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MAT B42 Practice Exam Winter 2025

Q1. (10 points) Calculate the fourier series of $f(x) = \cos(x)\sin(x) + \cos^4(x)$.

Write your final answer in the format $F(x) = a_0 + \sum_{k=1}^{\infty} a_k \cos(kx) + \sum_{k=1}^{\infty} b_k \sin(kx)$.

Fourier!

We re-write $f(x)$ in the format of $F(x)$.

$$f(x) = \cos(x)\sin(x) + \cos^4(x)$$

$$= \frac{1}{2}\sin(2x) + \cos^4(x) \quad \# \cos(x)\sin(x) = \frac{1}{2}\sin(2x)$$

$$= \frac{1}{2}\sin(2x) + \left(\frac{1+\cos(2x)}{2}\right)^2 \quad \# \cos^2(x) = \frac{1+\cos(2x)}{2}$$