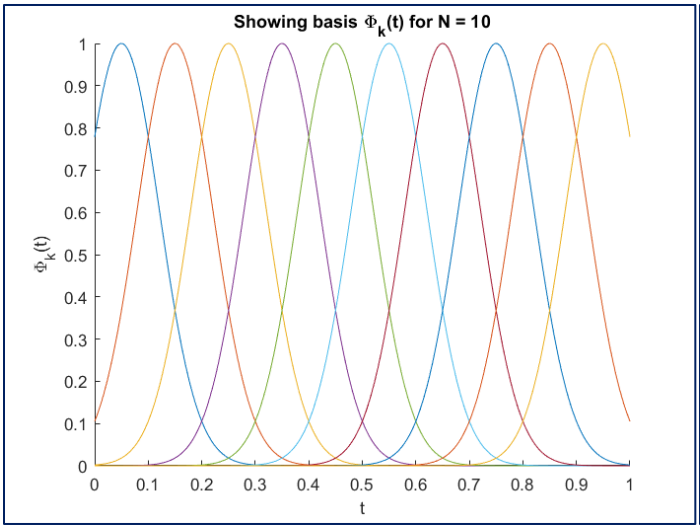
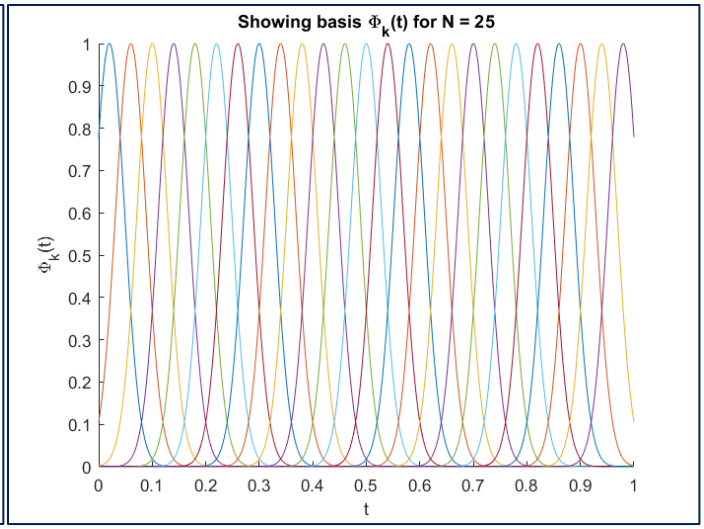
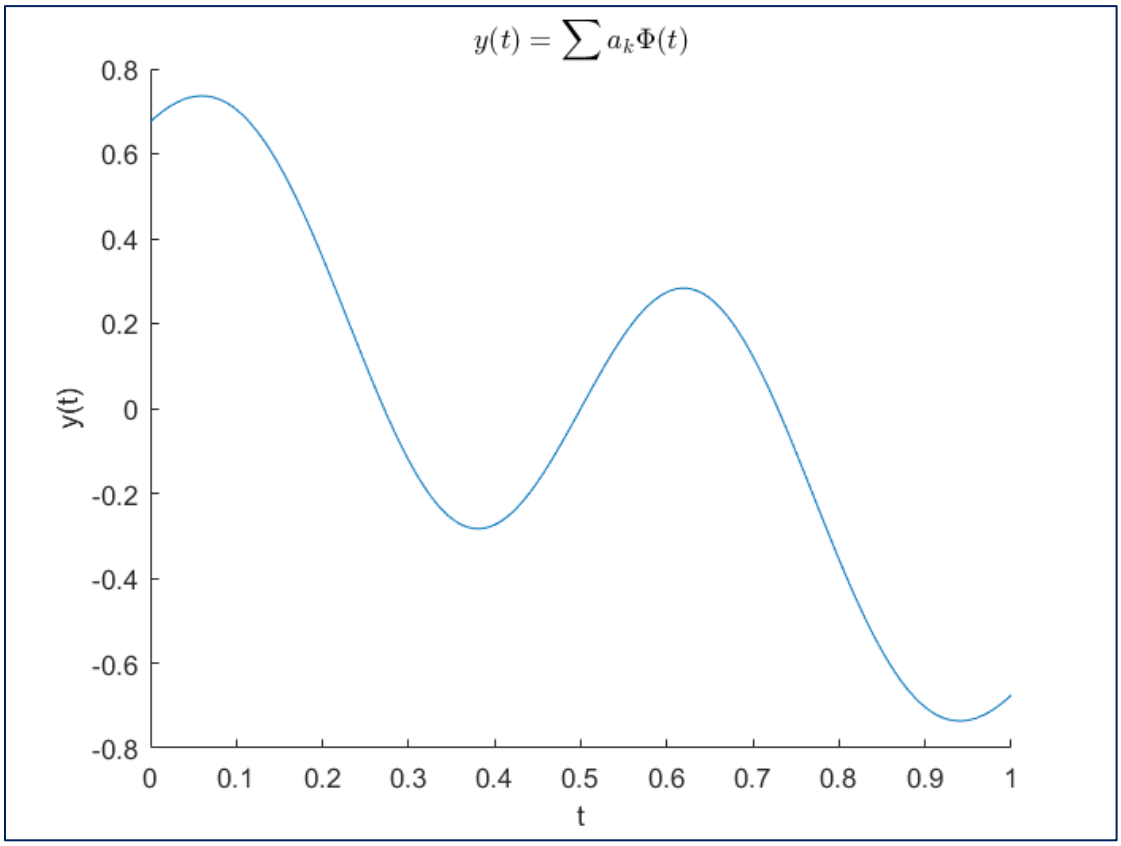
Q3.5.1

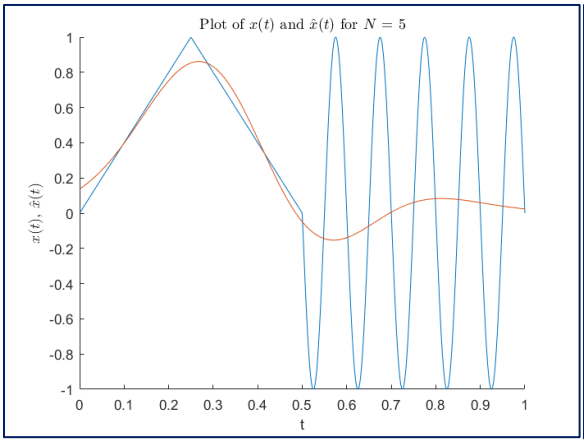

Showing basis $\Phi_k(t)$ for N = 10
$\Phi_k(t)$
t

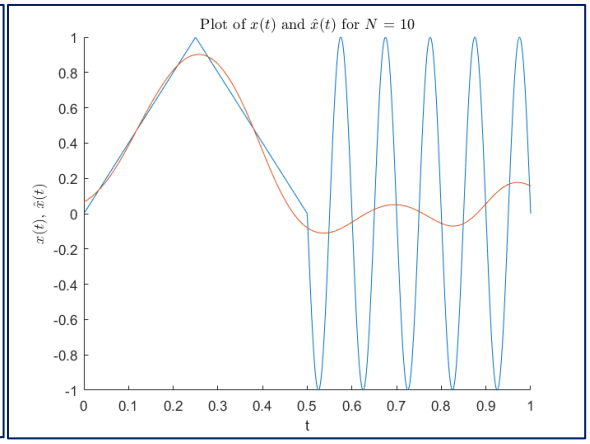

Showing basis $\Phi_k(t)$ for N = 25
$\Phi_k(t)$
t

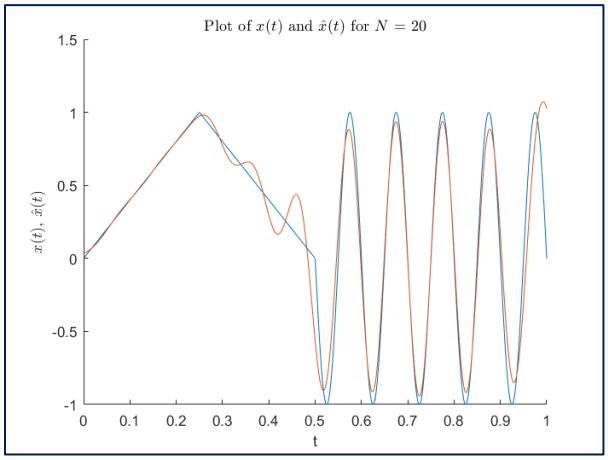
Q 3.5.2

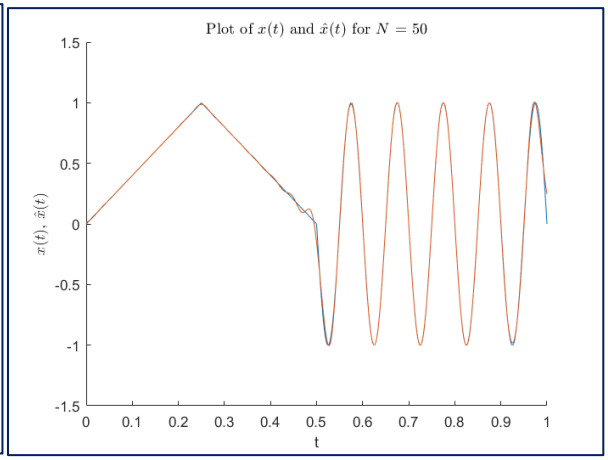

$y(t) = \sum a_k \Phi(t)$
y(t)
t

Q 3.5.3



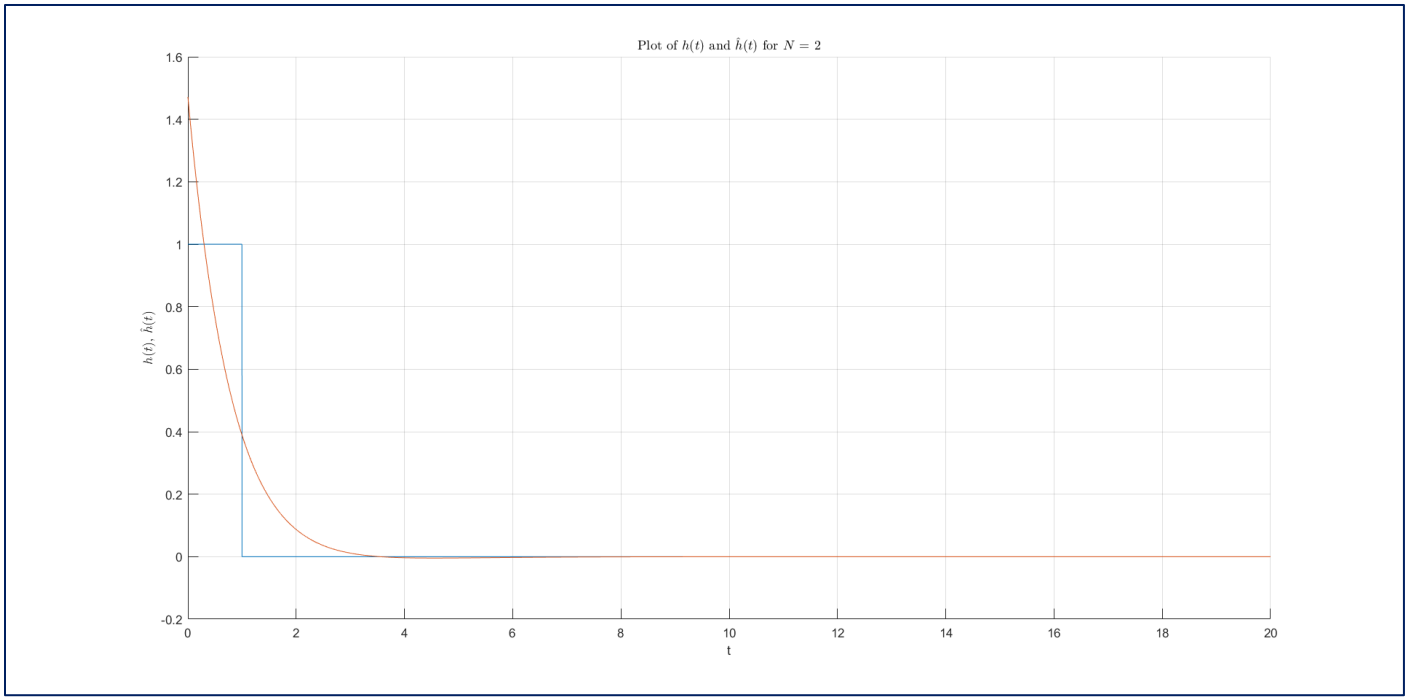


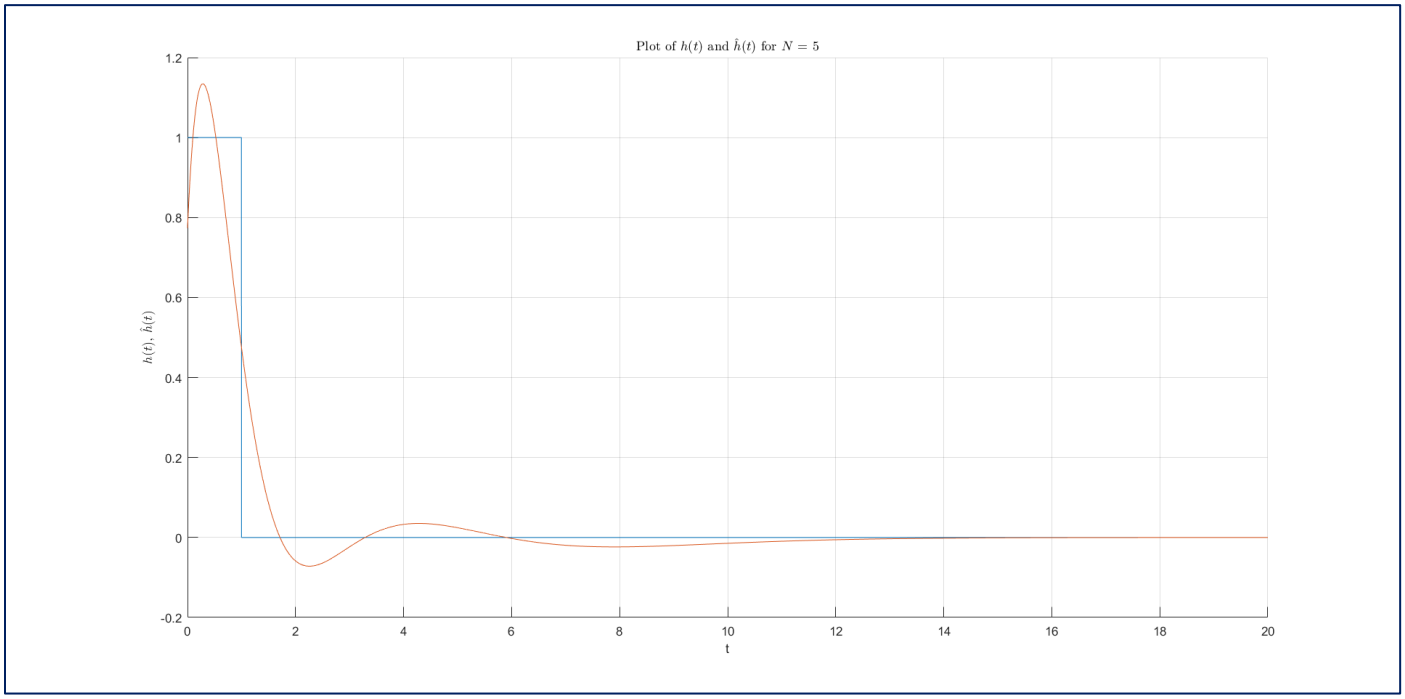


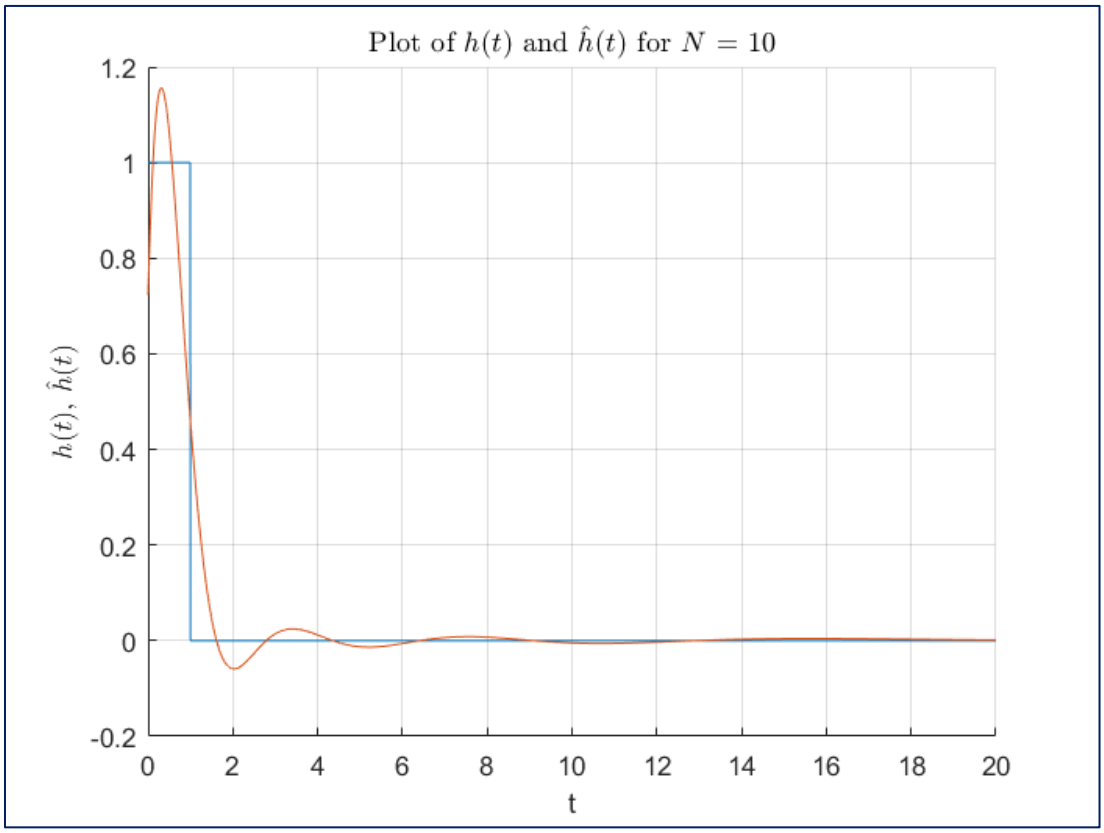



```
clear;
phi = @(z) exp(-z.^2);
x = @(z) (z < 1/4).*(4*z) + (z>=1/4).*(z<1/2).*(-4*z+2) - (z>=1/2).*sin(20*pi*z);
t = linspace(0, 1, 1000);
N = 50;


x_phik = @(z, ii) x(z).*phi(N*z - ii + 1/2);
phik_phik = @(z, ii, jj) phi(N*z - ii + 1/2).*phi(N*z - jj + 1/2);

G = -1*ones(N, N);
b = -1*zeros(N, 1);
a = -1*zeros(N, 1);

for ii = 1:N

    b(ii) = integral(@(z) x_phik(z, ii), 0, 1);

    for jj = 1:N
        G(ii, jj) = integral(@(z) phik_phik(z, ii, jj), 0, 1);
    end
end

a = pinv(G)*b;
x_cap = zeros(size(t));
for ii = 1:N
    x_cap = x_cap + (a(ii).*phi(N*t - ii + 1/2));
end

figure; hold on;
plot(t, x(t));
plot(t, x_cap);
txt = ['Plot of $$x(t)$$ and $$\hat{x}(t)$$ for $$N$$ = ' int2str(N)];
title(txt,'Interpreter','latex')
y_txt = '$$x(t)$$, $$\hat{x}(t)$$';
ylabel(y_txt, 'Interpreter','latex')
xlabel('t');
```

Q 3.6


Plot of $h(t)$ and $\tilde{h}(t)$ for $N = 2$
$h(t), \tilde{h}(t)$
t
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
2
4
6
8
10
12
14
16
18
20


Plot of $h(t)$ and $\tilde{h}(t)$ for $N = 5$
$h(t), \tilde{h}(t)$
t
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
2
4
6
8
10
12
14
16
18
20




```
clear;

phi_k = @(z, k) (z>=0).*z.^(k-1).*exp(-z);
h = @(z) (z >= 0).*1.*(z<1);
t = linspace(0, 20, 200000);
N = 5;


x_phik = @(z, ii) h(z).*phi_k(z, ii);
phik_phik = @(z, ii, jj) phi_k(z, ii).*phi_k(z, jj);

G = -1*ones(N, N);
b = -1*zeros(N, 1);
a = -1*zeros(N, 1);

for ii = 1:N

    b(ii) = integral(@(z) x_phik(z, ii), 0, inf);

    for jj = 1:N
        G(ii, jj) = integral(@(z) phik_phik(z, ii, jj), 0, inf);
    end
end

a = pinv(G)*b;
h_cap = zeros(size(t));
for ii = 1:N
    h_cap = h_cap + (a(ii).*phi_k(t, ii));
end

figure; hold on;
plot(t, h(t));
plot(t, h_cap);
txt = ['Plot of $$h(t)$$ and $$\hat{h}(t)$$ for $$N$$ = ' int2str(N)];
title(txt,'Interpreter','latex')
y_txt = '$$h(t)$$, $$\hat{h}(t)$$';
ylabel(y_txt, 'Interpreter','latex')
xlabel('t');
xlim([0 20]);
grid on;
```