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Integration By Partial Fractions

SUBJECT : MATHEMATICS
CHAPTER NUMBER:7
CHAPTER NAME : INTEGRALS

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Integration of Rational Algebraic Functions by Using Partial Fraction

Partial Fractions: if $P(x)$ and $Q(x)$ are polynomials, then $\frac{P(x)}{Q(X)}$ defines a rational algebraic function or a rational function of x.

If the integrand of the form $\frac{P(x)}{Q(x)}$, where $P(x)$ and $Q(x)$ are polynomials in x and $Q(x) \neq 0$.

To write $\frac{P(x)}{Q(x)}$ as a sum of simpler rational functions by a method which is known as partial fraction decomposition. Each such fraction is called a partial fraction and it has the simplest factor of $Q(x)$.

Integration of Rational Algebraic Functions by Using Partial Fraction

Working Rule

Step – I Suppose the given integral is in the form $\frac{P(x)}{Q(x)}$,then the first check $P(x)$ and $Q(x)$ are polynomials $Q(x) \neq 0$. Also for proper and improper.

Step – II If $\frac{P(x)}{Q(x)}$ is a proper fraction, then we go to the next step directly.

If $\frac{P(x)}{Q(x)}$ is an improper fraction then we divide $P(x)$ by $Q(x)$, then $\frac{P(x)}{Q(x)}$ is expressed in the form of $T(x) + \frac{P_1(x)}{Q(x)}$, $T(x)$, $P_1(x)$ are a polynomial in x and $\frac{P_1(x)}{Q(x)}$ proper factional function using division Algorithm.

Step – 3 Now the decomposition of the proper fraction $\frac{P(x)}{Q(x)}$ or $\frac{P_1(x)}{Q(x)}$ into partial fractions depends mainly upon the nature of the factors $Q(x)$.

Different Rational Functions and Their Corresponding Partial Fraction

Form of the rational Function	Form of the partial fraction
(a) $\frac{Px+q}{(x-a)(x-b)}; a \neq b$	$\frac{A}{x-a}+\frac{B}{x-b}$
(b) $\frac{Px^2+qx+r}{(x-a)(x-b)(x-c)}$	$\frac{A}{x-a}+\frac{B}{x-b}+\frac{C}{x-c}$
(c) $\frac{Px+q}{(x-a)^2}$	$\frac{A}{x-a}+\frac{B}{(x-a)^2}$
(d) $\frac{Px^2+qx+r}{(x-a)^2.(x-b)}$	$\frac{A}{x-a}+\frac{B}{(x-a)^2}+\frac{C}{x-b}$
(e) $\frac{px^2+qx+r}{(x-a)(x^2+bx+c)}$	$\frac{A}{x-a}+\frac{Bx+C}{x^2+bx+c}$

Example

Resolve $\frac{1}{(x+1)(x+2)}$ into Partial fractions.

Example

Resolve $\frac{3x-2}{(x+1)^2(x+3)}$ into Partial fractions.

Example

Resolve $\frac{x^2+x+1}{(x+2)\,(x^2+1)}$ into Partial fractions.

Assignments

1. Resolve into partial fractions

$(a)\ \frac{x-1}{(x+1)(x-2)}$

$(b)\ \frac{2x-1}{(x-1)(x+2)(x-3)}$

$(c)\ \frac{2x-1}{(x+1)(x^2+2)}$

$(d)\ \frac{3x-2}{(x-1)^2(x+1)(x+2)}$

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