Fourier Analysis and Wavelets
Homework 2

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Problem 5

Solution:

Problem 7

Solution:

Problem 12

Solution:

```
restart;
h := (d, t) -> piecewise(t < 0, 0, t <= d, 1/d, 0)
```

$$(d, t) \to piecewise\left(t < 0, 0, t \le d, \frac{1}{d}, 0\right) \tag{1}$$

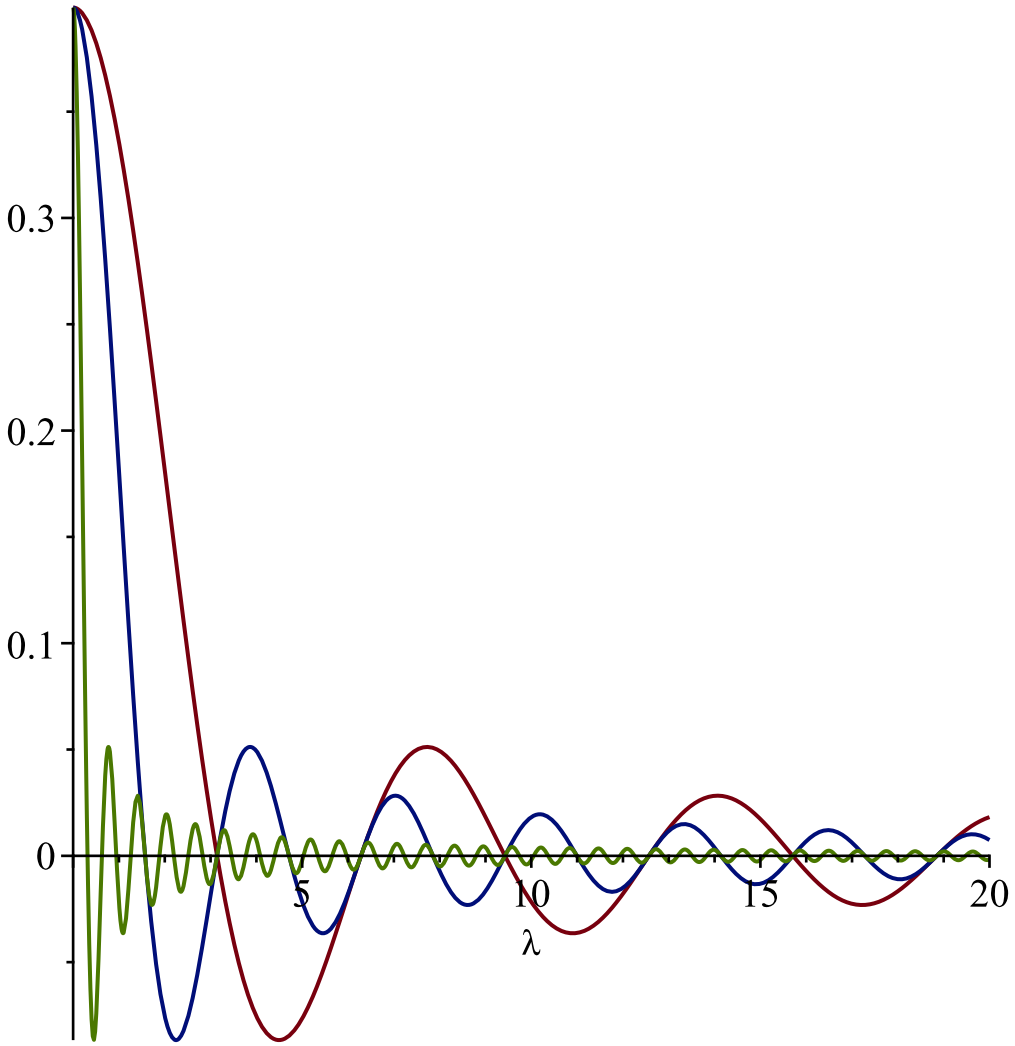
```
h(d, t)
```

$$\begin{cases} 0 & t < 0 \\ \frac{1}{d} & t \le d \\ 0 & otherwise \end{cases} \tag{2}$$

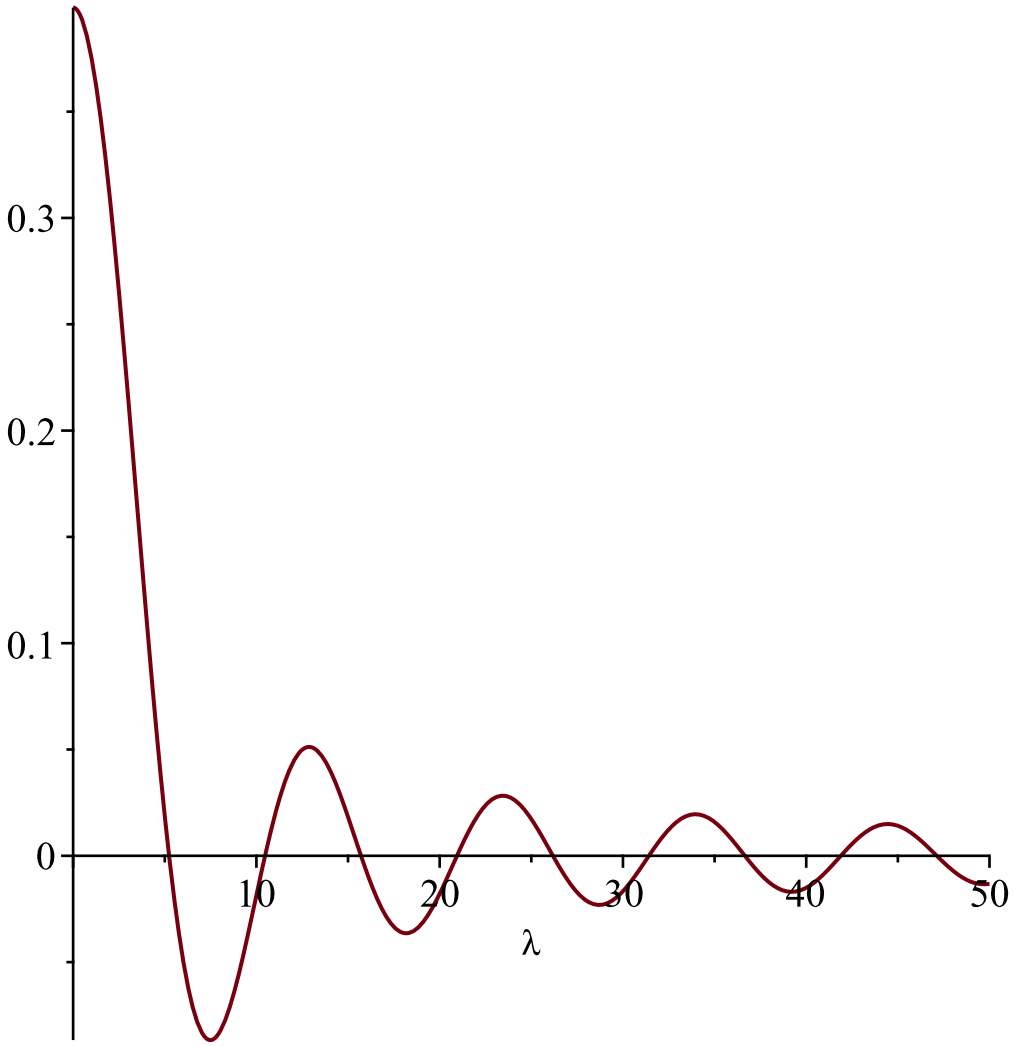
```
hhat := (d, lambda) -> 1/sqrt(2*Pi)*int(h(d, t)*exp(-I*lambda*t), t = -infinity..infinity)
```

$$(d, \lambda) \to \frac{\int_{-\infty}^{\infty} h(d, t)\, e^{-I\lambda t}\, dt}{\sqrt{2\,\pi}} \tag{3}$$

```
plot({Re(hhat(1, lambda)), Re(hhat(2, lambda)), Re(hhat(10, lambda))}, lambda = 0..20)
```



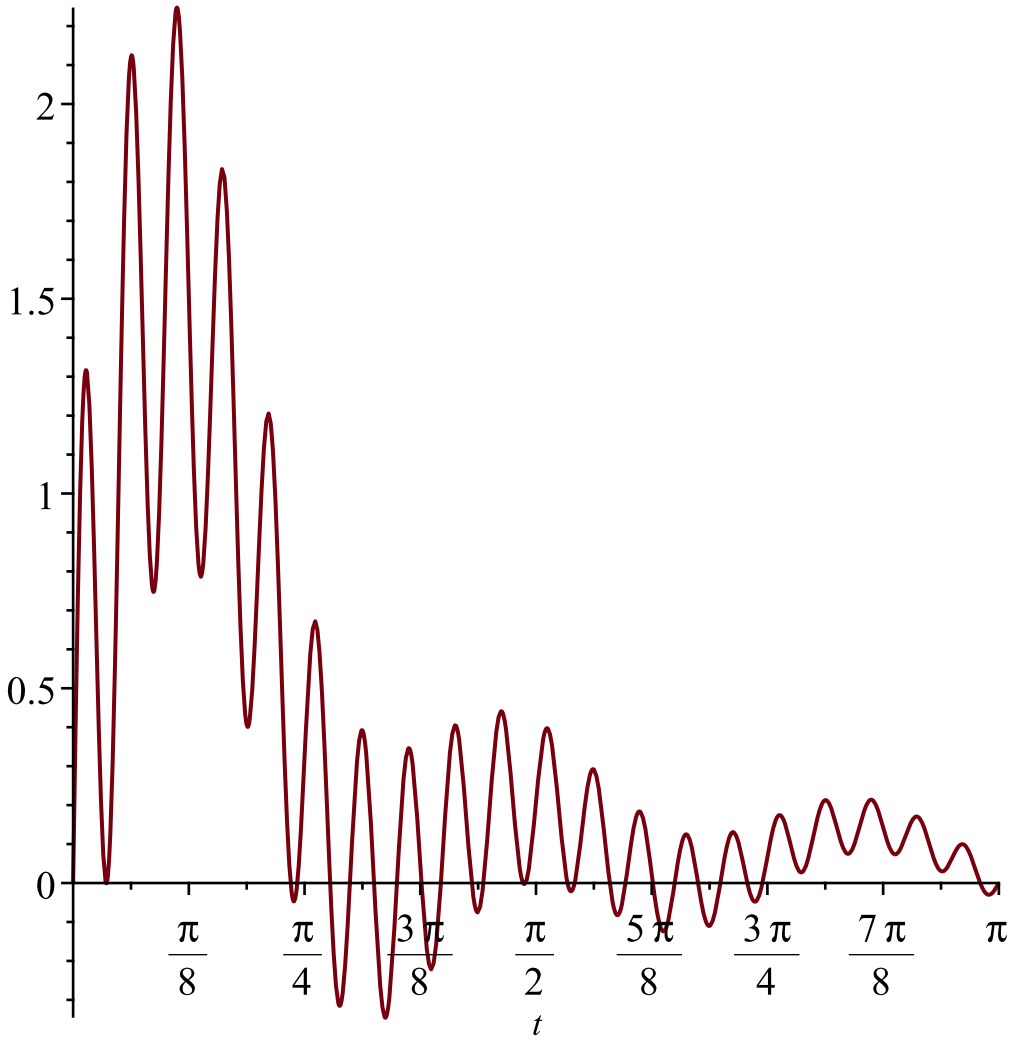
$d := 0.6$:
$plot(\mathrm{Re}(hhat(d, \mathrm{lambda})), \mathrm{lambda} = 0..50)$



$f := t \to \exp(-t) \cdot (\sin(5 \cdot t) + \sin(3 \cdot t) + \sin(t) + \sin(40 \cdot t))$

$$t \to e^{-t} (\sin(5\,t) + \sin(3\,t) + \sin(t) + \sin(40\,t)) \quad \textbf{(4)}$$

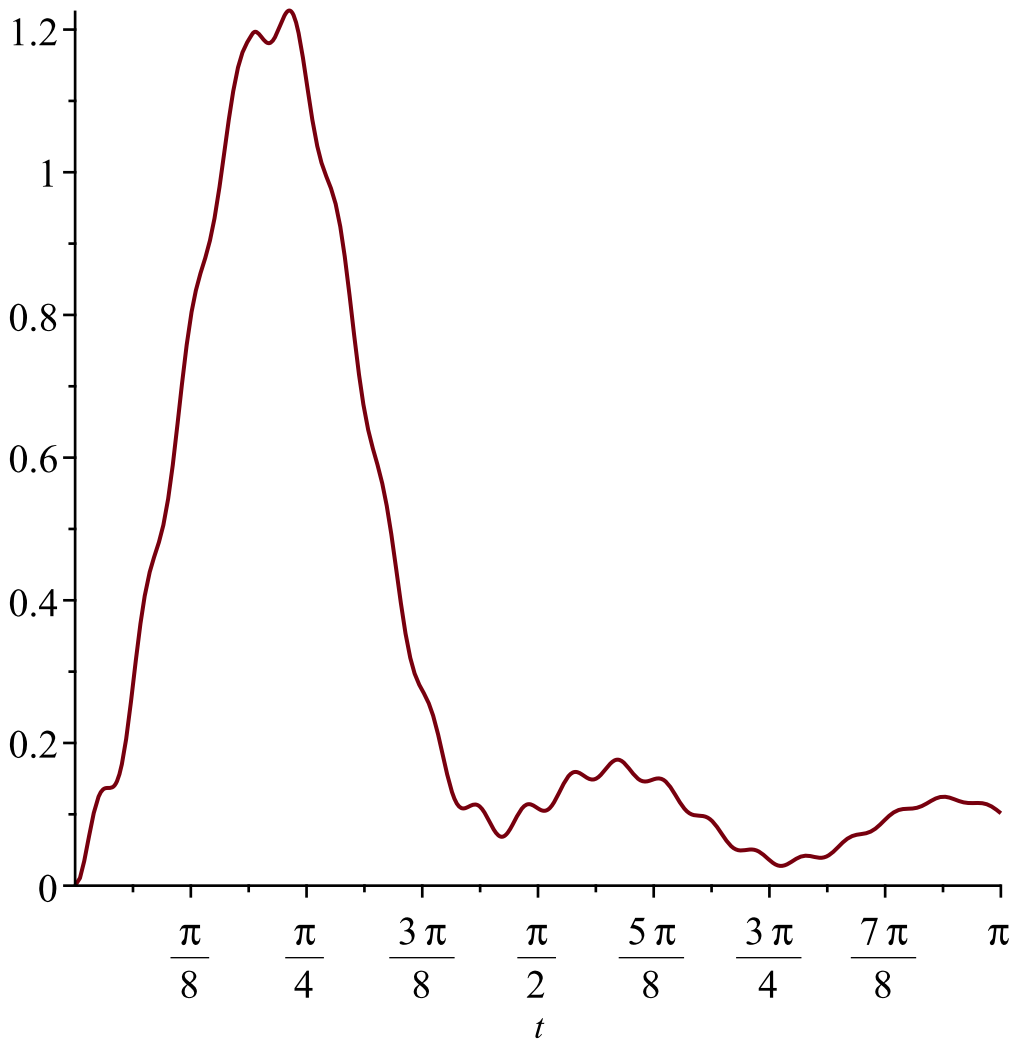
$plot(f(t), t = 0..\mathrm{Pi})$



$ff := t \to int(f(x) \cdot h(d, t-x), x = 0..\mathrm{Pi})$

$$t \to \int_0^{\pi} f(x)\, h(d, t-x)\, \mathrm{d}x \qquad \textbf{(5)}$$

$plot(ff(t), t = 0..\mathrm{Pi})$


1.2
1
0.8
0.6
0.4
0.2
0
π/8
π/4
3π/8
π/2
5π/8
3π/4
7π/8
π
t