XII STD
IMPORTANT DEFINITIONS &FORMULAE
STATE BOARD 2019 – 2020

1. APPLICATIONS OF MATRICES AND DETERMINANTS

1. Singular Square Matrix

   A square matrix is called singular if its determinant is zero.

2. Non-Singular Square Matrix

   A square matrix is called a non-singular if its determinant is not equal to zero.

3. Minor of the element $a_{i\,j}$ is denoted by $M_{i\,j}$

4. The cofactor of $a_{i\,j}$ is $A_{i\,j} = (-1)^{i+j} M_{i\,j}$

5. $a_{i\,1}A_{\,j1} + a_{i\,2}A_{\,j2} + \cdots + a_{i\,n}A_{\,jn} = \begin{cases} |A| \ if \ i = j \\ 0 \ if \ i \neq j \end{cases}$

6. Adj.A

   Let A be a square matrix of order . Then the matrix of cofactors of A is defined as the matrix obtained by replacing each element $a_{i\,j}$ of A with the corresponding cofactor $A_{i\,j}$.

   The adjoint matrix of |A is defined as the transpose of the matrix of cofactors of A

   It is denoted by $adj\ A$

   i.e.$adj\ A = \left[A_{i\,j}\right]^T = \left[(-1)^{i+j} M_{i\,j}\right]^T$

7. For every square matrix of A of order n,

   $$A(adj\ A) = (adj\ A)A = |A| I_n$$

8. If A is singular matrix of order n, $A(adj\ A) = (adj\ A)A = O_n$

9. Inverse matrix of a square matrix

   Let A be a square matrix of order . If there exists a square matrix B of order n such that $AB = BA = I_n$ then the matrix B is called an inverse of A

10. If a square matrix has an inverse, then it is unique

11. $A\,A^{-1} = A^{-1}\,A = I_n$

12. Let A be square matrix of order n,ThenA^{-1} exists if and only if A is non-singular.

13. $A^{-1} = \frac{1}{|A|}\, adj\ A$

14. Singular matrix has no inverse.

15. If A is non-singular then

i) $|A^{-1}| = \frac{1}{|A|}$

(ii) $|(A^T)^{-1}| = (A^{-1})^T$

(iii) $(\lambda\ A)^{-1} = \frac{1}{\lambda} A^{-1}$, where λ is a non-zero scalar

16. Left Cancellation Law:

Let A, B and C be square matrices of order n. If A is non-singular and $A\,B = AC$, then $B = C$

17. Right Cancellation Law:

Let A, B and C be square matrices of order n. If A is non-singular and $BA = CA$, then $B = C$.

18. If A is non-singular and $A\,B = AC$, (or) and $BA = CA$ then B and C need not be equal.

19. Reversal Law for Inverses:

If A and B are non-singular matrices of the same order, then the product AB is also non-singular and $(A\,B)^{-1} = B^{-1}A^{-1}$

20. Law of Double Inverse:

If A is non-singular then A^{-1} is also non-singular and $(A^{-1})^{-1} = A$

21. If A is non-singular square matrix of order n, then

(i) $(adj\ \ A)^{-1} = adj\ \ (A^{-1}) = \frac{1}{|A|}\ \ A$

(ii) $|adj\ \ A| = |A|^{n-1}$

(iii) $adj(adj\ \ A) = |A|^{n-2}\ A$

(iv) $adj(\lambda\ A) = \lambda^{n-1}\ adj\ (A)$, λ is a non-zero scalar.

(v) $|adj(adj\ \ A)| = |A|^{(n-1)^2}$

(vi) $(adj\ \ A)^T = adj\ \ (A^T)$

22. $|A| = \pm\sqrt{|adj\ \ A|}$

23. $A = \pm\ \frac{1}{\sqrt{|adj\ \ A|}}\ adj\ (adj\ A)$

24.If A is a non-singular matrix of odd order, $|adj\ \ A|$ is positive

25.If A is symmetric, $adj\ \ A$ is also symmetric.

26. If A and B are any two non-singular square matrices of order n, then

$$adj\ (AB) = (adj\ B)(adj\ A)$$

27.A square matrix A is called orthogonal if $AA^T = A^T A = I$

28.A is orthogonal if and only if A is non-singular and $A^{-1} = A^T$

29.One of the important applications of inverse of a non-singular square matrix in in cryptography.

30.Cryptography:

It is an art of communication between two people by keeping the information not known to others.

31.Encryption:

Encryption means the process of transformation of an information (plain form) into an unreadable for (coded form).

32.Decryption:

Decryption means the transformation of the coded message back into original form.

33.Elementary row transformation:

(i) Interchanging of i^{th} and j^{th} rows is denoted by $R_i \leftrightarrow R_j$

(ii) The multiplication of each element of i^{th} row by a non-zero constant λ is denoted by $R_i \rightarrow \lambda\ R_j$

(iii) Addition to i^{th} row, a non-zero constant λ multiple of j^{th} row is denoted by$R_i \rightarrow R_i + \lambda\ R_j$

34.$A \sim B$ means matrix A equivalent to the matrix B

35. An elementary transformation transforms a given matrix into another matrix which need not be equal to the given matrix.

36.Row-echelon form :

A non-zero matrix E is said to be in a row-echelon form if :

(i) All zero rows of E occur below non-zero row of E

(ii) If the first non-zero element in any row$i$ of E occurs in the j^{th} column of E, then all other entries in the j^{th} column of E below the first non-zero element of row i are zeros.

(iii) The first non-zero entry in the i^{th} row of E lies to the left of the first non-zero entry in $(i+1)^{th}$ row of E

37. Rank of a matrix:

The rank of a matrix A is defined as the order of a highest order non-vanishing minor of the matrix A.

It is denoted by $\rho\,(A)$

38. The rank of a zero matrix is defined to be 0

39. If a matrix contains at-least one non-zero element, then $\rho\,(A) \geq 1$

40. The rank of the identity matrix I_n is n

41. If the rank of a matrix A is r, then there exists at-least one minor of A of order r which does not vanish and every minor of A of order $r+1$ and higher order (if any) vanishes.

42. If A is an $m \times n$ matrix, then $\rho\,(A) \leq \min\{m\,, n\} = minimum\ of\ m, n$

43. A square matrix A order of n is invertible if and only if $\rho\,(A) = n$

44. The rank of a matrix in row echelon form is the number of non-zero rows in it.

45. An elementary matrix:

An elementary matrix is defined as a matrix which is obtained from an identity matrix by applying only one elementary transformations.

46. Every non-singular matrix can be transformed to an identity matrix, by a sequence of elementary row operations.

47. Gauss-Jordan Method:

Transforming a non-singular matrix A to the form I_n by applying elementary row operations is called Gauss-Jordan Method.

48. To find A^{-1} by Gauss-Jordan Method.

Step :1: $[A \mid I_n]$

Step : 2: (row operations)

$$(E_k \cdots E_2 E_1)A = I_n$$

Step :3: Apply $E_1,\ E_2,\ E_3,\ \cdots E_k$ on $[A \mid I_n]$

Step 4 :$[I_n \mid A^{-1}]$

49. Applications of Matrices:

System of linear equation arise as mathematical models of several phenomena occurring in biology, chemistry, commerce, economics, physics and engineering.

50.For instance, analysis of circuit theory, analysis of input-output models, and analysis of chemical reactions require solutions of systems of linear equations.

51.Consistent :

A system of linear equations having at-least one solution is said to be consistent.

52.Inconsistent:

A system of linear equations having no solution is said to be inconsistent.

53.Solve by using Matrix Inversion Method :

When the coefficient matrix is a square matrix and non-singular $X = A^{-1}B$

54.Solve By Cramer's rule :

$$x_1 = \frac{\Delta_1}{\Delta} x_2 = \frac{\Delta_2}{\Delta} x_3 = \frac{\Delta_3}{\Delta}$$

55.Solve by Gaussian Elimination Method:

Transforming the augmented matrix to echelon form.

56. The method of going from the last equation to the first equation (it is called the method of back substitution)

57.Rouche'-Capelli Theorem:

58. A system of linear equations written in the matrix from as $AX = B$ is consistent if and only if the rank of the coefficient matrix is equal to the rank of the augmented matrix.

59.i.e. $\rho\,(A) = \rho\,([\,A|B])$

60.The square matrix A is singular and so matrix inversion method cannot be applied to solve the system of equations.

61.Gaussian elimination method is applicable

62.If there are n unknown in the system of equations and $\rho\,(A) = \rho\,([\,A|B]) = n$then the system $AX = B$ is consistent and has a unique solution.

63. If there are n unknown in the system $AX = B$ and $\rho\,(A) = \rho\,([\,A|B]) = n - k, k \neq 0$then the system is consistent and has infinitely many solutions and these solutions form a k parameter family.

In particular, if there are 3 unknowns in a system of equation and $\rho\,(A) = \rho\,([\,A|B]) = 2$,then the system has infinitely many solutions and these solutions form a one parameter family.

In the same manner, if there are 3 unknowns in a system of equation and $\rho\,(A) = \rho\,([\,A|B]) = 1$,then the system has infinitely many solutions and these solutions form a two parameter family.

64. If $\rho\,(A) \neq \rho\,([\,A|B])$ then the system $AX = B$ is inconsistent and has no solution.

2. COMPLEX NUMBERS

1. $i^2 = -1$; $i^3 = -i$; $i^4 = i^2 \times i^2 = 1$
2. $(i)^{-1} = -i$; $(i)^{-2} = -1$; $(i)^{-3} = i$; $(i)^{-4} = 1$
3. $\sqrt{a\,b} = \sqrt{a}\sqrt{b}$
4. General form of a Complex number $x + i\,y$ where $x\ and\ y$ are real numbers.
5. In $x + i\,yx -$ real part ; $y -$ imaginary part
6. Two complex numbers $z_1 = x_1 + i\,y_1$ and $z_2 = x_2 + i\,y_2$ are said to be equal if and only if $Re\,(z_1) = Re\,(z_2)$and $Im\,(z_1) = Im\,(z_2)$.
   i.e.$x_1 = x_2$and$y_1 = y_2$
7. C denote the set of all complex numbers
8. Geometrically, a complex number can be viewed as either a point in R^2 or a vector in the Argand plane.
9. Scalar multiplication of complex number
   If $z = x + i\,y$ and $k \in R, k\,z = k(x) + (k\,y)\,i$
10. Addition of Complex number :
    If $z_1 = x_1 + i\,y_1$ and $z_2 = x_2 + i\,y_2$ where $x_1, x_2, y_1, y_2 \in R$
    $$z_1 + z_2 = (x_1 + x_2) + i\,(y_1 + y_2)$$
11. Subtraction of complex number:
    If $z_1 = x_1 + i\,y_1$ and $z_2 = x_2 + i\,y_2$ where $x_1, x_2, y_1, y_2 \in R$
    $$z_1 - z_2 = (x_1 - x_2) + i\,(y_1 - y_2)$$
12. Multiplication of complex number:
    If $z_1 = x_1 + i\,y_1$ and $z_2 = x_2 + i\,y_2$ where $x_1, x_2, y_1, y_2 \in R$
    $$z_1 z_2 = (x_1 x_2 - y_1 y_2) + i\,(x_1 y_2 + x_2 y_1)$$

13.Closure property under addition:

For any two complex number z_1 and z_2 the sum $z_1 + z_2$ is also a complex number.

14.The commutative property under addition $z_1 + z_2 = z_2 + z_1$

15.The associative property under addition

$$(z_1 + z_2) + z_3 = z_1 + (z_2 + z_3)$$

16.The additive identity

∃a complex number $0 = 0 + 0\,i$ such that $\forall\, z,\ z + 0 = 0 + z = z$

The complex number $0 = 0 + 0\,i$ is known as additive identity.

17.The additive inverse :

$\forall\, z,\ \exists -z$such that $z + (-z) = (-z) + z = 0$

$-z$is called the additive inverse of z.

18.Closure property under multiplication:

$\forall\, z_1, z_2 z_1 z_2$is also a complex number.

19.The commutative property under multiplication:$\forall\, z_1, z_2 z_1 z_2 = z_2 z_1$

20.The associative property under multiplication:

$$\forall\, z_1, z_2, \quad z_3 (z_1 z_2) z_3 = z_1\,(z_2 z_3)$$

21.The multiplication identity:

∃a complex number $1 = 1 + 0\,i$ such that $\forall\, z,\ z(1) = (1)z = z$

The complex number $1 = 1 + 0\,i$ is known as multiplicative identity.

22.The multiplicative inverse:

For any non-zero complex number Z , ∃ a complex number ω such that $z\,\omega = \omega\, z = 1. \omega$ is called the multiplicative inverse of Z .

It is denoted by z^{-1}

23.Distributive property (multiplication distributes over addition)

$\forall\, z_1, z_2,\ z_3 z_1 (z_2 + z_3) = z_1 z_2 + z_1 z_3$and

$(z_1 + z_2) z_3 = z_1 z_3 + z_2 z_3$

24.The conjugate of the complex number $x + i\,y$ is $x - i\,y$

25. The complex conjugate of z is denoted by $\overline{Z}$

26.To get the conjugate of Z simply change i by $-i$ in Z

27.$\overline{Z_1 + Z_2} = \overline{Z_1} + \overline{Z_2}$

28.$\overline{Z_1 - Z_2} = \overline{Z_1} - \overline{Z_2}$

29. $\overline{Z_1 Z_2} = \overline{Z_1}\,\overline{Z_2}$

30. $\overline{\left(\frac{Z_1}{Z_2}\right)} = \frac{\overline{Z_1}}{\overline{Z_2}}$; $\overline{Z_2} \neq 0$

31. $Re\ (z) = \frac{Z+\bar{Z}}{2}$

32. $Im\ (z) = \frac{Z-\bar{Z}}{2}$

33. $\overline{(Z^n)} = (\bar{Z})^n$, where n is an integer

34. Z is real if and only if $Z = \bar{Z}$

35. Z is purely imaginary if and only if $Z = -\bar{Z}$

36. $\bar{\bar{Z}} = Z$

37. $Z = x + i\,y, \quad |Z| = \sqrt{x^2 + y^2}$

38. $Z\,\bar{Z} = |Z|^2$

39. $|Z| = |\bar{Z}|$

40. Triangle inequality: $|z_1 + z_2| \leq |z_1| + |z_2|$

41. $|z_1 z_2| = |z_1||z_2|$

42. $|z_1 - z_2| \geq |z_1| - |z_2|$

43. $\left|\frac{z_1}{z_2}\right| = \frac{|z_1|}{|z_2|}$; $z_2 \neq 0$

44. $|z^n| = |z|^n$; where n is an integer

45. $Re\ (z) \leq |z|$

46. $Im\ (z) \leq |z|$

47. $\sqrt{a+ib} = \pm\left[\sqrt{\frac{|z|+a}{2}} + i\,\frac{b}{|b|}\sqrt{\frac{|z|-a}{2}}\right]$ where $b \neq 0, z = a + ib$

48. If b is negative $\frac{b}{|b|} = -1, x\ and\ y$ have different signs

49. If b is positive $\frac{b}{|b|} = 1, x\ and\ y$ have same signs

50. Circle:

A circle is defined as the locus of a point which moves in a plane such that its distance from a fixed point in that plane is always a constant.

The fixed point is the centre and the constant distant is the radius of the circle.

51. $|z - z_0| = r$ The complex form of the equation of a circle

(i) $|z - z_0| < r$, the points interior of the circle.

(ii) $|z - z_0| > r$, the points exterior of the circle.

52. $x^2 + y^2 = r^2$ represent a circle centre at the origin with radius r units

53. The polar from (or) Trigonometric form

$$z = r(\cos\theta + i\sin\theta) = r\,cis\,\theta$$

54. r represents the absolute value (or) modulus

55. θ called the argument (or) amplitude i.e. $\theta = \arg(z)$

56. $z = 0$, θ is undefined.

57. $Z = x + i\,y$, Polar co ordinate (r, θ)

58. $Z = x - i\,y$, Polar co ordinate $(r, -\theta)$

59. $-\pi < Arg\,(z) \leq \pi$ (or) $-\pi < \theta \leq \pi$

60. $\alpha = \tan^{-1}\left|\frac{y}{x}\right| \arg z = Arg\,z + 2\,n\,\pi$, $n \in z$

61. $\arg(z_1 z_2) = \arg z_1 + \arg z_2$

62. $\arg\left(\frac{z_1}{z_2}\right) = \arg z_1 - \arg z_2$

63. $\arg(z^n) = n \arg z$

64. The alternate form of $\cos\theta + i\sin\theta$ is

$$\cos(2\,k\,\pi + \theta) + i\sin(2\,k\,\pi + \theta),\ k \in z$$

65. The principle argument and argument of $1, i, -1, -i$

z	1	i	-1	$-i$
$Arg\,z$	0	$\frac{\pi}{2}$	π	$-\frac{\pi}{2}$
$\arg z$	$2\,n\,\pi$	$2\,n\,\pi + \frac{\pi}{2}$	$2\,n\,\pi + \pi$	$2\,n\,\pi - \frac{\pi}{2}$

66. Euler Form $e^{i\,\theta} = \cos\theta + i\sin\theta$

In Polar form $z = r\,e^{i\,\theta}$

67. If $z = r(\cos\theta + i\sin\theta)$ then $z^{-1} = \frac{1}{r}(\cos\theta - i\sin\theta)$

68. If $z_1 = r_1(\cos\theta_1 + i\sin\theta_1)$ and $z_2 = r_2(\cos\theta_2 + i\sin\theta_2)$ then

$$z_1 z_2 = r_1 r_2[\cos(\theta_1 + \theta_2) + i\sin(\theta_1 + \theta_2)]$$

69. If $z_1 = r_1(\cos\theta_1 + i\sin\theta_1)$ and $z_2 = r_2(\cos\theta_2 + i\sin\theta_2)$ then

$$\frac{z_1}{z_2} = \frac{r_1}{r_2}[\cos(\theta_1 - \theta_2) + i\sin(\theta_1 - \theta_2)]$$

70. $\arg\left(\frac{z_1}{z_2}\right) = \theta_1 - \theta_2 = \arg z_1 - \arg z_2$

71. De moivre's Theorem

Given any complex number $\cos\theta + i\sin\theta$ and any integer n

$$(\cos\theta + i\sin\theta)^n = \cos n\,\theta + i\sin n\,\theta$$

72. $(\cos\theta - i\sin\theta)^n = \cos n\,\theta - i\sin n\,\theta$

73. $(\cos\theta + i\sin\theta)^{-n} = \cos n\,\theta - i\sin n\,\theta$

74. $(\cos\theta - i\sin\theta)^{-n} = \cos n\,\theta + i\sin n\,\theta$

75. $\sin\theta + i\cos\theta = i(\cos\theta - i\sin\theta)$

76. n^{th} roots of z

$$z^{\frac{1}{n}} = r^{\frac{1}{n}}\left[\cos\left(\frac{\theta + 2k\pi}{n}\right) + i\sin\left(\frac{\theta + 2k\pi}{n}\right)\right] k = 0,1,2,3,\cdots n-1$$

77. The sum of all the n^{th} roots of unity is

$$1 + \omega + \omega^2 + \omega^3 + \cdots + \omega^{n-1} = 0$$

78. The product of all the n^{th} roots of unity is

$$(1)(\omega)(\omega^2)(\omega^3)\cdots(\omega^{n-1}) = (-1)^{n-1}$$

79. $|\omega| = 1, \quad (\omega)(\overline{\omega}) = 1$

80. $\omega^{n-k} = \omega^{-k} = (\overline{\omega})^k \;;\; 0 \le k \le n-1$

3. THEORY OF EQUATIONS

1. Polynomial functions are defined for all values of x
2. Every non-zero constant is a polynomial of degree 0
3. The constant 0 is also a polynomial called the zero polynomial its degree is not defined.
4. The degree of polynomial is a non-negative integer.
5. The zero polynomial is the only polynomial with leading coefficient 0
6. Polynomials of degree two are called quadratic polynomials.
7. Polynomials of degree three are called cubic polynomials.
8. Polynomials of degree four are called quartic polynomials.
9. For the quadratic equation $ax^2 + bx + c = 0$, the two roots are $\frac{-b+\sqrt{b^2-4ac}}{2a}$ and $\frac{-b-\sqrt{b^2-4ac}}{2a}$

   (i) If $\Delta = 0$, if and only if the roots are real.

(ii) If $\Delta > 0$, if and only if the roots are real and distinct

(iii) If $\Delta < 0$, if and only if the quadratic equation has no real roots.

10.Vieta's formula for Quadratic equation

$$x^2 - (sum\ of\ the\ roots\ )x + product\ of\ the\ roots = 0$$

11.The Fundamental Theorem of Algebra:

Every polynomial equation of degree $n \geq 1$ has at-least one root in C

12. Vieta's formula for Polynomial equation of degree 3

$$ax^3 + bx^2 + cx + d = 0, a \neq 0$$

$$\alpha + \beta + \gamma = \frac{-b}{a} \alpha\beta + \beta\gamma + \gamma\alpha = \frac{c}{a} \alpha\beta\gamma = \frac{-d}{a}$$

Coefficient of $x^2 = -(\alpha + \beta + \gamma)$

Coefficient of $x = \alpha\beta + \beta\gamma + \gamma\alpha$

Constant term $= \alpha\,\beta\,\gamma$

13. Vieta's formula for Polynomial equation of degree $n > 3$

If a monic polynomial equation of degree n has roots $\alpha_1, \alpha_2, \alpha_3, \cdots \alpha_n$ then

Coefficient of $x^{n-1} = \sum_1 = -\sum \alpha_1$

Coefficient of $x^{n-2} = \sum_2 = \sum \alpha_1\,\alpha_2$

Coefficient of $x^{n-3} = \sum_3 = -\sum \alpha_1\,\alpha_2\alpha_3$

Coefficient of $x = \sum_{n-1} = (-1)^{n-1} \sum \alpha_1\,\alpha_2\alpha_3 \cdots \alpha_{n-1}$

Coefficient of $x^0 = constant\ term = \sum_n$

$$= (-1)^n \alpha_1\alpha_2\alpha_3 \cdots \alpha_n$$

14.A Polynomial equation of degree n with roots $\alpha_1\alpha_2\alpha_3 \cdots \alpha_n$ is given by

$$x^n - (\sum \alpha_1)x^{n-1} + (\sum \alpha_1\,\alpha_2)x^{n-2} - (\sum \alpha_1\,\alpha_2\alpha_3)x^{n-3} + \cdots + (-1)^n \alpha_1\alpha_2\alpha_3 \cdots \alpha_n = 0$$

15. Complex Conjugate Root Theorem:

If a complex number z_0 is a root of a polynomial equation with real co-efficients, then its complex conjugate $\bar{z_0}$ is also a root.

16. Let p and q be rational numbers such that $\sqrt{q}$ is irrational. If $p+\sqrt{q}$ is a root of a quadratic equation with rational coefficients, then $p-\sqrt{q}$ is also a root of the same equation.

17. Two circles cannot intersect at more than two points.

18. A circle and an ellipse cannot intersect at more than four points.

19. Every polynomial is one variable is a continuous function from R to R

20. For a polynomial equation $P(x) = 0$ of even degree, $P(x) \to \infty$ as $P(x) \to \pm\infty$

    Thus the graph of an even degree polynomial start from left top ends at right top.

21. Every polynomial is differentiable any number of times.

22. The real roots of a polynomial equation $P(x) = 0$ are the points on the x axis where the graph of $P(x) = 0$ cuts the x axis.

23. If a and b are two real numbers such that $P(a)$ and $P(b)$ are of opposite sign, then

    (i) there is a point C on the real line for which $P(c) = 0$

    (ii) i.e. there is a root between a and b

    (iii) it is not necessary that there is only one root between such points. there may be $3,5,7,\cdots$ roots.

    i.e. the number of real roots between a and b is odd and not even.

24. Quadraic polynomial equation of the form $(ax+b)(cx+d)$

    $(px+q)(rx+s)+k=0,\ \ k\neq 0$ which can be rewritten in the form

    $(\alpha x^2+\beta x+\lambda)(\alpha x^2+\beta x+\mu)+k=0$

25. Rational Root Theorem:

    Let $a_n x^n + \cdots + a_1 x + a_0\ with\ \ a_n \neq 0\ \ and\ a_0 \neq 0$, be a polynomial with integer coefficient. If $\frac{p}{q}$ with $(p,q)=1$, is a root of the polynomial, then p is a factor of a_0 and q is a factor of a_n

26. A polynomial $P(x)$ of degree n is said to be a reciprocal polynomial if one of the following conditions is true.

    (i) $P(x) = x^n P\left(\frac{1}{x}\right)$

    (ii) $P(x) = -x^n P\left(\frac{1}{x}\right)$

27. A polynomial equation $a_n x^n + a_{n-1}x^{n-1} + a_{n-2}x^{n-2} + \cdots$
$+a_1 x + a_0 = 0$ $(a_0 \neq 0)$is a reciprocal equation if and only if one of the following two statements is true:
(i) $a_n = a_0$, $a_{n-1} = a_1$, $a_{n-2} = a_2$ $\cdots$
(ii) $a_n = -a_0$, $a_{n-1} = -a_1$, $a_{n-2} = -a_2$ $\cdots$

28. A reciprocal equation cannot have 0 as a solution.

29. The coefficients and the solutions are not restricted to be real.

30. If $P(x) = 0$ is a polynomial equation such that whenever α is a root, $\frac{1}{\alpha}$ is also a root, then the polynomial equation $P(x) = 0$ must be a reciprocal equation is not true.

31. A change of sign in the coefficients is said to occur at the j^{th} power of x of a polynomial $P(x)$ if the coefficient of x^{j+1} and the coefficient of x^j (or) also coefficient of x^{j-1}.
coefficient of x^j are of different signs (for zero coefficient we take the sin of the immediately preceding non-zero coefficient)

32. Descartes Rule:
If p is the number of positive zeros of a polynomial $P(x)$ with real coefficients and s is the number of sign changes the coefficient of $P(x)$ then $s \to p$ is a non -negative even integer.

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