ $(x_2, y_2) = (3,7)$ $(y - y_1) = \frac{(y_2 - y_1)}{(x_2 - x_1)}(x - x_1)$ $(y + 5) = \frac{(7+5)}{(3-2)}(x - 2)$ $(y + 5) = \frac{12}{1}(x - 2)$ $1(y + 5) = 12(x - 2)$ $y + 5 = 12x - 24$ $12x - y - 29 = 0$
2(c)	Using slope point form of straight line find the equation of line passing through the point (1,2) , inclined at 45^0 to the x – axis Given: $(x_1, y_1) = (1,2)$ $\theta = 45^0$ $m = tan\,\theta$ $m = tan\,45$ $m = 1$ $(y - y_1) = m(x - x_1)$ $(y - 2) = 1(x - 1)$ $y - 2 = x - 1$ $x - y + 1 = 0$
	OR
	Find the equation of straight line whose ‘x’- intercept and y-intercept are 5and 6 respectively. Write the standard form of it. Given: $a = 5$ $b = 6$ Standard form of equation is $\frac{x}{a} + \frac{y}{b} = 1$

	$\frac{x}{a} + \frac{y}{b} = 1$ $\frac{x}{5} + \frac{y}{6} = 1$ $\frac{(6x+5y)}{30} = 1$ $6x + 5y = 30$ $6x + 5y - 30 = 0$
2(d)	(d) Find the equation of straight line passing through the point (2,3) and parallel to $5x - 4y + 4 = 0$ Given: $5x - 4y + 4 = 0$ $a = 5 \quad b = -4 \quad c = 4$ $Slope = \frac{-a}{b} = \frac{-5}{-4} = \frac{5}{4}$ $(y - y_1) = m(x - x_1)$ $(y - 3) = \frac{5}{4}(x - 2)$ $4(y - 3) = 5(x - 2)$ $4y - 12 = 5x - 10$ $5x - 10 - 4y + 12 = 0$ $5x - 4y + 2 = 0$ Alternative method $5x - 4y + 4 = 0$ $5x - 4y + k = 0 \dots\dots\dots\dots(1)$ $5(2) - 4(3) + k = 0$ $10 - 12 + k = 0$ $-2 + k = 0$ $k = 2$ (substitute in equ -1) $5x - 4y + 2 = 0$
	OR
	If $\frac{3}{5}$ and $\frac{7}{3}$ are the slopes of two lines, find the angle between the two lines Given: $m_1 = \frac{3}{5}$ $\tan\theta = \left\lvert\frac{m_1 - m_2}{1 + m_1 m_2}\right\rvert$ $\tan\theta = \left\lvert\frac{\frac{3}{5} - \frac{7}{3}}{1 + \frac{37}{53}}\right\rvert$ $m_2 = \frac{7}{3}$ $\tan\theta = \left\lvert\frac{\frac{9-35}{15}}{1 + \frac{21}{15}}\right\rvert$ $\tan\theta = \left\lvert\frac{\frac{-26}{15}}{\frac{15+21}{15}}\right\rvert$ $\tan\theta = \left\lvert\frac{-26}{36}\right\rvert$ $\tan\theta = \left\lvert\frac{-13}{18}\right\rvert$ $\tan\theta = \frac{13}{18}$ $\theta = \tan^{-1}\left(\frac{13}{18}\right)$

SECTION III	
3(a)	Consider ,$30^0 = 30^0 \times \frac{\pi}{180^0}$ $= \frac{\pi}{6}\ radians$ Consider $\frac{\pi}{12} radians = \frac{\pi}{12} \times \frac{180^0}{\pi} = \frac{180^0}{12}$ $\frac{\pi}{12} = 15^0$

	OR
	We know that $\tan(A+B) = \dfrac{tanA + tanB}{1 - tanA\ tanB}$ Consider LHS = $\tan(45^0 + A)$ $\tan(45^0 + A) = \dfrac{tan45^0 + tanA}{1 - tan45^0\ tanA}$ $\tan(45^0 + A) = \frac{1+tanA}{1-tanA} =$ RHS
3(b)	Consider $\cos(90-\theta) = sin\theta$ $\sin(90-\theta) = cos\theta$ LHS= $sin\theta\cos(90-\theta) + cos\theta\sin(90-\theta)$ $= sin\theta\sin\theta + cos\theta\cos\theta$ $= \sin^2\theta + \cos^2\theta = 1 = RHS$ [acccording to first trigonometric identity]
	OR
	LHS= $\frac{\text{Sin}(A+B)+\sin(A-B)}{\cos(A+B)+\cos(A-B)}$ $= \dfrac{(sinA\ cosB + cosA\ sinB) + (sinA\ cosB - cosA\ sinB)}{(cosA\ cosB - sin\ sinB) + (cosA\ cosB + sinA\ sinB)}$ $= \dfrac{2\ sinA\cos B}{2\cos A\ cosB}$ $= \dfrac{sinA}{cosA}$ $= tanA$ =RHS
3(c)	Consider $\sin(A+B) = sinAcosB + cosA\sin B$ $\sin 75^0 = \sin(30^0 + 45^0)$ $\sin(30^0+45^0) = sin30^0\ cos45^0 + cos30^0 sin45^0$ $= \left(\dfrac{1}{2}\right)\left(\dfrac{1}{\sqrt{2}}\right) + \left(\dfrac{\sqrt{3}}{2}\right)\left(\dfrac{1}{\sqrt{2}}\right)$ $= \dfrac{1}{2\sqrt{2}} + \dfrac{\sqrt{3}}{2\sqrt{2}}$ $sin75^0 = \dfrac{\sqrt{3}+1}{2\sqrt{2}}$
	OR
	Consider $\cos(360^0 - A) = \cos(A)$ $\tan(360^0 + A) = \tan(A)$ $\cot(270^0 - A) = \tan(A)$ $\sin(90^0 + A) = \cos(A)$ Consider $\frac{\cos(360^0-A)\tan(360^0+A)}{\cot(270^0-A)\sin(90^0+A)}$ $= \dfrac{cosA\ tanA}{tanAcosA} = \frac{1}{1} = 1$
3(d)	LHS = $sin20^0\ sin40^0 sin80^0$ $= sin80^0 sin40^0 sin20^0$

	$= -\frac{1}{2}(\cos(120^0) - cos40^0)sin20^0$ $= -\frac{1}{2}\left(-\frac{1}{2} - cos40^0\right)sin20^0$ $= -\frac{1}{2}\left(-\frac{1}{2}sin20^0 - cos40^0 sin20^0\right)$ $= -\frac{1}{2}(-\frac{1}{2}sin20^0 - \frac{1}{2}(\sin(60^0) - sin20^0)$ $= -\frac{1}{2}\left(-\frac{1}{2}sin20^0 - \frac{1}{2}sin60^0 + \frac{1}{2}sin20^0\right)$ $= -\frac{1}{2}\left(-\frac{1}{2}sin60^0\right)$ $= -\frac{1}{2}\left(-\frac{1}{2} \times \frac{\sqrt{3}}{2}\right)$ $= \frac{\sqrt{3}}{8}$ =RHS
	OR
	We know that $cos2\theta = \cos^2\theta - \sin^2\theta$ $cos2\theta = \cos^2\theta - (1 - \cos^2\theta)$ $cos2\theta = \cos^2\theta - 1 + \cos^2\theta$ $cos2\theta = 2\cos^2\theta - 1$

SECTION-IV	
4 (a)	$\frac{d}{dx}(x^3 + x^2 + 3x + 9) = 3x^2 + 2x + 3 + 0$ $= 3x^2 + 2x + 3$
	OR

	$y=(x+1)(x-1)$ $y=x^2-1$ Diff w.r.t.x $\frac{dy}{dx}=\frac{d}{dx}(x^2-1)=2x-0=2x$
4 (b)	$y=x^3-12x^2-27x+16$ *Differentiate w.r.t.x* $\frac{dy}{dx}=\frac{d}{dx}(x^3-12x^2-27x+16)$ $\frac{dy}{dx}=3x^2-12\times 2x-27+0$ $\frac{dy}{dx}=3x^2-24x-27$ For function to be maxima or minima put $\frac{dy}{dx}=0$ $0=3x^2-24x-27 \quad \Rightarrow \quad 3x^2-24x-27=0$ Divide both side by 3 $x^2-8x-9=0$ Solve the above quadratice quation by factorizat ion method $x^2-8x-9=0 \qquad -9x^2=-9x+x$ $x^2-9x+x-9=0$ $x(x-9)+1(x-9)=0$ $(x-9)(x+1)=0$ $x-9=0 \quad or \quad x+1=0$ $x=9 \quad or \quad x=-1$ $x=9,-1$ are the stationary point*s* $\frac{dy}{dx}=3x^2-24x-27$ Again diff w.r.t.x $\frac{d^2y}{dx^2}=3\times 2x-24+0$ $\frac{d^2y}{dx^2}=6x-24$

	$When\ x=-1$ $\left(\frac{d^2y}{dx^2}\right)_{x=-1}=6(-1)-24=-6-24=-30\prec 0$ Therfore the function is maxima at x = -1 and its maximum value is given $y=x^3-12x^2-27x+16$ $put\ x=-1$ $y_{\max}=(-1)^3-12(-1)^2-27(-1)+16$ $y_{\max}=-1-12\times 1+27+16$ $y_{\max}=-1-12+27+16$ $y_{\max}=43-13=30$ $When\ x=9$ $\left(\frac{d^2y}{dx^2}\right)_{x=9}=6(9)-24=54-24=30\succ 0$ Therfore the function is minima at x = 9 and its minimum value is given $y=x^3-12x^2-27x+16$ $put\ x=9$ $y_{\min}=(9)^3-12(9)^2-27(9)+16$ $y_{\min}=729-12(81)-243+16$ $y_{\min}=729-972-243+16$ $y_{\min}=745-1215=-470$
	OR
	$s=-16t^2+64t.------------------(1)$ $Differentiate\ w.r.t.x$ $\frac{ds}{dt}=\frac{d}{dt}\left(-16t^2+64t\right)\Rightarrow\quad \frac{ds}{dt}=-16\times 2t+64$ $\frac{ds}{dt}=-32t+64$ when ball reaches maximum height at that time velocity v = 0 $0=-32t+64$ $32t=64$ $t=\frac{64}{32}=2$ $t=2\sec$ Therfore the ball taken time to raech maximum height is 2 sec. Now find maximum height put t = 2sec in (1) $s=-16t^2+64t$ $s=-16(2)^2+64(2)$ $s=-16\times 4+128=-64+128=64\ feet$

4 (c)	$y = Ae^{mx} + Be^{-mx} ---------------(1)$ $Differentiate\ w.r.t.x$ $\frac{dy}{dx} = \frac{d}{dx}\left(Ae^{mx} + Be^{-mx}\right)$ $\frac{dy}{dx} = A \times e^{mx} \times m + B \times e^{-mx} \times -m$ $\frac{dy}{dx} = Ame^{mx} - Bme^{-mx}$ Again differenti ate w.r.t.x $\frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dx}\left(Ame^{mx} - Bme^{-mx}\right)$ $\frac{d^2y}{dx^2} = Am \times e^{mx} \times m - Bm \times e^{-mx} \times -m$ $\frac{d^2y}{dx^2} = Am^2e^{mx} + Bm^2e^{-mx} = m^2\left(Ae^{mx} + Be^{-mx}\right)$ $\frac{d^2y}{dx^2} = m^2y$ from equation (1) $\frac{d^2y}{dx^2} - m^2y = 0$
	OR
	Let $y = \frac{1+\sin x}{1-\sin x}$ $Differentiate\ w.r.t.x$ $\frac{dy}{dx} = \frac{d}{dx}\left(\frac{1+\sin x}{1-\sin x}\right)$ $\quad w.k.t\ \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$ $\frac{dy}{dx} = \left(\frac{(1-\sin x)\frac{d}{dx}(1+\sin x) - (1+\sin x)\frac{d}{dx}(1-\sin x)}{(1-\sin x)^2}\right)$ $\frac{dy}{dx} = \frac{(1-\sin x)(0+\cos x) - (1+\sin x)(0-\cos x)}{(1-\sin x)^2}$ $\frac{dy}{dx} = \frac{(1-\sin x)(\cos x) - (1+\sin x)(-\cos x)}{(1-\sin x)^2}$ $\frac{dy}{dx} = \frac{\cos x - \sin x\cos x + \cos x + \sin x\cos x}{(1-\sin x)^2}$ $\frac{dy}{dx} = \frac{2\cos x}{(1-\sin x)^2}$
4 (d)	$y = 1 - x^3$ Differenti ate w.r.t.x $\frac{dy}{dx} = \frac{d}{dx}\left(1 - x^3\right) \Rightarrow \quad \frac{dy}{dx} = 0 - 3x^2$ $\frac{dy}{dx} = -3x^2$ $\left(\frac{dy}{dx}\right)_{at\ A(2,3)} = -3(2)^2 = -12$

	$m = -12$ The equation of normal to the curve at the point (2, 3) with slope m=-12 is $y - y_1 = \frac{-1}{m}(x - x_1) \quad \Rightarrow \quad y - 3 = \frac{-1}{-12}(x-2)$ $y - 3 = \frac{1}{12}(x-2) \quad \Rightarrow \quad 12(y-3) = 1(x-2)$ $12y - 36 = x - 2 \quad \Rightarrow \quad x - 2 - 12y + 36 = 0$ $x - 12y + 34 = 0$
	OR
	$y = (1+x^2)\tan^{-1} x$ *Differentiate w.r.t.x* $\frac{dy}{dx} = \frac{d}{dx}\left[(1+x^2)\tan^{-1} x\right]$ $w.k.t \frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$ $\frac{dy}{dx} = (1+x^2)\frac{d}{dx}(\tan^{-1} x) + \tan^{-1} x \frac{d}{dx}(1+x^2)$ $\frac{dy}{dx} = (1+x^2) \times \frac{1}{(1+x^2)} + \tan^{-1} x \times (0 + 2x)$ $\frac{dy}{dx} = 1 + 2x\tan^{-1} x$

	SECTION V
5 a)	Integrate $2x^3 - \frac{3}{x} + 4cosx + \frac{1}{1+x^2}$ w.r.t. x Let $I = \int 2x^3 dx - \int \frac{3}{x}$ dx $+ \int 4cosxdx + \int \frac{1}{1+x^2}$ dx $I = \int 2x^3 - \frac{3}{x} + 4cosx + \frac{1}{1+x^2}$ dx $I = \frac{x^4}{2} - 3logx + 4sinx + tan^{-1}x + c$
	OR
	Let $I = \int (x-2)(x+3)$ dx $I = \int x^2 + x - 6\, dx$ $I = \frac{x^3}{3} + \frac{x^2}{2} - 6x + c$

<table>
<tr><td>b)</td><td>Using $sin^2x = \frac{1-cos2x}{2}$
Then $I = \int sin^2x\,dx$
$I = \int \frac{1-cos2x}{2}dx$
$I = \int \frac{1}{2} - \frac{cos2x}{2}dx$
$I = \frac{1}{2}x - \frac{sin2x}{4} + c$</td></tr>
<tr><td></td><td>OR</td></tr>
<tr><td></td><td>Using $tan^2x = sec^2x - 1$
$I = \int_0^{\frac{\pi}{4}} tan^2x dx$
$I = \int_0^{\frac{\pi}{4}} sec^2x - 1\ dx$
$I = [tanx - x]_0^{\frac{\pi}{4}}$
$I = \left(tan\frac{\pi}{4} - \frac{\pi}{4}\right) - (\tan 0 - 0)$
$I = 1 - \frac{\pi}{4}$</td></tr>
<tr><td>c)</td><td>Required Area $A = \int_a^b y\,dx$
$A = \int_1^3 4x - x^2 - 3\,dx$
$A = \frac{4x^2}{2} - \frac{x^3}{3} - 3x$
$A = \left[\frac{4x^2}{2} - \frac{x^3}{3} - 3x\right]_1^3$
$A = \left[2(3)^2 - \frac{3^3}{3} - 3(3)\right] - \left[2(1)^2 - \frac{1^3}{3} - 3(1)\right]$
$A = [18 - 9 - 9] - \left[2 - \frac{1}{3} - 3\right] = \frac{4}{3}$ sq.units</td></tr>
<tr><td></td><td>OR</td></tr>
<tr><td></td><td>Required Volume, $V = \int_a^b y^2\,dx$
$V = \int_1^2 x^2 + 5x\ \mathrm{dx}$
$V = \left[\frac{x^3}{3} + \frac{5x^2}{2}\right]_1^2$
$V = \left[\frac{(2)^3}{3} + \frac{5(2)^2}{2}\right] - \left[\frac{(1)^3}{3} + \frac{5(1)^2}{2}\right]$
$V = \frac{59}{6}$ cubic.units</td></tr>
<tr><td>d)</td><td>Let $I = \int x\,sinx\,dx$
Integrating by parts using $\int uv\ dx = u\int v\ dx - \int \left[\frac{du}{dx}.\int v\ dx\right]dx$, we get
$I = x\int sinx\,dx - \int (-cosx)\ 1dx$
$I = x(-cosx) + \int cosx\,dx$</td></tr>
</table>

	$I = -x\, cosx + sinx + c$
	OR
	Let $I = \int_0^1 \frac{(tan^{-1}x)^3}{1+x^2} dx$ Substituting $tan^{-1}x = t$ Differentiating w.r.t t, $\frac{1}{1+x^2} = \frac{dt}{dx} \Rightarrow \frac{dx}{1+x^2} = dt$ Lower limit $x = 0$, $t = 0$; Upper limit $x = 1$, $t = \frac{\pi}{4}$ $I = \int_0^{\frac{\pi}{4}} t^3 dt = \left[\frac{t^4}{4}\right]_0^{\frac{\pi}{4}} = \frac{\pi^4}{1024}$

1601

Code : 20SC01T

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I/II Semester Diploma Examination, Oct./Nov.-2021

ENGINEERING MATHEMATICS

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

Special Note : Students can answer for max. of **100** marks, selecting any sub-section from any main section.

SECTION – I

1. (a) If the matrix $\begin{bmatrix} 1 & 3 & -1 \\ 0 & 2 & 4 \\ 3 & 2 & x \end{bmatrix}$ is singular, then find 'x'. **4**

(b) If $A = \begin{bmatrix} 2 & 3 \\ 1 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 4 \\ 1 & 2 \end{bmatrix}$, then find 2A + 3B. **5**

(c) Solve the system of equations $2x + 3y = 5$ and $x + 4y = 5$ by Cramer's Rule. **5**

(d) Find the characteristic roots for the matrix $\begin{bmatrix} 2 & 3 \\ 0 & 4 \end{bmatrix}$. **6**

2. (a) If $A = \begin{bmatrix} 2 & 1 \\ 0 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -1 \\ 3 & 6 \end{bmatrix}$, then find $(A + B)^2$. **4**

(b) If $A = \begin{bmatrix} 1 & 3 & -1 \\ 3 & 2 & 0 \\ 4 & 1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 & 3 \\ 4 & 2 & 1 \\ 1 & 3 & -2 \end{bmatrix}$, then find $(AB)^T$. **5**

(c) Find the characteristic equation and Eigen roots of the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 1 \end{bmatrix}$. **5**

(d) Find the Inverse of the matrix $A = \begin{bmatrix} 5 & 1 & 3 \\ 1 & 4 & -1 \\ 2 & 0 & 4 \end{bmatrix}$. **6**

[Turn over

SECTION – II

3. (a) Find the slope of the straight line passing through the points (1, 2) and (3, 4). 4

(b) If the x-intercept of the line is 3 units and y-intercept is 2 times x-intercept, then find the equation of the line. 5

(c) If a straight line makes an angle of inclination of 60° with respect to positive x-axis and passes through the point (1, –1), then find the equation of the straight line. 5

(d) Find the equation of the straight line parallel to the line joining the points (3, –1) and (4, –2), passing through the point (2, 2). 6

4. (a) Write the slope and x-intercept of the line $2x + 4y + 5 = 0$. 4

(b) Find the equation of the straight line passing through the points (4, 2) and (1, 3). 5

(c) Find the equation of the straight line perpendicular to the line $4x - 2y + 3 = 0$ and passing through the points (1, 2). 5

(d) Find the acute angle between the lines $7x - 4y = 0$ and $3x - 11y + 5 = 0$. 6

SECTION – III

5. (a) Express 75° in radian measure and $\frac{7\pi}{2}$ in degree. 4

(b) Simplify : $\dfrac{\sec(360 - A)\cot(90 - A)}{\tan(360 + A)\operatorname{cosec}(90 + A)}$ 5

(c) Prove that : $\cos 2\theta = \cos^2\theta - \sin^2\theta$ 5

(d) Prove that : $\sin 20 \cdot \sin 40 \cdot \sin 80 = \frac{\sqrt{3}}{8}$ 6

6. (a) Find the value of cos (15°) 4

(b) Prove that : $\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta$ 5

(c) Prove that : $\sin 600° \cos 390° + \cos 480° \sin 150° = -1$ 5

(d) Show that : $\cos 55 + \cos 65 + \cos 175 = 0$ 6

SECTION – IV

7. (a) Find the derivative of $y = x^3 + e^{3x} + \sin 3x - 4 \log x$ w.r.t. 'x'. 4

(b) Find $\frac{dy}{dx}$ for $y = \frac{1+\cos x}{1-\cos x}$ 5

(c) Find $\frac{dy}{dx}$ for $y = e^{\sin x} + \sin (x^3) + \tan x$ 5

(d) If $S = t^2 + 6t + 5$ represents the displacement of the particle in motion at time 't', then find the velocity of the particle and acceleration at t = 3 secs. 6

8. (a) If $y = e^x \sin x$, then find $\frac{dy}{dx}$. 4

(b) If $y = \tan^{-1}\left(\frac{1+x}{1-x}\right)$, then find $\frac{dy}{dx}$. 5

(c) Find the equation of the tangent to the curve $y = x^3$ at the point (1, 2). 5

(d) If $y = \tan^{-1} x$, show that $(1 + x^2)y_2 + 2xy_1 = 0$. 6

SECTION – V

9. (a) Evaluate : $\int \left(x^2 + \sin x + \frac{1}{x} + e^{2x} \right) dx$ 4

(b) Evaluate : $\int_0^{\pi/2} \cos^2 x \, dx$ 5

(c) Evaluate : $\int xe^x \, dx$ 5

(d) Find the area bounded by the curve $y = x^2 + 3$, x-axis and co-ordinates $x = 1$ & $x = 2$. 6

10. (a) Evaluate : $\int_1^2 \frac{1}{x} \, dx$ 4

(b) Evaluate : $\int \frac{\tan^{-1} x}{1+x^2} \, dx$ 5

(c) Evaluate : $\int x \sec^2 x \, dx$ 5

(d) Find the volume of the solid generated by revolving the curve $y = \sqrt{x^2+1}$ between $x = 0$ and $x = 2$. 6

GOVERNMENT OF KARNATAKA

DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION

I/II SEMESTER DIPLOMA EXAMINATIONS, OCT/NOV-2021

Sub: Engineering Mathematics **Code: 20SC01T**

SCHEME AND SOLUTION

SECTION 1

1	a) Expansion, Simplification, Answer	2+1+1
	b) Finding 2A and 3B, 2A+3B, Sum	2+2+1
	c) Finding Δ, Δ_1, Δ_2, x and y	1+1+1+1+1
	d) General CE, Particular CE, Roots	1+3+2
2	a) A+B, Writing $(A+B)^2$, Product	1+1+2
	b) Writing AB, Product, Transpose	1+3+1
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	d) Δ, Adjoint, Formula, Inverse	1+3+1+1

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3	a) Formula, Substitution, Slope	2+1+1
	b) Writing intercepts, General form, Equation	1+2+2
	c) Slope formula, slope, line formula, Equation of the line	1+1+2+1
	d) Finding slope of lines, General equation of the line, equation of the line.	2+2+2
4	a) Slope formula, intercept formula, slope and x-intercept	2+2
	b) Slope formula, slope, line formula, Equation of the line	1+1+2+1
	c) Finding slopes of lines, General equation of the line, Equation of the line.	2+2+1
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5	a) Conversion radian to degree, vice-versa	2+2
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	c) cos(A+B), Writing 2A=A+A, simplification	2+1+2
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6	a) Writing cos15= cos(45-30), cos(A-B) formula, simplification, Answer	1+1+1+1
	b) Writing $\sin 3\theta = \sin(2\theta + \theta)$, sin(A+B), cos2θ sin2θ formula, Simplification	2+2+1 1+3+1
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	d) Applying cosC+cosD formula Writing cos120, Simplification and solution.	3+1+2

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7	a) Each term derivative	1+1+1+1
	b) Applying quotient rule, ~~Each~~ diff, Simplification & Answer	2+1+2
	c) Finding derivative of $\sin(x^3)$ Finding derivative of e^{sinx} Finding derivative of tanx	2+2+1
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8	a) Product rule, Each derivative	2+1+1
	b) Apply chain rule, Apply quotient rule, Simplification and Answer	2+2+1
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	d) Finding y_1, second derivative, Proof	2+2+2

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9	a) Evaluation of each integrand	1+1+1+1
	b) Integrand simplification, Evaluation.	2+3
	c) Choosing first and second function Applying by part rule, Integral of e^x, Derivative of x	2+2+1
	d) Applying data in Area formula, Integration, tending the limits.	2+2+2
10	a) Integration, Applying limit, Solution.	2+1+1
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GOVERNMENT OF KARNATAKA
DEPARTMENT OF COLLEGIATE AND TECHNICAL EDUCATION
I/II SEMESTER DIPLOMA EXAMINATIONS, OCT/NOV-2021

Sub: Engineering Mathematics **Code: 20SC01T**

SOLUTION

<table>
<tr><th>Qno</th><th>SECTION 1</th><th>MARK</th></tr>
<tr><td>1a)</td><td>If $A = \begin{bmatrix}1 & 3 & -1\\ 0 & 2 & 4\\ 3 & 2 & x\end{bmatrix}$ is Singular Matrix, Find x
Solution:
Given A is singular i.e $|A| = 0$
$|A| = \begin{vmatrix}1 & 3 & -1\\ 0 & 2 & 4\\ 3 & 2 & x\end{vmatrix} = 0$
$1(2x-8) - 3(0x - 12) + (-1)(0-6) = 0$
$x = -17$</td><td>1
1
1
1</td></tr>
<tr><td>1b)</td><td>If $A=\begin{bmatrix}2 & 3\\ 1 & -1\end{bmatrix}$ $B=\begin{bmatrix}3 & 4\\ 1 & 2\end{bmatrix}$ find 2A+3B
Solution:
$2A= \begin{bmatrix}2X2 & 2X3\\ 2X1 & 2X(-1)\end{bmatrix} = \begin{bmatrix}4 & 6\\ 2 & -2\end{bmatrix}$
$3B = \begin{bmatrix}3X3 & 3X4\\ 3X1 & 3X2\end{bmatrix} = \begin{bmatrix}9 & 12\\ 3 & 6\end{bmatrix}$
$2A+3B = \begin{bmatrix}4 & 6\\ 2 & -2\end{bmatrix} + \begin{bmatrix}9 & 12\\ 3 & 6\end{bmatrix} = \begin{bmatrix}13 & 18\\ 5 & 4\end{bmatrix}$</td><td>2
2
1</td></tr>
<tr><td>1c)</td><td>Solve 2x +3y = 5, x +4 y = 5 by Cramer's rule.
Solution:Given system of the equations is 2x +3y = 5 & x +4 y = 5
let $\Delta= \begin{vmatrix}2 & 3\\ 1 & 4\end{vmatrix} = 8 - 3 = 5$
$\Delta_1= \begin{vmatrix}5 & 3\\ 5 & 4\end{vmatrix} = 20 - 15 = 5$
$\Delta_2= \begin{vmatrix}2 & 5\\ 1 & 5\end{vmatrix} = 10 - 5 = 5;$
$\therefore x = 1$ and $y = 1$</td><td>1
1
1
1+1</td></tr>
<tr><td>1d)</td><td>Find the characteristic roots for the matrix $A = \begin{bmatrix}2 & 3\\ 0 & 4\end{bmatrix}$
Solution:Given $A = \begin{bmatrix}2 & 3\\ 0 & 4\end{bmatrix}$
C.E is given by $|A - \lambda I| = 0$
$\left|\begin{bmatrix}2 & 3\\ 0 & 4\end{bmatrix} - \lambda\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}\right| = 0$
$\begin{vmatrix}2-\lambda & 3\\ 0 & 4-\lambda\end{vmatrix} = 0$
$(2-\lambda)(4-\lambda) = 0$
$\lambda = 2$ or $\lambda = 4$ are characteristic roots.</td><td>1
1
1
1
2</td></tr>
</table>

Qno	SECTION 1	MAR
2a)	If A=$\begin{bmatrix}2 & 1\\0 & 4\end{bmatrix}$ B=$\begin{bmatrix}1 & -1\\3 & 6\end{bmatrix}$ find $(A+B)^2$ Solution: $A+B=\begin{bmatrix}2 & 1\\0 & 4\end{bmatrix}+\begin{bmatrix}1 & -1\\3 & 6\end{bmatrix}=\begin{bmatrix}2+1 & 1-1\\0+3 & 4+6\end{bmatrix}=\begin{bmatrix}3 & 0\\3 & 10\end{bmatrix}$ $(A+B)^2=\begin{bmatrix}3 & 0\\3 & 10\end{bmatrix}\begin{bmatrix}3 & 0\\3 & 10\end{bmatrix}=\begin{bmatrix}3x3+0x3 & 3x0+0x10\\3x3+10x3 & 3x0+10x10\end{bmatrix}$ $=\begin{bmatrix}9+0 & 0+0\\9+30 & 0+100\end{bmatrix}=\begin{bmatrix}9 & 0\\39 & 100\end{bmatrix}$	1 1+1 1
2b)	Find $(AB)^T$ if $A=\begin{bmatrix}1 & 3 & -1\\3 & 2 & 0\\4 & 1 & 3\end{bmatrix}$ $B=\begin{bmatrix}2 & 1 & 3\\4 & 2 & 1\\1 & 3 & -2\end{bmatrix}$ Solution: $AB=\begin{bmatrix}1 & 3 & -1\\3 & 2 & 0\\4 & 1 & 3\end{bmatrix}\begin{bmatrix}2 & 1 & 3\\4 & 2 & 1\\1 & 3 & -2\end{bmatrix}$ $=\begin{bmatrix}2+12-1 & 1+6-3 & 3+3+2\\6+8+0 & 3+4+0 & 9+2+0\\8+4+3 & 4+2+9 & 12+1-6\end{bmatrix}$ $=\begin{bmatrix}13 & 4 & 8\\14 & 7 & 11\\15 & 15 & 7\end{bmatrix}$ $(AB)^T=\begin{bmatrix}13 & 14 & 15\\4 & 7 & 15\\8 & 11 & 7\end{bmatrix}$	1 1 2 1
2c)	Find the characteristic equation and Eigen roots for the matrix $A=\begin{bmatrix}1 & 2\\3 & 1\end{bmatrix}$ Solution: Given $A=\begin{bmatrix}1 & 2\\3 & 1\end{bmatrix}$ C.E is given by $\lvert A-\lambda I\rvert=0$ $\left\lvert\begin{bmatrix}1 & 2\\3 & 1\end{bmatrix}-\lambda\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}\right\rvert=0$ $\begin{vmatrix}1-\lambda & 2\\3 & 1-\lambda\end{vmatrix}=0$ $\lambda^2-2\lambda-5=0$ $\lambda=1\pm\sqrt{6}$	1 1 1 1+1
2d)	Find the inverse of the matrix $A=\begin{bmatrix}5 & 1 & 3\\1 & 4 & -1\\2 & 0 & 4\end{bmatrix}$ Solution: Given $A=\begin{bmatrix}5 & 1 & 3\\1 & 4 & -1\\2 & 0 & 4\end{bmatrix}$; $\lvert A\rvert=\begin{vmatrix}5 & 1 & 3\\1 & 4 & -1\\2 & 0 & 4\end{vmatrix}=50$ $adjA=\begin{bmatrix}16 & -4 & -13\\-6 & 14 & 8\\-8 & 2 & 19\end{bmatrix}$, $A^{-1}=Adj(A)/\lvert A\rvert$ $A^{-1}=\frac{1}{50}\begin{bmatrix}16 & -4 & -13\\-6 & 14 & 8\\-8 & 2 & 19\end{bmatrix}$	1 3+1 1

Qno	SECTION 2	MARK
3a)	**Find the slope of a straight line passing through the points $(1,2)$ & $(3,4)$** Solution: Let $A=(x_1,y_1)=(1,2)$ and $B=(x_2,y_2)=(3,4)$ $\therefore$ Slope of AB $=\frac{y_2-y_1}{x_2-x_1}$ $\Rightarrow m=\frac{4-2}{3-1}$ $=1$	2 1 1
3b)	**If x- intercept of the line is 3 units and y-intercept is 2 times x-intercept ,the find the equation of the line.** Solution: Given that: $a=3$ and $b=2a=2X3=6$ Equation of a straight line is $\frac{x}{a}+\frac{y}{b}=1$ $\Rightarrow \frac{x}{3}+\frac{y}{6}=1$ $\Rightarrow \frac{2x+y}{6}=1$ $\Rightarrow 2x+y-6=0$	1 2 1 1
3c)	**If a straight line makes an angle of 60^{o} with the positive direction of the x-axis and passes through the point (1, -1), then find the equation of the straight line.** Solution: Given $\theta=60^{o}$ slope is $m=\tan\theta$ then, $m=\tan\theta=\tan 60^{o}=\sqrt{3}$ $y-y_1=m(x-x_1)$ $\sqrt{3}x-y-1-\sqrt{3}=0$	1 1 2 1
3d)	**Find the equation of the straight line parallel to the line joining the points (3, -1) and (4, -2) and passing through the point (2,2).** Solution: $\mathbf{m=-1}$ Since the given line is parallel to required line $m_1=m_2=-1$ $y-y_1=m(x-x_1)$ $y-2=-x+2$ $x+y-4=0$ is the required equation of line.	1+1 2 1 1

Qno	SECTION 2	MA
4a)	**Write the slope and x-intercept of line $2x + 4y + 5 = 0$.** Solution: Here $a = 2, b = 4$ and $c = 5$ Slope, $m = -\frac{a}{b} = -\frac{2}{4} = -\frac{1}{2}$ $x - \text{intercept} = -\frac{c}{a} = -\frac{5}{2}$	1+1 1+1
4b)	**Find the equation of the line passing through the points (4, 2) and (1, 3).** Solution: $m = \left(\frac{y_2 - y_1}{x_2 - x_1}\right) = -1/3$ $y - y_1 = (x - x_1)$ $y - 2 = \left(\frac{3-2}{1-4}\right)(x - 4)$ $-x - 3y + 6 + 4 = 0$ $x + \cancel{2}3y - 10 = 0$ is the required equation of the line.	1+1 2 1
4c)	**Find the equation of line perpendicular to the line 4x-2y+3=0 and passing through the point (1,2).** Solution: $m = \frac{-4}{-2} = \frac{2}{4} = 2$; $m_1 \times m_2 = -1$; $m_2 = \frac{-1}{2}$ $y - y_1 = m(x - x_1)$ $y - 2 = \frac{-1}{2}(x - 1)$ $x + 2y - 5 = 0$ is the required equation of line.	1+1 2 1
4d)	**Find the acute angle between the two lines $7x - 4y = 0$ and $3x - 11y + 5 = 0$** Solution: Given line l_1 $7x - 4y = 0$ and l_2 $3x - 11y + 5 = 0$ Let the slope of l_1 be $m_1 = -\frac{a}{b} = -\frac{7}{-4} = \frac{7}{4}$ Slope of l_2 be $m_2 = -\frac{a}{b} = -\frac{-3}{-11} = \frac{3}{11}$ $\tan\theta = \left(\frac{m_1 - m_2}{1 + m_1 m_2}\right)$ $\tan\theta = \left(\frac{\left(\frac{7}{4}\right) - \left(\frac{3}{11}\right)}{1 + \left(\frac{7}{4}\right)\left(\frac{3}{11}\right)}\right) = \left(\frac{77-12}{44+21}\right) = \left(\frac{65}{65}\right) = 1$ $\theta = \tan^{-1}(1) = 45^0$	 1 1 2 1 1

Qno	SECTION 3	MARK
5a)	**Convert $75°$ in radians measure and $\frac{7\pi}{2}$ in degree.** Solution: $x \text{ degree} = \frac{\pi}{180} \times x \text{ radians}$; $75° = \frac{5\pi}{12}$ radians $x \text{ radians} = \frac{180°}{\pi} \times x \text{ degree}$; $\frac{7\pi}{2}$ radians $= 630$ degree	1+1 1+1
5b)	**Simplify:** $\frac{\sec(360-A)\cot(90-A)}{\tan(360+A)\,\mathrm{cosec}(90+A)}$ Solution: Consider $\frac{\sec(360-A)\cot(90-A)}{\tan(360+A)\,\mathrm{cosec}(90+A)}$ $= \frac{\sec A \times \tan A}{\tan A \times \sec A} = 1$	1+1+1+1 1
5c)	**Prove that $\cos 2\theta = \cos^2\theta - \sin^2\theta$.** Proof: We have $\cos(A+B) = \cos A \cos B - \sin A \sin B$ put $B = A = \theta$ $\cos(\theta+\theta) = \cos\theta\cos\theta - \sin\theta\sin\theta$ $\cos 2\theta = \cos^2\theta - \sin^2\theta$.	2 1 1 1
5d)	**Show that $\sin 20^0 \sin 40^0 \sin 80^0 = \frac{\sqrt{3}}{8}$.** Solution: SinA $\sin B = \frac{1}{2}[\cos(A-B) - \cos(A+B)]$ $= \frac{1}{2}[\cos(40^0 - 20^0) - \cos(40^0 + 20^0)] \sin 80^0$ $= \frac{1}{2}[\cos 20^0 - \cos 60^0] \sin 80^0$ $= \frac{1}{2}\left(\cos 20^0 - \frac{1}{2}\right) \sin 80^0$ $\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$ $= \frac{1}{4}[\sin(80^0 + 20^0) + \sin(80^0 - 20^0)] - \frac{1}{4}\sin(180 - 100^0) = \frac{1}{4}\sin 60^0 = \frac{\sqrt{3}}{8}$	2 1 1 1 1

Qno	SECTION 3	MA
6a)	**Find the value of $\cos 15^\circ$** Solution: Given $\cos 15^\circ = \cos(45^\circ - 30^\circ)$ We know that $\cos(A-B) = \cos A \cos B + \sin A \sin B \rightarrow (1)$ Substitute $A = 45^\circ, B = 30^\circ$ in equation (1), then we get $\cos 15^\circ = \cos(45^\circ - 30^\circ) = \cos 45^\circ \cos 30^\circ + \sin 45^\circ \sin 30^\circ$ $\cos 15^\circ = \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \times \frac{1}{2} = \frac{\sqrt{3}}{2\sqrt{2}} + \frac{1}{2\sqrt{2}} = \frac{\sqrt{3}+1}{2\sqrt{2}}$	1 1 1 1
6b)	**Prove that $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$.** Proof: $\sin 3\theta = \sin(2\theta + \theta)$ $\sin 3\theta = \sin 2\theta \cos\theta + \cos 2\theta \sin\theta$ $\sin 3\theta = 2\sin\theta\cos\theta \times \cos\theta + (1 - 2\sin^2\theta)\sin\theta$ $\sin 3\theta = 2\sin\theta\cos^2\theta + \sin\theta - 2\sin^3\theta$ $\sin 3\theta = 2\sin\theta(1 - \sin^2\theta) + \sin\theta - 2\sin^3\theta$ $\sin 3\theta = 2\sin\theta - 2\sin^3\theta + \sin\theta - 2\sin^3\theta$ $\sin 3\theta = 3\sin\theta - 4\sin^3\theta$	1 1 1 1 1
6c)	**Show that $\sin 600^o \cos 390^o + \cos 480^o \sin 150^o = -1$** Solution: $\sin 600^\circ = \frac{-\sqrt{3}}{2}$; $\cos 390^\circ = \frac{\sqrt{3}}{2}$; $\cos 480^\circ = -\frac{1}{2}$; $\sin 150^\circ = \frac{1}{2}$ Now, Consider LHS $= \sin 120^\circ \cos 330^\circ + \cos 420^\circ \sin 30^\circ$ $= \left(\frac{-\sqrt{3}}{2}\right)\left(\frac{\sqrt{3}}{2}\right) + \left(\frac{-1}{2}\right)\left(\frac{1}{2}\right) = \frac{-3}{4} - \frac{1}{4} = \frac{-4}{4} = -1 =$ RHS	1+1+1+1 1
6d)	**Prove that $\cos 55 + \cos 65 + \cos 175 = 0$.** Solution: $\cos C + \cos D = 2\cos\left(\frac{C+D}{2}\right)\cos\left(\frac{C-D}{2}\right)$ $= \cos 55 + \cos 175 + \cos 65$ $= \cos 55 + 2\cos\left(\frac{175+65}{2}\right)\cos\left(\frac{175-65}{2}\right)$ $= \cos 55 + 2\cos 120 \cos 55$ $= \cos 55 + 2\cos(180 - 60)\cos 55$ $= \cos 55 - \cos 55 = 0$	1 1 1 1 1 1

Qno	SECTION 4	MARK
7a)	If $y = x^3 + e^{3x} + \sin 3x - 4\log x$ then find $\frac{dy}{dx}$. Solution: $y = x^3 + e^{3x} + \sin 3x - 4\log x$; $\frac{dy}{dx} = 3x^2 + 3e^{3x} + 3\cos 3x - 4(\frac{1}{x})$	1+1+1+1
7b)	Find $\frac{dy}{dx}$ where $y = \frac{1+\cos x}{1-\cos x}$ Solution: $\frac{dy}{dx} = \frac{(1-\cos x)\frac{d}{dx}(1+\cos x)-(1+\cos x)\frac{d}{dx}(1-\cos x)}{(1-\cos x)^2}$ $= \frac{(1-\cos x)(0-\sin x)-(1+\cos x)(0+\sin x)}{(1-\cos x)^2}$ $= \frac{-\sin x(1-\cos x)-\sin x(1+\cos x)}{(1-\cos x)^2}$ $= \frac{-\sin x+\sin x\cos x-\sin x-\sin x\cos x}{(1-\cos x)^2}$ $\frac{dy}{dx} = \frac{-2\sin x}{(1-cosx)^2}$	1 1 1 1 1
7c)	Find $\frac{dy}{dx}$ for $y = e^{sinx} + \sin(x^3) + \tan x$ Solution: $y = \sin(x^3) + e^{sinx} + \tan x$ $\frac{dy}{dx} = \frac{d(e^{sinx}+\sin(x^3)+\tan x)}{dx}$ $= e^{sinx}(\cos x) + \cos(x^3)(3x^2) + sec^2x$	2+2+1
7d)	The displacement of a particle from one point to another is given by $s = t^2 + 6t + 5$, find the velocity and acceleration at the end of t=3 sec Solution: $\frac{ds}{dt} = 2t + 6 + 0$; $\frac{ds}{dt} = 2t + 6$; $\frac{d^2s}{dt^2} = 2 + 0$; $\frac{d^2s}{dt^2} = 2$ Velocity =12 unit/sec; Acceleration = 2 unit/s^2	2+2 1+1

Qno	SECTION 4	MA
8a)	If $y = e^x \sin x$ then find $\frac{dy}{dx}$. Solution: $y = e^x sinx \qquad (uv) = u\frac{dv}{dx} + v\frac{du}{dx}$ $\frac{dy}{dx} = e^x \frac{d}{dx}(sinx) + sinx\ \frac{d}{dx}(e^x)$ $\frac{dy}{dx} = e^x \cos x + \sin x\ e^x$	2 1+1
8b)	If $y = \tan^{-1}\left(\frac{1+x}{1-x}\right)$ then find $\frac{dy}{dx}$. Solution: $y = \tan^{-1}\left(\frac{1+x}{1-x}\right)$ $\frac{dy}{dx} = \frac{d}{dx}\left(\tan^{-1}\left(\frac{1+x}{1-x}\right)\right) = \frac{1}{1+\left(\frac{1+x}{1-x}\right)^2} \times \frac{d}{dx}\left(\frac{1+x}{1-x}\right)$ w.k.t $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$; $\frac{dy}{dx} = \frac{(1-x)^2}{(1-x)^2+(1+x)^2} X \frac{(1-x)\frac{d}{dx}(1+x)-(1+x)\frac{d}{dx}(1-x)}{(1-x)^2}$ $\frac{dy}{dx} = \frac{(1-x)(0+1)-(1+x)(0-1)}{[(1-x)^2+(1+x)^2]}$ $\frac{dy}{dx} = \frac{2}{2(1+x^2)} = \frac{1}{(1+x^2)}$	2 1 1 1
8c)	Obtain the equation of tangent to the curve $y = x^3$ at the point $(1, 2)$ Solution: $y = x^3$; $\frac{dy}{dx} = 3x^2$; $\left(\frac{dy}{dx}\right)_{at(1,2)} = 3(1) = 3$ $m = 3$ The equation of tangent to the curve at the point (1, 2) with slope m=3 is $Y - y_1 = m(x - x_1)$ $y - 2 = 3(x - 1)$ $y - 2 = 3x - 3$ $3x - y - 1 = 0$	1+1 2 1
8d)	If $y = \tan^{-1} x$ then prove that $(1+x^2)y_2 - 2xy_1 = 0$ Solution: $y = \tan^{-1} x$ $y_1 = \frac{d}{dx}(\tan^{-1} x)$ $y_1 = \frac{1}{1+x^2}$ $(1+x^2)y_1 = 1$ Again differentiate w.r.t.x $(1+x^2)\frac{d}{dx}(y_1) + y_1\frac{d}{dx}(1+x^2) = \frac{d}{dx}(1)$ $(1+x^2)y_2 + y_1(0+2x) = 0$ $(1+x^2)y_2 + 2xy_1 = 0$	1 1 1+1 1 1

<table>
<tr><th>Qno</th><th>SECTION 5</th><th>MARK</th></tr>
<tr><td>9a)</td><td>Evaluate $\int\left(x^2+\sin x+\frac{1}{x}+e^{2x}\right)dx$
Solution: $I=\frac{x^3}{3}-\cos x+\log x+\frac{e^{2x}}{2}+c$</td><td>1+1+1+1</td></tr>
<tr><td>9b)</td><td>Evaluate $\int_0^{\frac{\pi}{2}}\cos^2x\,dx$
Solution: $\int_0^{\frac{\pi}{2}}\cos^2x\,dx=\int_0^{\frac{\pi}{2}}\left(\frac{1+\cos 2x}{2}\right)dx=\frac{1}{2}\left[x+\frac{\sin 2x}{2}\right]_0^{\frac{\pi}{2}}$
$=\frac{1}{2}\left[\left(\frac{\pi}{2}+\frac{\sin 2\frac{\pi}{2}}{2}\right)-\left(0+\frac{\sin 2(0)}{2}\right)\right]$
$=\frac{1}{2}\left[\left(\frac{\pi}{2}+\frac{0}{2}\right)-\left(0+\frac{0}{2}\right)\right]=\frac{\pi}{4}$</td><td>1+1
1+1
1</td></tr>
<tr><td>9c)</td><td>Evaluate: $\int x\,e^x\,dx$
Solution: Here x is Algebraic function and e^x is Exponential function.
According to the ILATE rule of choosing the first function,
$u = \mathrm{I\ fn} = x$ and $v = \mathrm{II\ fn} = e^x$
$\int(\mathrm{I\ fn}\times\mathrm{II\ fn})dx=\mathrm{I\ fn}\int(\mathrm{II\ fn})dx-\int\left(\int(\mathrm{II\ fn})\,dx\right)\frac{d}{dx}(\mathrm{I\ fn})\,dx$
$I=\int x\,e^x\,dx$
$=x\int e^x\,dx-\int\left(\int e^x\,dx\right)\frac{d}{dx}(x)\,dx$
$=x\,e^x-\int e^x\times 1dx$
$=x\,e^x-\int e^x\,dx$
$=x\,e^x-e^x+c$</td><td>1+1
1
1
1</td></tr>
<tr><td>9d)</td><td>Find the area bounded by the curve $y=x^2+3$, x − axis and the ordinates $x=1$ & $x=2$.
Solution: Area enclosed by a curve is $A=\int_a^b y\,dx \rightarrow (1)$
$A=\int_a^b y\,dx=\int_1^2(x^2+3)dx$
$=\left[\frac{x^3}{3}+3x\right]_1^2$
$=\left[\frac{2^3}{3}+3\times 2\right]-\left[\frac{(1)^3}{3}+3(1)\right]$
$=\left[\frac{8}{3}+6\right]-\left[\frac{1}{3}+3\right]$
$=\left[\frac{26}{3}\right]-\left[\frac{10}{3}\right]=\frac{16}{3}\ \therefore A=\frac{16}{3}$ Square units</td><td>1
1
1+1
1
1</td></tr>
</table>

Qno	SECTION 5	MARK
10a)	Evaluate: $\int_1^2 \frac{1}{x}\,dx$	
	Solution: $\int_1^2 \frac{1}{x}\,dx = \log x|_1^2 = [\log 2 - \log 1] = [\log 2 - 0] = \log 2$	1+1+1+1
10b)	Evaluate: $\int \frac{\tan^{-1}x}{1+x^2}\,dx$	
	Solution: Put $\tan^{-1}x = t : \frac{1}{1+x^2}\,dx = dt$	1+1
	Let $I = \int \frac{\tan^{-1}x}{1+x^2}\,dx$	
	$= \int \tan^{-1}x \frac{1}{1+x^2}\,dx$	1
	$= \int t \, .dt$	1
	$= \frac{t^{1+1}}{1+1} + C$	
	$= \frac{(\tan^{-1}x)^2}{2}$ +C== $\frac{t^2}{2} + C$	1
10c)	Evaluate: $\int x\, sec^2x\, dx$	
	Solution: Let $I = \int x\, sec^2x\, dx$	
	Here x is Algebraic function and $\sec^2 x$ is Trigonometric function.	
	According to the ILATE rule of choosing the first function,	
	$u = \text{I fn} = x$ and $v = \text{II fn} = \sec^2 x$	1+1
	$\int (\text{I fn} \times \text{II fn})dx = \text{I fn} \int(\text{II fn})dx - \int\left(\int(\text{II fn})\,dx\right)\frac{d}{dx}(\text{I fn})\,dx$	1
	$I = \int x\, sec^2x\, dx$	
	$= x\int sec^2x\, dx - \int\left(\int sec^2x\, dx\right)\frac{d}{dx}(x)\,dx$	1
	$= x(\tan x) - \int(\tan x) \times 1dx$	
	$= x\tan x - \int \tan x\, dx$	1
	$= x\tan x - \log(\sec x) + c$	
10d)	Find the volume of the solid generated by revolving the curve $y = \sqrt{x^2+1}$ between x=0 and x=2	
	Solution: We know that, the volume of the solid formed by revolving the curve y=f(x) and the x−axis between x=a and x=b about the x−axis is	
	$V = \pi\int_a^b y^2\,dx$	1
	$= \pi\int_0^2 (\sqrt{x^2+1})^2\,dx$	1
	$= \pi\int_0^2 x^2 + 1\,dx$	1
	$= \pi\left[\frac{x^3}{3} + x\right]_0^2$	1+1
	$= \pi\left[\left(\frac{2^3}{3} + 2\right) - 0\right] \therefore V = \frac{14}{3}\pi$ cubic units	1