THE UNIVERSITY OF LAHORE

SARGODHA CAMPUS

ASSIGNMENT 04

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SECTION : BSSE-1

REGISTRATION NO : BSSE07193048

1) Share any 3 applications of ant-derivatives in CS.

Anti-derivatives (Integration) are used in computer science in many way.

i) They are used to calculate probability.

ii) Their application includes finding area between curves.

iii) Functions are also used in computer science and to find average value between two functions, we use anti-derivatives.

2) Solve Ex 4.8

8) a) $\frac{4}{3}\sqrt[3]{x}$

$= \frac{4}{3}\int x^{1/3}\,dx$

$= \frac{4}{3}\frac{x^{4/3}}{4/3}$

$= x^{4/3} + C$

b) $\frac{1}{3\sqrt[3]{x}}$

$= \int \frac{1}{3\sqrt[3]{x}}\,dx$

$= \frac{1}{3}\int x^{-1/3}\,dx$

$= \frac{1}{3}\frac{x^{2/3}}{2/3}$

$= \frac{1}{2}x^{2/3} + C$

c) $\sqrt[3]{x} + \frac{1}{\sqrt[3]{x}}$

$= \int (x^{1/3} + x^{-1/3})$

$= \frac{x^{4/3}}{4/3} + \frac{x^{2/3}}{2/3}$

$= \frac{3}{4}x^{4/3} + \frac{3}{2}x^{2/3} + C$

11) a) $-\pi \sin \pi x$

$= -\pi \int \sin \pi x$

$= -\pi \dfrac{(\cos \pi x)}{\pi}$

$= \cos \pi x + c$

b) $3 \sin x$

$= -3 \cos x + c$

c) $\sin \pi x - 3 \sin 3x$

$= \int \sin \pi x - 3 \int \sin 3x$

$= \dfrac{-\cos \pi x}{\pi} + \cos 3x + c$

13) a $\sec^2 x$

$= \tan x + c$

c) $-\sec^2 \dfrac{3x}{2}$

$= \dfrac{3}{2} \int -\sec^2 \dfrac{3x}{2} \dfrac{3}{2} \, dx$

$= \dfrac{2}{3} \tan^{3/2} x + c$

b) $\dfrac{\pi}{2} \cos \dfrac{\pi}{2} x$

$= \dfrac{\pi}{2} \cos \dfrac{\pi}{2} x$

$= 2 \sin \dfrac{\pi}{2} + c$

16) a) $\sec x \tan x$

$= \sec x$

c) $\sec \dfrac{\pi}{2} x \tan \dfrac{\pi}{2} x$

$= \dfrac{2}{\pi} \sec \left(\dfrac{\pi}{2} x \right)$

b) $4 \sec 3x \tan 3x$

$= \dfrac{4}{3} \sec (3x)$

24) $\int \left(\dfrac{1}{5} - \dfrac{2}{x^3} + 2x \right) dx$

$= \int \dfrac{1}{5} - \int \dfrac{2}{x^3} + \int 2x$

$= \dfrac{x}{5} - \cancel{2} \dfrac{x^{-3+1}}{-\cancel{2}} + \dfrac{\cancel{2} x^2}{\cancel{2}}$

$= \dfrac{x}{5} + \dfrac{1}{x^2} + x^2 + c$

27) $\int \left(\sqrt{x} + \sqrt[3]{x} \right)$

$= \dfrac{x^{1/2+1}}{1/2+1} + \dfrac{x^{1/3+1}}{1/3+1}$

$= \dfrac{2}{3} x^{3/2} + \dfrac{3}{4} x^{4/3} + c$

40) $\int -\dfrac{\sec^2 x}{3} \, dx$

$= -\dfrac{1}{3} \tan x + c$

$= -\dfrac{\tan x}{3} + c$

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(5.3)

18) $\int_{1/2}^{3/2} (-2x+4)$

$= \int_{1/2}^{3/2} -2x\,dx + 4\int_{1/2}^{3/2} 1\,dx$

$= -2\int_{1/2}^{3/2} x\,dx + 4\int_{1/2}^{3/2} dx$

$= -2\left[\frac{x^2}{2}\right]_{1/2}^{3/2} + 4\left[x\right]_{1/2}^{3/2}$

$= -2\left[\frac{(3/2)^2}{2} - \frac{(1/2)^2}{2}\right] + 4\left[\frac{3}{2}-\frac{1}{2}\right]$

$= -2[4] + 4 = -4$

19) $\int_{-2}^{1} (x)\cdot dx$

$= \left[\frac{x^2}{2}\right]_{-2}^{1}$

$= \frac{1}{2} - \frac{(-2)^2}{2}$

$= \frac{1}{2} - 2 = -\frac{3}{2}$

27) $\int_{1}^{\sqrt{2}} x\,dx$

$= \left|\frac{x^2}{2}\right|_{1}^{\sqrt{2}}$

$= \frac{(\sqrt{2})^2}{2} - \frac{1}{2} = \frac{1}{2}$

33) $\int_{0}^{1/2} t^2\,dt$

$= \left|\frac{t^3}{3}\right|_{0}^{1/2}$

$= \frac{(1/2)^3}{3} - \frac{(0)}{2}$

$= \frac{1}{24}$

34) $\int_{0}^{\pi/2} \theta^2\,d\theta$

$= \left(\frac{\pi}{2}\right)^3/3$

$= \frac{\pi^3}{24}$

36) $\int_{a}^{\sqrt{3a}} x\,dx$

$= \left|\frac{x^2}{2}\right|_{a}^{\sqrt{3a}}$

$= \frac{\sqrt{3a}}{2} - \frac{(a)^2}{2}$

$= a^2$

38) $\int_{0}^{3b} x^2$

$= \left|\frac{x^3}{3}\right|_{0}^{3b}$

$= \frac{(3b)^3 - 0}{3}$

$= 9b^3$

44) $\int_{0}^{\sqrt{2}} (t - \sqrt{2})\,dt$

$= \left(\frac{t^2}{2}\right|_{0}^{\sqrt{2}} - \frac{(2)^{3/2}}{3}\int \sqrt{t}$

$= 1 - 2 = -1$

45) $\int_2^1 \left(1+\frac{2}{z}\right)dz$

$= \int_2^1 1\,dz + \frac{1}{2}\int_1^2 2$

$= 1[1-2] - \frac{1}{2}\left[\frac{x}{2} - \frac{1}{2}\right]$

$= -7/4$

50) $\int_1^0 (3x^2 + x - 5)$

$= \int_1^0 3x^2 + \int_1^0 x - \int_1 5$

$= \left[3(0) - 3\left(\frac{1}{3}\right) + \frac{0}{2} - \frac{(1)^2}{2} - 5(0-1)\right]$

$= \left(-\frac{3}{2} - 5\right) = \frac{7}{2}$

5.4

4) $\int_{-2}^2 (x^3 - 2x + 3)dx$

$= \int_{-2}^2 x^3 - \int_{-2}^2 2x + \int_{-2}^2 3$

$= \left|\frac{x^4}{4}\right|_{-2}^2 - 2\left|\frac{x^2}{2}\right|_{-2}^2 + 3|x|_{-2}^2$

$= \left(\frac{(2)^4}{4} - 2^2 + (3)(2)\right) - \left(\frac{(-2)^4}{4} - (-2)^2 + 3(-2)\right)$

$= 12$

7) $\int_1^{32} x^{-6/5}$

$= \left[-5x^{-1/5}\right]_1^{32}$

$= \left(\frac{-5}{2}\right) - (-5)$

$= 5/2$

9) $\int_0^\pi \sin x\,dx$

$= \left[-\cos x\right]_0^\pi$

$= (-\cos\pi) - (\cos 0)$

$= -(-1) - (-1)$

$= 2$

22) $\int_{1/2}^1 \left(\frac{1}{v^3} - \frac{1}{v^4}\right)dv$

$= \int_{1/2}^1 (v^{-3} - v^{-4})dv$

$= \left(\frac{-1}{2v^2} + \frac{1}{3v^3}\right]_{1/2}^1 = \left(\frac{-1}{2(1)^2} + \frac{1}{3(1)^3}\right)$

$- \left[\frac{-1}{2(1/2)^2} + \frac{1}{3(1/2)^3}\right] = -5/6$

38) $\int_1^2 3x^2 - 3 = 0$

$\text{Area} = 2\left(-\int_0^1 (3x^2-3)dx + \int_1^2 (3x^2-3)dx\right)$

$= 2\left(-|x^3 - 3x|_0^1 + |x^3 - 3x|_1^2\right)$

$= 2\left[-(1-3) - (0-0) + (2)^3 - 3(2) - (1-3)\right]$

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$= 2(6)$

$= 12$

12) $y = x^{1/3} - x$

$$\text{Area} = -\int_{1}^{0} (x^{1/3} - x)\,dx + \int_0^1 (x^{1/3} - x)\,dx - \int_1^8 (x^{1/3} - x)\,dx$$

$$= \left[\frac{3}{4}x^{4/3} - \frac{x^2}{2}\right]_{-1}^{0} + \left[\frac{3}{4}x^{4/3} - \frac{x^2}{2}\right]_0^1 - \left[\frac{3}{4}x^{4/3} - \frac{x^2}{2}\right]_1^8$$

$$= \left\{\left(\frac{3}{4} - 0\right) - \left(\frac{3}{4}(-1)^{4/3} - \left(-\frac{1}{2}\right)^2\right)\right\} + \left[\left(\frac{3}{4}(1)^{4/3} - \left(\frac{1}{2}\right)^2\right) - \frac{3}{4}(0) - \frac{0}{2}\right)\right]$$

$$- \left[\left(\frac{3}{4}(8)^{4/3} - \frac{8^2}{2}\right) - \left(\frac{3}{4}(1)^{4/3} - \left(\frac{1}{2}\right)^2\right)\right]$$

$$= \frac{83}{4}$$