TIWARI'S CLASSES

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DIFFERENTIATION

1. $\frac{d}{dx}(x^n) = nx^{n-1}$
2. $\frac{d}{dx}(x) = 1$
3. $\frac{d}{dx}\left(\frac{1}{x}\right) = \frac{-1}{x^2}$
4. $\frac{d}{dx}\left(\sqrt{x}\right) = \frac{1}{2\sqrt{x}}$
5. $\frac{d}{dx}(c) = 0$
   where c is a constant
6. $\frac{d}{dx}[cf(x)] = c\frac{d}{dx}[f(x)]$
7. $\frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}$
8. $\frac{d}{dx}(e^x) = e^x$
9. $\frac{d}{dx}(a^x) = a^x\, log_e a$
10. $\frac{d}{dx}(log_e x) = \frac{1}{x}$
11. $\frac{d}{dx}(log_a x) = \frac{1}{x} log_a e$
12. $\frac{d}{dx}(sinx) = Cos\, x$
13. $\frac{d}{dx}(cosx) = -Sin\, x$
14. $\frac{d}{dx}(\tan x) = Sec^2 x$
15. $\frac{d}{dx}(cotx) = -cosec^2 x$
16. $\frac{d}{dx}(sec\, x) = secx\, tanx$
17. $\frac{d}{dx}(cosec\, x) = -cosec\, x\, cotx$
18. $\frac{d}{dx}(Sin^{-1}x) = \frac{1}{\sqrt{1-x^2}}$
19. $\frac{d}{dx}(cos^{-1}x) = \frac{-1}{\sqrt{1-x^2}}$
20. $\frac{d}{dx}(tan^{-1}x) = \frac{1}{(1+x^2)}$
21. $\frac{d}{dx}(cot^{-1}x) = \frac{-1}{(1+x^2)}$
22. $\frac{d}{dx}(sec^{-1}x) = \frac{1}{1x1\sqrt{x^2-1}}$
23. $\frac{d}{dx}(cosec^{-1}x) = \frac{-1}{1x1\sqrt{x^2-1}}$

24. Product Rule:-

If $y = u \times v$

then $\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

25. Division Rule or Quotient Rule:-

$If\ y = \frac{N}{D}$

then $\frac{dy}{dx} = \frac{D\frac{d}{dx}(N) - N\frac{d}{dx}(D)}{D^2}$

26. Chain Rule:-

Let $y = f(t)\ and\ t = g\ (x)$.

Then $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$

This rule may be extended further on more variables

Logarithmic function:-

1. If $a^b = c$ and $a > 1$ then $log_a c = b$
2. If $log_m\ p = n$ then $p = m^n$
3. $log_a b = \frac{1}{log_b a}$
4. $log_a 1 = 0$
5. $log_a a = 1$
6. $log_a\ m \times n = log_a m + log_a n$
7. $log_a \frac{m}{n} = log_a m - log_a n$
8. $log_a\ m^n = n\ log_a m$

INTEGRATION

1. $\int x^n dx = \frac{x^{n+1}}{n+1} + c, n \neq -1$

   where c = constant of integration
2. $\int \frac{1}{x} dx = log_e\ |\ x\ |\ + c$
3. $\int dx = x + c$
4. $\int \frac{1}{2\sqrt{x}} dx = \sqrt{x} + c$
5. $\int \left(\frac{-1}{x^2}\right) dx = \frac{1}{x} + \ c$
6. $\int e^x\ dx = e^x + c$
7. $\int a^x dx = \frac{a^x}{log_e a} + c$
8. $\int sinx\ dx = -cosx + c$
9. $\int cosx\ dx = sinx + c$
10. $\int sec^2 x\ \ dx = tanx + c$
11. $\int cosec^2 x\ dx = -\cot x + c$
12. $\int secx\ tanx\ dx = secx + c$
13. $\int cosecx \cot x\ dx = -cosecx + c$
14. $\int \sec x\ dx = log|secx + tanx| + c$

    $= log\left|tan\left(\frac{\pi}{4} + \frac{x}{2}\right)\right| + c$
15. $\int cosecx\ dx = log|cosecx - \cot x| + c$

    $= log\left|tan\frac{x}{2}\right| + \ c$

16. $\int \tan x \ dx = log|secx| + c$
$= -log|cosx| + c$

17. $\int \cot x \ dx = log|\sin x| + c$

18. $\int \frac{dx}{\sqrt{1-x^2}} = sin^{-1}x + c$

19. $\int \frac{dx}{1+x^2} = tan^{-1}x + c$

20. $\int \frac{dx}{x\sqrt{x^2-1}} = sec^{-1}x + c$

21. **Integration by parts**

22. $\int uv\,dx = u\int v\ dx - \int \left[\frac{du}{dx}\int v\,dx\right]dx$

I L A T E

23. $\int e^x[f(x) + f'(x)]dx = e^x f(x) + c$

24. $\int \frac{dx}{(a^2-x^2)} = \frac{1}{2a} log\left|\frac{a+x}{a-x}\right| + c$

25. $\int \frac{dx}{(x^2-a^2)} = \frac{1}{2a} log\left|\frac{x-a}{x+a}\right| + c$

26. $\int \frac{dx}{(x^2+a^2)} = \frac{1}{a} tan^{-1}\frac{x}{a} + c$

27. $\int \frac{dx}{\sqrt{a^2-x^2}} = sin^{-1}\frac{x}{a} + c$

28. $\int \frac{dx}{\sqrt{x^2-a^2}} = log\left|x + \sqrt{x^2-a^2}\right| + c$

29. $\int \frac{dx}{\sqrt{x^2+a^2}} = log\left|x + \sqrt{x^2+a^2}\right| + c$

30. $\int \sqrt{a^2-x^2}\,dx = \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2} sin^{-1}\frac{x}{a} + c$

31. $\int \sqrt{x^2-a^2}\,dx = \frac{x}{2}\sqrt{x^2-a^2} - \frac{a^2}{2} log\left|x + \sqrt{x^2-a^2}\right| + c$

32. $\int \sqrt{x^2+a^2}\ dx = \frac{x}{2}\sqrt{x^2+a^2} + \frac{a^2}{2} log\left|x + \sqrt{x^2+a^2}\right| + c$

DEFINITE INTEGRATION

33. $\int_a^b f(x)dx = [F(x)]_a^b = F(b) - F(a)$

34. $\int_a^b f(x)dx = \int_a^b f(t)dt$

35. $\int_a^b f(x)dx = -\int_b^a f(x)\,dx$

36. $\int_a^b f(x)dx = \int_a^c f(x)\,dx + \int_c^b f(x)dx$, where $a < c < b$

37. $\int_0^b f(x)dx = \int_0^a f(a-x)dx$

38. $\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

39. $\int_a^b [f(x) + g(x)]dx = \int_a^b f(x)dx + \int_a^b g(x)dx$

40. $\int_{-a}^a f(x)dx = \begin{cases} 0, when\ f(x) is\ an\ odd\ function \\ 2\int_0^a f(x)dx, when\ f(x)\ is\ an\ even\ function \end{cases}$

41. $\int_0^{2a} f(x)dx = \begin{cases} 0, if\ f(2a-x) = -f(x) \\ 2\int_0^a f(x)dx, if\ f(2a-x) = f(x) \end{cases}$