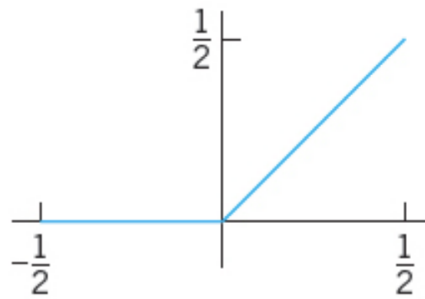**Problem 1.** Find the Fourier series of the function x^2 which is assumed to be periodic outside with period 2π when $-\pi < x < \pi$.

Problem 2. Find the Fourier series of the periodic function $f(x)$, such that

$$f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$$

Problem 3. Calculate the Fourier series of period $p = 1$ of the function below

Problem 4. Find a general solution of the ODE

$$y'' + \omega^2 y = \sin(\alpha t) + \sin(\beta t)$$

with $\omega^2 \neq \alpha^2, \beta^2$.

Problem 5. Find the eigenvalues and eigenfunctions of

$$\left(\frac{y'}{x}\right)' + (\lambda + 1)\frac{y}{x^3} = 0 \quad y(1) = 0, \quad y(e^\pi) = 0$$

The following strategy is suggested:

- Do the change of variable $x = e^t$.

- Find the general solution without considering boundary constraints.

- Apply the boundary conditions to find the eigenvalues and eigenfunctions of the ODE.