

Theoretical Physics
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Chapter O Homework. Fourier Series

HW-O1. Orthogonality of the Sine Functions.

(a) Show that

$$\int_{-\pi}^{+\pi} \sin(nx) \sin(mx) dx = \pi \delta_{nm}$$
$$\int_{-\pi}^{+\pi} \cos(nx) \sin(mx) dx = 0.$$

Hint: Use the backward Euler formulas for the cosine and sine so that you first express your sine functions as a combination of exponentials. Then see what we did in class for the similar cosine-cosine case.

(b) Then use your above result to show that

$$b_n = \frac{1}{\pi} \int_{-\pi}^{+\pi} f(x) \sin(nx) dx,$$

where

$$f(x) = A_0 + \sum_{m=1}^{\infty} [a_m \cos(mx) + b_m \sin(mx)].$$

HW-O2. The Ramp or Sawtooth Waveform. Find the Fourier amplitudes for the ramp wave which has an amplitude of 1 as shown in the figure below. Write out the first 5 terms.

