22/5/2020

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Assignment 12.

Integrate the following functions.

① $2x^2 \ln x$ ② $3te^{2t}$ ③ $x^2 \sin x$ ④ $\cos 5x \cos 6x$
⑤ $\sin 7x \cos 2x$

solution.

① $\int 2x^2 \ln x$

$u = \ln x \qquad dv = 2x^2$

$du = \frac{1}{x}dx \qquad v = \frac{2x^3}{3}$

$\int u\,dv = uv - \int v\,du$

$\int 2x^2 \ln x = \ln x \cdot \frac{2x^3}{3} - \int \frac{2x^3}{3} \cdot \frac{1}{x}dx$

$\int 2x^2 \ln x = \frac{2x^3}{3}\ln x - \int \frac{2x^3}{3}dx$

$\int 2x^2 \ln x = 2x^3 \ln x - \frac{2x^3}{9}$

$\int 2x^2 \ln x = \frac{2}{3}x^3(\ln x - \frac{1}{3}) + c$

② $\int 3te^{2t}$

$u = 3t \qquad du = 3dt$

$dv = e^{2t}, \quad v = e^{2t}/t$

$\int 3te^{2t} = 3t \cdot e^{2t} - \int e^{2t} \cdot 3dt$

$\int 3te^{2t} = e^{2t}/2\ 3t - \int e^{2t}/2\ 3dt$

$\int 3te^{2t} = \frac{3e^{2t}}{2} - \frac{3e^{2t}}{4} + c$

③ $\int x^2 \sin x \, dx$

$u = x^2 \qquad dv = \sin x$

$du/dx = 2x \qquad v = -\cos x$

$\int u\,dv = uv - \int v\,du$

$= x^2(-\cos x) - \int -2x\cos x \, dx$

$= -x^2\cos x + 2x\sin x + c$

④ $\int \cos 5x \cos 6x \, dx$

$A = 5x, \quad B = 6x$

$\cos A \cos B = \frac{1}{2}[\cos(A+B) + \cos(A-B)]$

$= \frac{1}{2}[\cos(11x) + \cos(-1x)]$

$\int \cos 5x \cos 6x \, dx = \frac{1}{2}\int (\cos 11x + \cos(-1x)$

$= \frac{1}{2}\left[\frac{\sin 11x}{11} + \frac{\sin(-1x)}{-1}\right]$

$= \frac{\sin 11x}{22} - \frac{\sin x}{-2} + c$

⑤ $\int \sin 7x \cos 2x$

$A = 7x, \quad B = 2x$

$\sin A \cos B = \frac{1}{2}[\sin(A+B) + \sin(A-B)]$

$= \frac{1}{2}[\sin 9x + \sin 5x]$

$\int \sin 7x \cos 2x \, dx = \frac{1}{2}\int (\sin 9x + \sin 5x)$

$= \frac{1}{2}\left[\frac{\sin 9x}{9} + \frac{\sin 5x}{5}\right]$

$= \frac{\sin 9x}{18} + \frac{\sin 5x}{10}$