1. Determinants & Matrices

- Proving determinant identities (e.g., Vandermonde, triangular properties).

- Matrix operations (inverse, adjoint, solving systems using Cramer's Rule).

- Repeated question:

  - Prove:

$$\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix} = (a-b)(b-c)(c-a).$$

2. Binomial Theorem

- Middle term, term independent of x, coefficient extraction.

- Repeated question:

  - Find the term independent of x in $\left(2x^2 - \dfrac{3}{x^3}\right)^{25}$.

3. Trigonometry

- Value proofs (e.g., $\sin 18^\circ = \frac{\sqrt{5}-1}{4}$).

- Angle sum identities (e.g., $2\tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{7} = \frac{\pi}{4}$).

- Repeated question:

  - Prove $\cos 20^\circ \cos 40^\circ \cos 60^\circ \cos 80^\circ = \dfrac{1}{16}$.

- Prove $\cos 20° \cos 40° \cos 60° \cos 80° = \dfrac{1}{16}$.

4. Coordinate Geometry

- Line equations (intercept form, perpendicularity).

- Circle properties (center, radius, diameter form).

- Repeated question:

  - Find the equation of the line through \((-2, -4)\) perpendicular to \(3x - y + 5 = 0\).

5. Calculus (Derivatives & Integrals)

- Second-order derivatives, maxima/minima.

- Integrals (e.g., \(\int \sqrt{\frac{a-x}{a+x}} \, dx\)).

- Repeated question:

  - Find local maxima/minima of $f(x) = x^3 - 6x^2 + 9x + 15$.

6. Partial Fractions

- Decomposition (e.g., \(\frac{5x+1}{(x+2)(x-1)}\)).

- Repeated question:

  - Resolve $\dfrac{2x + 3}{(x - 3)(x + 1)}$ into partial fractions.

7. Logarithms & Series

- AM/GM, logarithmic identities.

- Repeated question:

  - If $\dfrac{\log a}{b-c} = \dfrac{\log b}{c-a} = \dfrac{\log c}{a-b}$, prove $a^{b+c} \cdot b^{c+a} \cdot c^{a+b} = 1$.

8. Vectors

- Dot/cross products, work done.

- Repeated question:

  - Find the moment of force $\vec{F} = 3\vec{i} + 2\vec{j} - 4\vec{k}$ about the point \(2, -1, 3)\).

Important Questions to Prepare

1. Determinants/Matrices

- Solve using Cramer's Rule:

  $$x + y + z = 6, \quad 2x + 3y - z = 5, \quad 6x - 2y - 3z$$

- Find A^{-1} for $A = \begin{bmatrix} 3 & 5 & 7 \\ 2 & -3 & 1 \\ 1 & 1 & 2 \end{bmatrix}$.

2. Trigonometry

- Prove: $\sin^3 A + \cos^3 A = (\sin A + \cos A)(1 - \sin A \cos A)$.

- Find $\cos 120°$ and other exact values.

- Prove: $\sin^3 A + \cos^3 A = (\sin A + \cos A)(1 - \sin A \cos A)$.

- Find $\cos 120°$ and other exact values.

3. Coordinate Geometry

- Find the distance between parallel lines $3x + 4y - 5 = 0$ and $6x + 8y - 45 = 0$.

- Equation of the circle with diameter ends at \(1, 0)\) and \((-3, 5)\).

4. Calculus

- Find $\dfrac{d^2}{dx^2}\left(e^{2x}\cos 3x + x^4\right)$.

- Evaluate $\displaystyle\int_{-a}^{a}\sqrt{\dfrac{a-x}{a+x}}\,dx$.

5. Binomial Theorem

- Middle term of $\left(1 - \dfrac{x^2}{2}\right)^{14}$.

- Coefficient of x^7 in $\left(x^2 + \dfrac{1}{x}\right)^{11}$.

Exam Strategy

- **Focus Areas**: Determinants, binomial expansion, trigonometry proofs, and coordinate geometry.

- **Practice**: Repeated questions from 2014–2019 (e.g., matrix inversion, partial fractions).