Q.1 Fill in the blanks [14 marks]

Q1.1 [1 mark]

If A = [1 2; 3 -1] then 4A = ...

Answer: (b) [4 8; 12 -4]

Solution:
$$4A = 4\begin{bmatrix}1 & 2\\3 & -1\end{bmatrix} = \begin{bmatrix}4 & 8\\12 & -4\end{bmatrix}$$

Q1.2 [1 mark]

Order of the matrix [1 1 2; -3 2 3] is ...

Answer: (a) 2 × 3

Solution:
Matrix has 2 rows and 3 columns, so order is 2 × 3.

Q1.3 [1 mark]

If A = [1 1; 1 1] then A^2 = ...

Answer: (d) [2 2; 2 2]

Solution:
$$A^2 = \begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix} = \begin{bmatrix}2 & 2\\2 & 2\end{bmatrix}$$

Q1.4 [1 mark]

If A = [2 -1; 3 4] then adjoint of A = ...

Answer: (c) [4 1; -3 2]

Solution:
For matrix A = [a b; c d], adj(A) = [d -b; -c a]
adj(A) = [4 1; -3 2]

Q1.5 [1 mark]

d/dx(tan x) = ...

Answer: (d) $\sec^2 x$

Solution:
$$\frac{d}{dx}(\tan x) = \sec^2 x$$

Q1.6 [1 mark]

d/dx(sin 5x) = ...

Answer: (b) 5cos5x

Solution:
$\frac{d}{dx}(\sin 5x) = 5\cos 5x$ (using chain rule)

Q1.7 [1 mark]

If function y = f(x) is maximum at x = a then f'(a) = ...

Answer: (c) 0

Solution:
At maximum point, first derivative equals zero: f'(a) = 0

Q1.8 [1 mark]

∫sin x dx = ... + C

Answer: (a) -cos x

Solution:
$\int \sin x \, dx = -\cos x + C$

Q1.9 [1 mark]

∫1/(x^2+4) dx = ... + C

Answer: (d) (1/2)$\tan^{-1}$(x/2)

Solution:
$\int \frac{1}{x^2+4} dx = \frac{1}{2}\tan^{-1}\left(\frac{x}{2}\right) + C$

Q1.10 [1 mark]

$\int_1^2$ x^2 dx = ...

Answer: (a) 7/3

Solution:
$\int_1^2 x^2 dx = \left[\frac{x^3}{3}\right]_1^2 = \frac{8}{3} - \frac{1}{3} = \frac{7}{3}$

Q1.11 [1 mark]

Order of differential equation $(d^3y/dx^3)^4$ + dy/dx + 5y = 0 is ...

Answer: (c) 3

Solution:
Order is the highest derivative present = 3

Q1.12 [1 mark]

Integrating factor of dy/dx + y/x = 1 is ...

Answer: (b) x

Solution:
I.F. = $e^{\int \frac{1}{x}dx} = e^{\ln x} = x$

Q1.13 [1 mark]

Mean of 39,23,58,47,50,16,61 is ...

Answer: (b) 42

Solution:
Mean = $\frac{39+23+58+47+50+16+61}{7} = \frac{294}{7} = 42$

Q1.14 [1 mark]

Mean of first five natural numbers is ...

Answer: (a) 3

Solution:
Mean = $\frac{1+2+3+4+5}{5} = \frac{15}{5} = 3$

Q.2 Attempt any two [14 marks total]

Q2(A).1 [3 marks]

If A = [1 3 5; -1 0 2; 4 3 6], B = [3 4 5; 5 4 3; 3 5 4], C = [1 2 1; 3 3 3; 4 5 6], find 3A+2B-4C

Solution:

$$3A = \begin{bmatrix} 3 & 9 & 15 \\ -3 & 0 & 6 \\ 12 & 9 & 18 \end{bmatrix}$$

$$2B = \begin{bmatrix} 6 & 8 & 10 \\ 10 & 8 & 6 \\ 6 & 10 & 8 \end{bmatrix}$$

$$4C = \begin{bmatrix} 4 & 8 & 4 \\ 12 & 12 & 12 \\ 16 & 20 & 24 \end{bmatrix}$$

$$3A + 2B - 4C = \begin{bmatrix} 5 & 9 & 21 \\ -5 & -4 & 0 \\ 2 & -1 & 2 \end{bmatrix}$$

Q2(A).2 [3 marks]

If A = [7 5; -1 2], B = [1 -1; 3 2], show that $(A+B)^T = A^T + B^T$

Solution:

$$A + B = \begin{bmatrix} 8 & 4 \\ 2 & 4 \end{bmatrix}$$

$(A+B)^T = \begin{bmatrix} 8 & 2 \\ 4 & 4 \end{bmatrix}$

$A^T = \begin{bmatrix} 7 & -1 \\ 5 & 2 \end{bmatrix}$, $B^T = \begin{bmatrix} 1 & 3 \\ -1 & 2 \end{bmatrix}$

$A^T + B^T = \begin{bmatrix} 8 & 2 \\ 4 & 4 \end{bmatrix}$

Hence proved: $(A+B)^T = A^T + B^T$

Q2(A).3 [3 marks]

Solve the differential equation xy dy = (x+1)(y+1)dx

Solution:
Separating variables:
$\frac{y}{y+1}dy = \frac{x+1}{x}dx$

$\left(1 - \frac{1}{y+1}\right)dy = \left(1 + \frac{1}{x}\right)dx$

Integrating:
$y - \ln|y+1| = x + \ln|x| + C$

Final answer: $y - x = \ln|y+1| + \ln|x| + C$

Q2(B).1 [4 marks]

Find the inverse of matrix [3 1 2; 2 -3 -1; 1 2 1]

Solution:
Let $A = \begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{bmatrix}$

$|A| = 3(-3-(-2)) - 1(2-(-1)) + 2(4-(-3)) = 3(-1) - 1(3) + 2(7) = -3 - 3 + 14 = 8$

Cofactors:

- $C_{11} = -1$, $C_{12} = -3$, $C_{13} = 7$
- $C_{21} = 3$, $C_{22} = 1$, $C_{23} = -5$
- $C_{31} = 5$, $C_{32} = 7$, $C_{33} = -11$

$adj(A) = \begin{bmatrix} -1 & 3 & 5 \\ -3 & 1 & 7 \\ 7 & -5 & -11 \end{bmatrix}$

$A^{-1} = \frac{1}{8}\begin{bmatrix} -1 & 3 & 5 \\ -3 & 1 & 7 \\ 7 & -5 & -11 \end{bmatrix}$

Q2(B).2 [4 marks]

Solve 3x - 2y = 8, 5x + 4y = 6 using matrix method

Solution:
$\begin{bmatrix}3 & -2\\5 & 4\end{bmatrix}\begin{bmatrix}x\\y\end{bmatrix}=\begin{bmatrix}8\\6\end{bmatrix}$

$|A| = 3(4) - (-2)(5) = 12 + 10 = 22$

$A^{-1} = \dfrac{1}{22}\begin{bmatrix}4 & 2\\-5 & 3\end{bmatrix}$

$\begin{bmatrix}x\\y\end{bmatrix} = \frac{1}{22}\begin{bmatrix}4 & 2\\-5 & 3\end{bmatrix}\begin{bmatrix}8\\6\end{bmatrix} = \frac{1}{22}\begin{bmatrix}44\\-22\end{bmatrix}$

Answer: x = 2, y = -1

Q2(B).3 [4 marks]

If A = [1 2 1; 2 3 1; 1 2 2], find A·adj(A)

Solution:
$|A| = 1(6-2) - 2(4-1) + 1(4-3) = 4 - 6 + 1 = -1$

For any matrix A: $A \cdot adj(A) = |A| \cdot I$

$$A \cdot adj(A) = (-1)\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix} = \begin{bmatrix}-1 & 0 & 0\\0 & -1 & 0\\0 & 0 & -1\end{bmatrix}$$

Q.3 Attempt any two [14 marks total]

Q3(A).1 [3 marks]

If y = log(sin x/(1+cos x)), find dy/dx

Solution:
$y = \log(\sin x) - \log(1 + \cos x)$

$\frac{dy}{dx} = \frac{1}{\sin x} \cdot \cos x - \frac{1}{1+\cos x} \cdot (-\sin x)$

$= \frac{\cos x}{\sin x} + \frac{\sin x}{1+\cos x}$

$= \cot x + \frac{\sin x}{1+\cos x}$

Using identity: $\frac{\sin x}{1+\cos x} = \tan(\frac{x}{2})$

Answer: $\frac{dy}{dx} = \cot x + \tan(\frac{x}{2})$

Q3(A).2 [3 marks]

If y = sin(x+y), find dy/dx

Solution:
Differentiating both sides:
$\frac{dy}{dx} = \cos(x+y) \cdot \left(1 + \frac{dy}{dx}\right)$

$\frac{dy}{dx} = \cos(x+y) + \cos(x+y) \cdot \frac{dy}{dx}$

$\frac{dy}{dx} - \cos(x+y) \cdot \frac{dy}{dx} = \cos(x+y)$

$\frac{dy}{dx}[1 - \cos(x+y)] = \cos(x+y)$

Answer: $\frac{dy}{dx} = \frac{\cos(x+y)}{1-\cos(x+y)}$

Q3(A).3 [3 marks]

Obtain ∫x²log x dx

Solution:
Using integration by parts: ∫u dv = uv - ∫v du

Let u = log x, dv = x^2 dx
Then du = (1/x) dx, v = $x^3/3$

$\int x^2 \log x \, dx = \log x \cdot \frac{x^3}{3} - \int \frac{x^3}{3} \cdot \frac{1}{x} dx$

$= \frac{x^3 \log x}{3} - \int \frac{x^2}{3} dx$

$= \frac{x^3 \log x}{3} - \frac{x^3}{9} + C$

Answer: $\frac{x^3}{3}(\log x - \frac{1}{3}) + C$

Q3(B).1 [4 marks]

Motion equation s = 2t³ - 3t² - 12t + 7. Find s and t when acceleration is zero

Solution:
$s = 2t^3 - 3t^2 - 12t + 7$

Velocity: $v = \frac{ds}{dt} = 6t^2 - 6t - 12$

Acceleration: $a = \frac{dv}{dt} = 12t - 6$

When acceleration = 0:
$12t - 6 = 0$
$t = \frac{1}{2}$

At t = 1/2:
$s = 2(\frac{1}{2})^3 - 3(\frac{1}{2})^2 - 12(\frac{1}{2}) + 7 = \frac{1}{4} - \frac{3}{4} - 6 + 7 = \frac{1}{2}$

Answer: t = 1/2, s = 1/2

Q3(B).2 [4 marks]

If y = 2e³ˣ + 3e⁻²ˣ, prove d²y/dx² - dy/dx - 6y = 0

Solution:
$y = 2e^{3x} + 3e^{-2x}$

$\frac{dy}{dx} = 6e^{3x} - 6e^{-2x}$

$\frac{d^2y}{dx^2} = 18e^{3x} + 12e^{-2x}$

Now: $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 6y$

$= (18e^{3x} + 12e^{-2x}) - (6e^{3x} - 6e^{-2x}) - 6(2e^{3x} + 3e^{-2x})$

$= 18e^{3x} + 12e^{-2x} - 6e^{3x} + 6e^{-2x} - 12e^{3x} - 18e^{-2x}$

$= (18 - 6 - 12)e^{3x} + (12 + 6 - 18)e^{-2x} = 0$

Hence proved

Q3(B).3 [4 marks]

Find maximum and minimum values of f(x) = x³ - 3x + 11

Solution:
$f(x) = x^3 - 3x + 11$

$f'(x) = 3x^2 - 3 = 3(x^2 - 1) = 3(x - 1)(x + 1)$

Critical points: x = 1, x = -1

$f''(x) = 6x$

At x = 1: f''(1) = 6 > 0 → Local minimum
At x = -1: f''(-1) = -6 < 0 → Local maximum

$f(1) = 1 - 3 + 11 = 9$ (minimum)
$f(-1) = -1 + 3 + 11 = 13$ (maximum)

Answer: Maximum = 13 at x = -1, Minimum = 9 at x = 1

Q.4 Attempt any two [14 marks total]

Q4(A).1 [3 marks]

Obtain ∫sin 5x sin 6x dx

Solution:
Using identity: $\sin A \sin B = \frac{1}{2}[\cos(A - B) - \cos(A + B)]$

$\sin 5x \sin 6x = \frac{1}{2}[\cos(5x - 6x) - \cos(5x + 6x)]$

$= \frac{1}{2}[\cos(-x) - \cos(11x)] = \frac{1}{2}[\cos x - \cos(11x)]$

$\int \sin 5x \sin 6x \, dx = \frac{1}{2} \int [\cos x - \cos(11x)] dx$

$= \frac{1}{2}[\sin x - \frac{\sin(11x)}{11}] + C$

Answer: $\frac{1}{2}\sin x - \frac{\sin(11x)}{22} + C$

Q4(A).2 [3 marks]

Obtain ∫(1+x)eˣ/cos²(xeˣ) dx

Solution:
Let $u = xe^x$, then $du = (1+x)e^x dx$

The integral becomes:
$\int \frac{du}{\cos^2 u} = \int \sec^2 u \, du = \tan u + C$

Substituting back:
$= \tan(xe^x) + C$

Answer: $\tan(xe^x) + C$

Q4(A).3 [3 marks]

Find standard deviation for data: 6,7,10,12,13,4,8,12

Solution:
Data: 6, 7, 10, 12, 13, 4, 8, 12
n = 8

Mean = $\frac{6+7+10+12+13+4+8+12}{8} = \frac{72}{8} = 9$

x	x-9	(x-9)²
6	-3	9
7	-2	4
10	1	1
12	3	9
13	4	16
4	-5	25
8	-1	1
12	3	9

Σ(x-9)² = 74

Standard deviation = $\sqrt{\frac{\sum(x-\bar{x})^2}{n}} = \sqrt{\frac{74}{8}} = \sqrt{9.25} = 3.04$

Answer: σ = 3.04

Q4(B).1 [4 marks]

Obtain ∫(2x+1)/[(x+1)(x-3)] dx

Solution:
Using partial fractions:
$\frac{2x+1}{(x+1)(x-3)} = \frac{A}{x+1} + \frac{B}{x-3}$

$2x + 1 = A(x - 3) + B(x + 1)$

When x = -1: $2(-1) + 1 = A(-4) \Rightarrow -1 = -4A \Rightarrow A = \frac{1}{4}$

When x = 3: $2(3) + 1 = B(4) \Rightarrow 7 = 4B \Rightarrow B = \frac{7}{4}$

$\int \frac{2x+1}{(x+1)(x-3)} dx = \frac{1}{4} \int \frac{1}{x+1} dx + \frac{7}{4} \int \frac{1}{x-3} dx$

$= \frac{1}{4} \ln |x + 1| + \frac{7}{4} \ln |x - 3| + C$

Answer: $\frac{1}{4} \ln |x + 1| + \frac{7}{4} \ln |x - 3| + C$

Q4(B).2 [4 marks]

Obtain ∫₀^(π/2) √(cot x)/(√(cot x) + √(tan x)) dx

Solution:
Let $I = \int_0^{\pi/2} \frac{\sqrt{\cot x}}{\sqrt{\cot x}+\sqrt{\tan x}} dx$

Using property: $\int_0^a f(x)dx = \int_0^a f(a-x)dx$

$I = \int_0^{\pi/2} \frac{\sqrt{\cot(\pi/2-x)}}{\sqrt{\cot(\pi/2-x)}+\sqrt{\tan(\pi/2-x)}} dx$

Since $\cot(\pi/2 - x) = \tan x$ and $\tan(\pi/2 - x) = \cot x$:

$I = \int_0^{\pi/2} \frac{\sqrt{\tan x}}{\sqrt{\tan x}+\sqrt{\cot x}} dx$

Adding both expressions:
$2I = \int_0^{\pi/2} \frac{\sqrt{\cot x}+\sqrt{\tan x}}{\sqrt{\cot x}+\sqrt{\tan x}} dx = \int_0^{\pi/2} 1\, dx = \frac{\pi}{2}$

Answer: $I = \frac{\pi}{4}$

Q4(B).3 [4 marks]

Find mean deviation for grouped data

x_i	4	8	11	17	20	24	32
f_i	3	5	9	5	4	3	1

Solution:
N = Σf_i = 3+5+9+5+4+3+1 = 30

Mean = $\frac{\sum f_i x_i}{N} = \frac{3(4)+5(8)+9(11)+5(17)+4(20)+3(24)+1(32)}{30}$

$= \frac{12+40+99+85+80+72+32}{30} = \frac{420}{30} = 14$

x_i	f_i	$\|x_i-14\|$	$f_i\|x_i-14\|$
4	3	10	30
8	5	6	30
11	9	3	27
17	5	3	15
20	4	6	24
24	3	10	30
32	1	18	18

$\Sigma f_i|x_i-14| = 174$

Mean deviation = $\frac{\sum f_i|x_i-\bar{x}|}{N} = \frac{174}{30} = 5.8$

Answer: Mean deviation = 5.8

Q.5 Attempt any two [14 marks total]

Q5(A).1 [3 marks]

Find mean deviation for grouped data

Class	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Freq	3	7	12	15	8	3	2

Solution:

Class	Mid-value	f_i	f_ix_i
30-40	35	3	105
40-50	45	7	315
50-60	55	12	660
60-70	65	15	975
70-80	75	8	600
80-90	85	3	255
90-100	95	2	190

$N = 50$, $\Sigma f_ix_i = 3100$

Mean = 3100/50 = 62

Class	x_i	f_i	$\|x_i-62\|$	$f_i\|x_i-62\|$
30-40	35	3	27	81
40-50	45	7	17	119

50-60	55	12	7	84
60-70	65	15	3	45
70-80	75	8	13	104
80-90	85	3	23	69
90-100	95	2	33	66

Mean deviation = 568/50 = 11.36

Answer: Mean deviation = 11.36

Q5(A).2 [3 marks]

Find standard deviation for given data

Class	60	61	62	63	64	65	66	67	68
Freq	2	1	12	29	25	12	10	4	5

Solution:
N = 100, Mean = (2×60 + 1×61 + ... + 5×68)/100 = 6380/100 = 63.8

x_i	f_i	$(x_i-63.8)$	$(x_i-63.8)^2$	$f_i(x_i-63.8)^2$
60	2	-3.8	14.44	28.88
61	1	-2.8	7.84	7.84
62	12	-1.8	3.24	38.88
63	29	-0.8	0.64	18.56
64	25	0.2	0.04	1.00
65	12	1.2	1.44	17.28
66	10	2.2	4.84	48.40
67	4	3.2	10.24	40.96
68	5	4.2	17.64	88.20

$\Sigma f_i(x_i-\bar{x})^2 = 290$

Standard deviation = $\sqrt{(290/100)} = \sqrt{2.9} = 1.70$

Answer: $\sigma = 1.70$

Q5(A).3 [3 marks]

Find mean for grouped data

Class	0-20	20-40	40-60	60-80	80-100	100-120
Freq	26	31	35	42	82	71

Solution:

Class	Mid-value	f_i	$f_i x_i$
0-20	10	26	260
20-40	30	31	930
40-60	50	35	1750
60-80	70	42	2940
80-100	90	82	7380
100-120	110	71	7810

N = 287, $\Sigma f_i x_i$ = 21070

Mean = $\frac{\sum f_i x_i}{N} = \frac{21070}{287} = 73.42$

Answer: Mean = 73.42

Q5(B).1 [4 marks]

Solve differential equation (x + y + 1)² dy/dx = 1

Solution:
Let z = x + y + 1, then dz/dx = 1 + dy/dx
So dy/dx = dz/dx - 1

Substituting: $z^2(dz/dx - 1) = 1$
$z^2 dz/dx - z^2 = 1$
$z^2 dz/dx = 1 + z^2$
$\frac{z^2}{1+z^2} dz = dx$

Integrating:
$\int \frac{z^2}{1+z^2} dz = \int dx$

$\int \left(1 - \frac{1}{1+z^2}\right) dz = x + C$

$z - \tan^{-1} z = x + C$

Substituting back z = x + y + 1:
$(x + y + 1) - \tan^{-1}(x + y + 1) = x + C$

Answer: $y + 1 = \tan^{-1}(x + y + 1) + C$

Q5(B).2 [4 marks]

Solve dy/dx + y/x = e^x, y(0) = 2

Solution:
This is a linear differential equation of the form dy/dx + P(x)y = Q(x)

Here P(x) = 1/x, Q(x) = e^x

Integrating factor: $I.F. = e^{\int \frac{1}{x}dx} = e^{\ln|x|} = |x| = x$ (for x > 0)

Multiplying the equation by x:
$x\frac{dy}{dx} + y = xe^x$

$\frac{d}{dx}(xy) = xe^x$

Integrating both sides:
$xy = \int xe^x dx$

Using integration by parts for ∫xe^x dx:
Let u = x, dv = e^x dx
Then du = dx, v = e^x

$\int xe^x dx = xe^x - \int e^x dx = xe^x - e^x = e^x(x-1)$

So: $xy = e^x(x-1) + C$
$y = \frac{e^x(x-1)+C}{x}$

Using initial condition y(0) = 2:
As x → 0, we need to use L'Hôpital's rule or series expansion.

From the original equation at x = 0: dy/dx = e^x - y/x
This suggests we need to be more careful with the initial condition.

Alternative approach: Since the equation has a singularity at x = 0, we solve in the neighborhood where x ≠ 0.

Answer: $y = \frac{e^x(x-1)+C}{x}$ where C is determined by boundary conditions.

Q5(B).3 [4 marks]

Solve y dy/dx = √(1 + x² + y² + x²y²)

Solution:
$y\frac{dy}{dx} = \sqrt{1 + x^2 + y^2 + x^2y^2}$

$y\frac{dy}{dx} = \sqrt{(1 + x^2)(1 + y^2)}$

$\frac{ydy}{\sqrt{1+y^2}} = \sqrt{1 + x^2}dx$

Integrating both sides:
$\int \frac{ydy}{\sqrt{1+y^2}} = \int \sqrt{1 + x^2}dx$

For the left side, let u = 1 + y², then du = 2y dy:
$\int \frac{ydy}{\sqrt{1+y^2}} = \frac{1}{2}\int \frac{du}{\sqrt{u}} = \sqrt{u} = \sqrt{1 + y^2}$

For the right side:
$\int \sqrt{1+x^2}dx = \frac{x\sqrt{1+x^2}}{2} + \frac{1}{2}\ln|x + \sqrt{1+x^2}| + C$

Therefore:
$\sqrt{1+y^2} = \frac{x\sqrt{1+x^2}}{2} + \frac{1}{2}\ln|x + \sqrt{1+x^2}| + C$

Answer: $\sqrt{1+y^2} = \frac{x\sqrt{1+x^2}}{2} + \frac{1}{2}\ln|x + \sqrt{1+x^2}| + C$

Formula Cheat Sheet

Matrix Operations

- $(A+B)^T = A^T + B^T$
- $(AB)^T = B^T A^T$
- $A \cdot adj(A) = |A| \cdot I$
- For 2×2 matrix $[a\ b; c\ d]$: $adj = [d\ \ -b; -c\ a]$

Differentiation Formulas

- $\frac{d}{dx}(\sin x) = \cos x$
- $\frac{d}{dx}(\cos x) = -\sin x$
- $\frac{d}{dx}(\tan x) = \sec^2 x$
- $\frac{d}{dx}(\log x) = \frac{1}{x}$
- $\frac{d}{dx}(e^x) = e^x$
- Chain rule: $\frac{d}{dx}f(g(x)) = f'(g(x)) \cdot g'(x)$

Integration Formulas

- $\int \sin x\, dx = -\cos x + C$
- $\int \cos x\, dx = \sin x + C$
- $\int \sec^2 x\, dx = \tan x + C$
- $\int \frac{1}{x}dx = \ln|x| + C$
- $\int e^x dx = e^x + C$
- $\int \frac{1}{x^2+a^2}dx = \frac{1}{a}\tan^{-1}(\frac{x}{a}) + C$

Differential Equations

- **Linear DE**: $\frac{dy}{dx} + P(x)y = Q(x)$
- **Integrating Factor**: $I.F. = e^{\int P(x)dx}$
- **Variable Separable**: $\frac{dy}{dx} = f(x)g(y) \Rightarrow \frac{dy}{g(y)} = f(x)dx$

Statistics

- **Mean**: $\bar{x} = \frac{\sum x_i}{n}$ (ungrouped), $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$ (grouped)
- **Mean Deviation**: $M.D. = \frac{\sum |x_i - \bar{x}|}{n}$
- **Standard Deviation**: $\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$

Problem-Solving Strategies

Matrix Problems

1. **Always check dimensions** before operations
2. **For inverse**: Calculate determinant first, then adjoint
3. **For system of equations**: Use $X = A^{-1}B$ where $AX = B$

Differentiation Problems

1. **Identify the type**: Chain rule, product rule, quotient rule
2. **For implicit differentiation**: Differentiate both sides, collect dy/dx terms
3. **For parametric**: Use $\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$

Integration Problems

1. **Try substitution** if you see function and its derivative
2. **Use integration by parts** for products (LIATE rule)
3. **For definite integrals**: Check for symmetry properties

Differential Equations

1. **Identify type**: Separable, linear, exact
2. **For linear DE**: Find integrating factor first
3. **Always verify** your solution by substitution

Statistics Problems

1. **Find mean first** for deviation calculations
2. **Use grouped data formulas** when data is in classes
3. **Create frequency table** to organize calculations

Common Mistakes to Avoid

1. **Matrix multiplication**: Order matters (AB ≠ BA generally)
2. **Chain rule**: Don't forget to multiply by derivative of inner function
3. **Integration by parts**: Choose u and dv carefully using LIATE
4. **Differential equations**: Don't forget the constant of integration

5. **Statistics**: Use correct formula for grouped vs ungrouped data

Exam Tips

1. **Read questions carefully** - especially for OR questions
2. **Show all steps** - partial marks are awarded
3. **Check units and signs** in your final answers
4. **Verify solutions** when possible by substitution
5. **Manage time wisely** - attempt questions you're confident about first
6. **Use standard formulas** - memorize the formula sheet content
7. **For fill-in-blanks**: Eliminate obviously wrong options first