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SUBJ Applied Calculus

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(1)

Applications of Derivatives in engineering

(1) Rate of Change of quantity:- This is the general and most important application of derivative. to check the rate of Change of volume of cube with respect to its decreasing sides. we can use the derivative form as dy/dx. where dy/dx represent the rate of Change of volume of cube and dx represents the change of sides of cube

(2) Increasing and decreasing functions:- To find the given or decreasing or function is increasing or decreasing or constant, say in a graph we use derivatives. if f is a function which is continuous in $[p,q]$ and differential in the open interval (p,q) then,

- f is increasing at $[p,q]$ if $f(x) > 0$ for each $x \in [p,q]$
- f is decreasing at $[p,q]$ if $f'(x) < 0$ for each $x \in [p,q]$
- f is constant function in $[p,q]$ if $f'(x) = 0$ for each $x \in [p,q]$

(2)

(3) Tangents and normals: we often need tangents and normals to curves when we are analysing forces on a moving body

A tangent to curve is the line that touches the curve at one point and has same slope as the curve at that point

A normal to the curve is a line perpendicular to a tangent to the curve.

we can find the slope of tangent at any point (x,y) using $\frac{dy}{dx}$

To find the equation of a normal.

$$m_1 \times m_2 = -1$$

4) Newtons method for solving equations:-

Computers use itterative methods to solve equation the process involves making a guess at the true solution and then applying a formula to get a better guess and so until we arrive at an acceptable approximation for the solution.

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(3) If we wish to find x so that $f(x) = 0$ (a common type of problem) then we guess some intial value x_0 which is close to the desired solution the we get better approximation using newton method

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

(4) maxima and minima :- To calculate the highest and lowest point of the curve in a graph or to know it turning point) the derivative function is used

(5) Monotonicity :-

Function are said to be monotonic if they are either increasing or decreasing in their entire domain.

$f(x) = e^x$, $f(x) = n^x$,

$f(x) = 2x + 3$ are some function which are said to be increasing or decreasing in their entire domain are said to be non-monotonic example : $f(x) = \sin x$, $f(x) = x^2$

4)

(5) Approximation or finding approximate value:- To find very small change or variation of quantity we can use derivative to give the approximate value of it the approximate value represented by Δ value suppose the change in the value x_1 dn $= x$ then

$dy/dn = \Delta n = x$

since then the chang in x_1 $dx = x$ therefore $dx \cong y$.

(6) point of inflection:- for continious function $f(x)$, if $f'(x_0) = 0$ or $f''(x_0)$ does not exist at points where $f'(x_0)$ exists and if $f''(x)$ changes sign when passing through $x = x_0$ then x_0 is called the point of inflection.

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(5)

Application of integration in engineering

(1) Area between the curves:-

we have seen how integration can be used to find the area between the curves and the x-axis. with very little change we can find some areas between the curves. indeed the area between the curve and x-axis may be interpreted as the area between the curve and the 'second' curve with equation $y=0$. in the simplest of cases the ideas is quite easy to understand

(2) Volume :-

Volume of complicated shapes can be calculated using integeral calculus if formula exist for the shapes boundry.

(3)

(3) Shear force and bending movement

Shear force and bending moment are one of the important parameter for Structural design these parameter offset a structure alot

Take example of a rod suspended between two horizontal supports and Same load is applied at the center with application of load beam will beam Some forces will develop inside the rod which will try to break the rod

(4) Area under the curve

In civil engineering we are dealing with curve or structure having curves the we may need to find the are under the curve which is to be construt So we use integration for this

$$\text{Area} = \int_a^b f(x)\,dx$$

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(5) Average value of function:

Average of some finite set of values is a similar concept. For example the class score on the quiz are 10, 9, 10, 8, 7, 8, 7, 6, 3, 2, 7, 8 then the average score is the sum of these numbers divided by the size of class.

(6) center of mass:

Suppose a beam is 10m long and there are three weights on it an 10 kg weigth 3m from the left end, a five (5) kg weight 6m from the left end, and a 4 kg weight 8m from the left end where should be fulcrum be placed so that the beam is balanced? lets assign a scale to the beam from 0 to left end to 10 to right end so we can denote locations on the beam simply as x coordinate the weights are x=3, x=6, x=8

7) Radius of curvature

The radius of curvature $= \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{1/2}$

The radius of the curvature of the curve at particular curve is defined as the radius of approximity. this radius changes as we move along the curve the formular for the radius of curvature at any point x for the curve $y = f(x)$

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