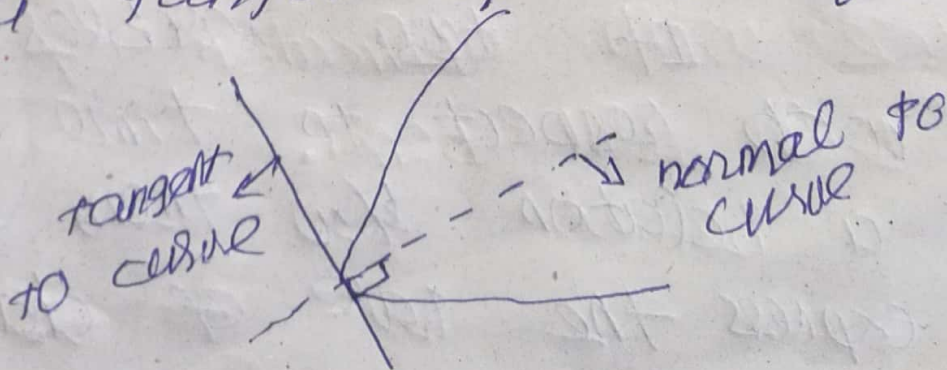


# Application of derivatives and integration in Engineering:

we use the derivatives to determine the maximum values of particular functions (cost, strength, amount of material in buildings).

## Tangent and normal:

A tangent to a curve is that line that touches the curve at one point and has the same slope as the curve at that point. A normal to a curve is a line perpendicular to a tangent of the curve.



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

## 2) Newton's method

The process involve making a guess at the true solution and then applying a formula to set a better guess and so on, until we arrive at an acceptable approximation for solution. If we wish to find  $x$  so that  $f(x) = 0$  then we guess some initial value,  $x_0$  which is close to desired sol and then discussed we get approx using newton method.

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

## Related Rates:-

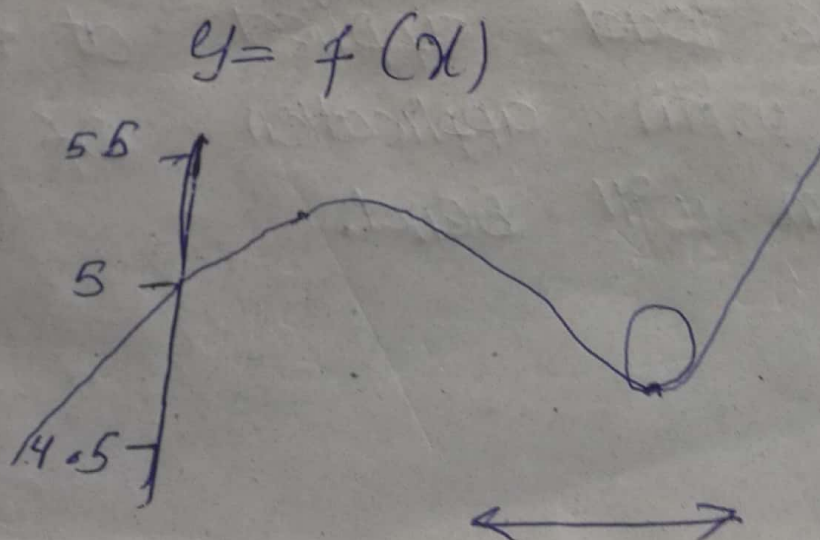
If two variables both vary with respect to time and have a relation b/w them, we can express the rate of change

of one in terms of another.  
That is we'll be finding  
it for some function  $f(x)$ .

Radius of curvature:-

$$\text{Radius of curvature} = \frac{[1 + (\frac{dy}{dx})^2]^{3/2}}{[\frac{d^2y}{dx^2}]}$$

The radius of curvature at  
the curve at a particular  
point is defined as the  
radius of approximating circle.  
This radius changes as we move  
along the curve. The formula for  
the radius of curvature at  
any point  $x$  for the curve



## Application of Integration:-

### Integration:-

The process of finding a function, given its derivatives is called integration.

⇒ If  $f'(x) = f(x)$  we say  $f(x)$  is an anti-derivative of  $f'(x)$ .

⇒ It is usually used to find the area.

① Shear force and Bending moment.

Shear force and bending moment are one of the imp parameters

for structural design these parameters affect a structure a lot.

→ Take example of a rod suspended by two horizontal supports and some load applied at the centre with application of load the beam will bend.

② length of curves  
corrugated iron sheeting:-

→ Corrugated iron is used extensively throughout the world as a versatile building material. Bending the material to a regular sine wave pattern gives it greater strength than if a flat sheet is used.

→ So integration is used to find out how wide should the flat sheet be to give us a corrugated sheet at required width.

③ Area under a curve:-

In civil engineering we are dealing with curve of structure having curves then may need to find the area under the curve which is to be

constructed so we use integration  
for this purpose

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

① moment of inertia by integration  
moment of inertia is a  
geometrical property of a section  
of a structural member, which  
is required to measure its  
resistance to bending and  
buckling.

→ 2 moment of inertia about x-axis

$$I_x = \int_A y^2 dA$$

where  $y$  is the y-coordinate  
of differential element of area  $dA$ .

→ 2 moment of inertia about  
y-axis.

$$I_y = \int_A x^2 dA.$$

where  $x$  is a coordinate of  
element  $dA$ .