Submit your solutions to the following problems in lecture on the due date above. Present your work in a clean and organized fashion, either on a printed copy of this document (preferred) or a separate sheet of paper. As stated in the syllabus, late submissions will **not** be accepted.

1. Evaluate the following integrals.

(a) $\int x^2 e^{5x}\, dx$

$u = x^2 \qquad v = \frac{1}{5} e^{5x}$

$du = 2x\,dx \qquad dv = e^{5x} dx$

$= \frac{1}{5} x^2 e^{5x} - \int \frac{2}{5} x e^{5x} dx \qquad = \frac{1}{5} x^2 e^{5x}$

$u = x \qquad v = \frac{1}{5} e^{5x}$

$du = dx \qquad dv = e^{5x} dx$

$- \frac{2}{5}\left(\frac{1}{5} x e^{5x} - \int \frac{1}{5} e^{5x} dx \right)$

$\boxed{= \frac{1}{5} x^2 e^{5x} - \frac{2}{5}\left(\frac{1}{5} x e^{5x} - \frac{1}{25} e^{5x} \right) + C}$

(b) $\int x^2 \ln(x^3)\, dx$

$u = \ln(x^3) \qquad v = \frac{1}{3} x^3 \qquad = \frac{1}{3} x^3 \ln(x^3) - \int x^2 dx = \boxed{\frac{1}{3} x^3 \ln(x^3) - \frac{1}{3} x^3 + C}$

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

$= (3/x)\,dx$

U-sub with $u = x^3$ also works here

(c) $\int e^{2x} \cos(e^{2x})\, dx \qquad = \int \frac{1}{2} \cos(u)\, du = \frac{1}{2} \sin(u) + C$

let $u = e^{2x}$

$\frac{du}{dx} = 2e^{2x}$

$\frac{1}{2} du = e^{2x} dx$

$\qquad = \boxed{\frac{1}{2} \sin(e^{2x}) + C}$

(d) $\int \frac{x^2 - 3}{(x^2 - 1)(x + 1)}\, dx = \int \frac{x^2 - 3}{(x+1)^2 (x-1)}\, dx = \int \left(\frac{A}{x+1} + \frac{B}{(x+1)^2} + \frac{C}{x-1} \right) dx$

$x^2 - 3 = A(x+1)(x-1) + B(x-1) + C(x+1)^2$

$x = 1: \quad -2 = 0 + 0 + 4C \quad \Rightarrow C = -\frac{1}{2}$

$x = -1: \quad -2 = 0 + (-2)B + 0 \quad \Rightarrow B = 1$

$x^2 - 3 = A(x+1)(x-1) + (x-1) - \frac{1}{2}(x+1)^2$

$x = 0: \quad -3 = -A - 1 - \frac{1}{2} \quad \Rightarrow A = \boxed{\frac{3}{2}}$

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

$\boxed{= \frac{3}{2} \ln|x+1| - \frac{1}{x+1} \cdot - \frac{1}{2} \ln|x-1| + C}$