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COLLEGE: MEDICAL AND HEALTH SCIENCES

DEPARTMENT: MEDICINE AND SURGERY

MATRIC NUMBER: 19/MHS01/166

COURSE: MAT 104

MATHS 104 ASSIGNMENT

1) Integrate the following

$$\int 2x^2 \ln x$$

Integrating by parts

$$\text{let } u = \ln x \text{ and } dv = 2x^2 \therefore \frac{du}{dx} = \frac{1}{x} \text{ and } v = \frac{x^3}{3}$$

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

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

$$= 2 \left(\frac{x^3 \ln x}{3} - \int \frac{x^2}{3} dx \right)$$

$$= 2 \left(\frac{x^3 \ln x}{3} - \frac{1}{3} \int x^2 dx \right)$$

$$= 2 \left(\frac{x^3 \ln x}{3} - \frac{1}{3} \cdot \frac{x^3}{3} \right) dx = 2 \left(\frac{x^3 \ln x}{3} - \frac{x^3}{9} \right) dx$$

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

$$= \frac{3 \times 2x^3 \ln x - 2x^3}{9} dx = \frac{2x^3 (3 \ln x - 1)}{9} + C$$

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

$$\therefore \int 2x^2 \ln x = \frac{2x^3 \ln x - 1}{3} + C$$

2 $\int 3t e^{2t}$

Integrating by parts:

$$\text{let } u = 3t; \quad dv = e^{2t}; \quad \frac{du}{dt} = 3; \quad v = \int e^{2t} = \frac{1}{2} e^{2t}$$

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

$$= \int 3t e^{2t} = 3t \cdot \frac{1}{2} e^{2t} - \int \frac{1}{2} e^{2t} \cdot 3 dt$$

$$= \int 3t e^{2t} = \left(\frac{3t e^{2t}}{2} - \frac{3}{4} e^{2t} \right) dt$$

$$\therefore \int 3t e^{2t} = \frac{3t e^{2t}}{2} - \frac{3}{4} e^{2t} + C$$

3

$$\int x^2 \sin x$$

Integrating by parts:

$$\text{let } u = x^2, \quad dv = \sin x, \quad dx = 2x \, dx, \quad v = -\cos x$$

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

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

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

Use integration by parts to solve the underlined area

$$\text{let } u = x, \quad dv = \cos x, \quad du = dx, \quad v = \sin x$$

$$\int x^2 \sin x \, dx = [-x^2 \cos x + 2 \int x \cos x] \, dx$$

$$\int x^2 \sin x \, dx = [-x^2 \cos x + 2(x \sin x)] \, dx$$

$$\int x^2 \sin x \, dx = -x^2 \cos x + 2x \sin x + C$$

$$\therefore \int x^2 \sin x \, dx = -x^2 \cos x + 2x \sin x + C$$

4

$$\int \cos 5x \cos 6x$$

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

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

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

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

$$= \frac{1}{2} [\cos 11x - \cos x] \, dx$$

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

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

$$\therefore \int \cos 5x \cos 6x = \frac{-\sin 11x}{22} + \frac{\sin x}{2} + C$$

$$\int \sin 7x \cos 2x \quad ; \quad \text{let } A = 7x, \quad B = 2x$$

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

$$= \frac{1}{2} [\sin(7x+2x) + \sin(7x-2x)] \, dx$$

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

$$= \frac{1}{2} \int -\cos 9x + (-\cos 5x) \, dx = \frac{1}{2} \left[\frac{-\cos 9x}{9} - \frac{\cos 5x}{5} \right] + C$$

$$\therefore \int \sin 7x \cos 2x = \frac{-\cos 9x}{18} - \frac{\cos 5x}{10} + C$$