535.641 Mathematical Methods Assignment 8 (Problems 32–34)

G. Nakos

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32. Check to see if the following set of functions is orthogonal on the interval $[0, 3]$ with respect to the integral inner product. Show all work. Recall that a set of functions is orthogonal if all pairs of functions are orthogonal.

$$\left\{\cos\left(\frac{\pi x}{3}\right), \sin\left(\frac{\pi x}{3}\right), 1\right\}$$

33.

(a) Solve the 1-dimensional wave equation problem

$$\begin{aligned}
\frac{\partial^2 u}{\partial t^2} &= 4\frac{\partial^2 u}{\partial x^2} \\
u(0,t) &= u(3,t) = 0, \text{ for } t > 0 \\
u(x,0) &= f(x) = -3\sin(2\pi x) + 5\sin\left(\frac{8\pi x}{3}\right), \quad \text{for } 0 \le x \le 3 \\
\left.\frac{\partial u}{\partial t}\right|_{t=0} &= g(x) = 0, \quad \text{for } 0 \le x \le 3
\end{aligned}$$

and **(b)** find the displacement at location 2 and at time $t = 1$.

34.

Solve the 1-dimensional wave equation problem with $c = 1$, $L = 2$, initial velocity zero and initial displacement

$$f(x) = \begin{cases} x & \text{if } 0 \leq x \leq 1 \\ 2 - x & \text{if } 1 \leq x \leq 2 \end{cases}$$