Faculty of Engineering
Mechanical Engineering Department

CALCULUS FOR ENGINEERS
MATH 1110

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Integral Calculus

3. Evaluate $\int 12t^7 - t^2 - t + 3\,dt$.

$$\int 12t^7 - t^2 - t + 3\,dt = \boxed{\tfrac{3}{2}t^8 - \tfrac{1}{3}t^3 - \tfrac{1}{2}t^2 + 3t + c}$$

4. Evaluate $\int 10w^4 + 9w^3 + 7w\ dw$.

$$\int 10w^4 + 9w^3 + 7w\ dw = \boxed{2w^5 + \tfrac{9}{4}w^4 + \tfrac{7}{2}w^2 + c}$$

5. Evaluate $\int z^6 + 4z^4 - z^2\,dz$.

$$\int z^6 + 4z^4 - z^2\,dz = \boxed{\tfrac{1}{7}z^7 + \tfrac{4}{5}z^5 - \tfrac{1}{3}z^3 + c}$$

6. Determine $f(x)$ given that $f'(x) = 6x^8 - 20x^4 + x^2 + 9$.

$$f(x) = \int f'(x)\,dx = \int 6x^8 - 20x^4 + x^2 + 9\,dx = \boxed{\tfrac{2}{3}x^9 - 4x^5 + \tfrac{1}{3}x^3 + 9x + c}$$

Evaluate $\int \sqrt[3]{w} + 10\sqrt[5]{w^3}\,dw$.

$$\int \sqrt[3]{w} + 10\sqrt[5]{w^3}\,dw = \int w^{\frac{1}{3}} + 10\left(w^3\right)^{\frac{1}{5}}\,dw = \int w^{\frac{1}{3}} + 10w^{\frac{3}{5}}\,dw$$

$$\int \sqrt[3]{w} + 10\sqrt[5]{w^3}\,dw = \int w^{\frac{1}{3}} + 10w^{\frac{3}{5}}\,dw = \tfrac{3}{4}w^{\frac{4}{3}} + 10\left(\tfrac{5}{8}\right)w^{\frac{8}{5}} + c = \boxed{\tfrac{3}{4}w^{\frac{4}{3}} + \tfrac{25}{4}w^{\frac{8}{5}} + c}$$

8. Evaluate $\int \frac{4}{x^2}+2-\frac{1}{8x^3}\,dx$.

$$\int \frac{4}{x^2}+2-\frac{1}{8x^3}\,dx = \int 4x^{-2}+2-\frac{1}{8}x^{-3}\,dx$$

$$\int \frac{4}{x^2}+2-\frac{1}{8x^3}\,dx = \int 4x^{-2}+2-\frac{1}{8}x^{-3}\,dx$$

$$= 4\left(\frac{1}{-1}\right)x^{-1}+2x-\frac{1}{8}\left(\frac{1}{-2}\right)x^{-2}+c = \boxed{-4x^{-1}+2x+\frac{1}{16}x^{-2}+c}$$

9. Evaluate $\int \frac{7}{3y^6}+\frac{1}{y^{10}}-\frac{2}{\sqrt[3]{y^4}}\,dy$.

$$\int \frac{7}{3y^6}+\frac{1}{y^{10}}-\frac{2}{\sqrt[3]{y^4}}\,dy=\int \frac{7}{3y^6}+\frac{1}{y^{10}}-\frac{2}{y^{\frac{4}{3}}}\,dy=\int \frac{7}{3}y^{-6}+y^{-10}-2y^{-\frac{4}{3}}\,dy$$

$$\int \frac{7}{3y^6}+\frac{1}{y^{10}}-\frac{2}{\sqrt[3]{y^4}}\,dy=\int \frac{7}{3}y^{-6}+y^{-10}-2y^{-\frac{4}{3}}\,dy$$

$$=\frac{7}{3}\left(\frac{1}{-5}\right)y^{-5}+\left(\frac{1}{-9}\right)y^{-9}-2\left(-\frac{3}{1}\right)y^{-\frac{1}{3}}+c$$

$$=\boxed{-\frac{7}{15}y^{-5}-\frac{1}{9}y^{-9}+6y^{-\frac{1}{3}}+c}$$

10. Evaluate $\int \left(t^2 - 1\right)\left(4 + 3t\right) dt$.

$$\int \left(t^2 - 1\right)\left(4 + 3t\right) dt = \int 3t^3 + 4t^2 - 3t - 4\, dt$$

$$\int \left(t^2 - 1\right)\left(4 + 3t\right) dt = \int 3t^3 + 4t^2 - 3t - 4\, dt = \boxed{\tfrac{3}{4}t^4 + \tfrac{4}{3}t^3 - \tfrac{3}{2}t^2 - 4t + c}$$

Common Integrals.

$f(x)$	$F(x)=\int f(x)dx$	Integral Number
$af(x)$	$aF(x)$	I-1
$u(x)+v(x)$	$\int u(x)dx+\int v(x)dx$	I-2
a	ax	I-3
$x^n \quad (n \neq -1)$	$\frac{x^{n+1}}{n+1}$	I-4
e^{ax}	$\frac{e^{ax}}{a}$	I-5
$\frac{1}{x}$	$\ln x$	I-6
$\sin ax$	$-\frac{1}{a}\cos ax$	I-7
$\cos ax$	$\frac{1}{a}\sin ax$	I-8
$\sin^2 ax$	$\frac{1}{2}x-\frac{1}{4a}\sin 2ax$	I-9

Continuation.

$\cos^2 ax$	$\frac{1}{2}x + \frac{1}{4a}\sin 2ax$	I-10
$x \sin ax$	$\frac{1}{a^2}\sin ax - \frac{x}{a}\cos ax$	I-11
$x \cos ax$	$\frac{1}{a^2}\cos ax + \frac{x}{a}\sin ax$	I-12
$\sin ax \cos ax$	$\frac{1}{2a}\sin^2 ax$	I-13
$\sin ax \cos bx$ for $a^2 \neq b^2$	$-\frac{\cos(a-b)x}{2(a-b)} - \frac{\cos(a+b)x}{2(a+b)}$	I-14
xe^{ax}	$\frac{e^{ax}}{a^2}(ax-1)$	I-15
$\ln x$	$x(\ln x - 1)$	I-16
$\frac{1}{ax^2+b}$	$\frac{1}{\sqrt{ab}}\tan^{-1}\left(x\sqrt{\frac{a}{b}}\right)$	I-17