دانشکده مهندسی مکانیک

دانشگاه صنعتی امیرکبیر

درس LES

تمرین سری ۴ (HM4)

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Question 1 :

k	$Re(\hat{f}_k)$	$Im(\hat{f}_k)$	$\lvert\hat{f}_k\rvert$
-8	0	0	0
-7	0.125	-0.025	0.127
-6	0	0	0
-5	0.125	-0.084	0.150
-4	0	0	0
-3	0.125	-0.187	0.225
-2	0	0	0
-1	0.125	-0.628	0.641
0	0	0	0
1	0.125	-0.628	0.641
2	0	0	0
3	0.125	-0.187	0.225
4	0	0	0
5	0.125	-0.084	0.150
6	0	0	0
7	0.125	-0.025	0.127

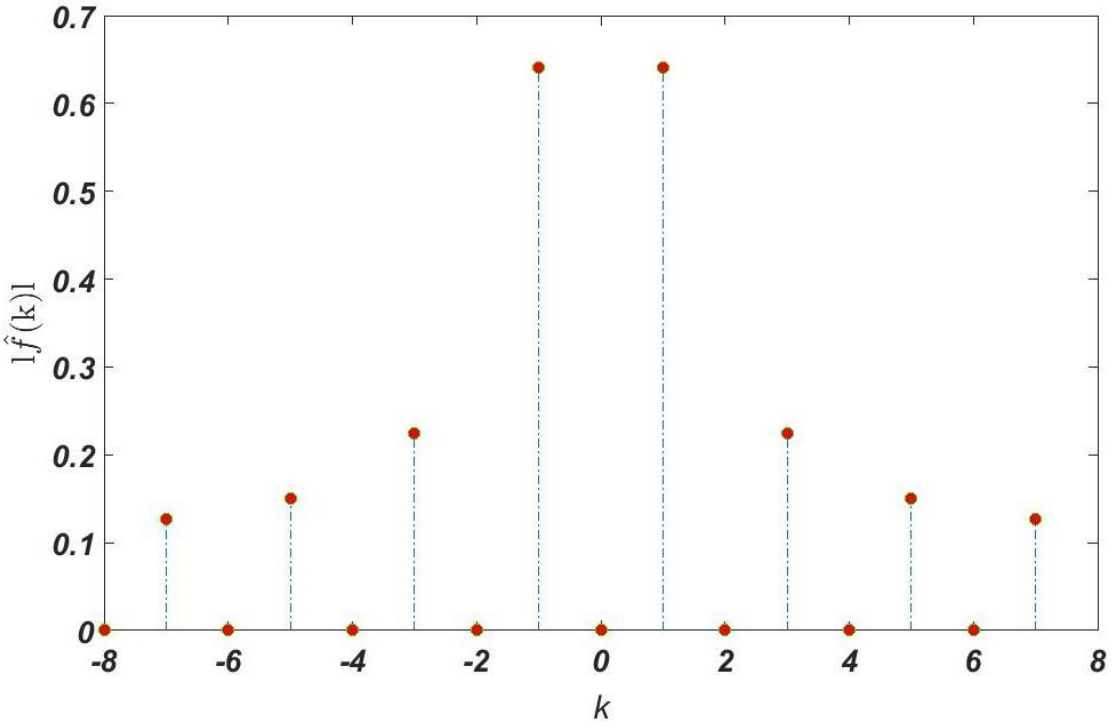

Figure 1 The magnitudes of the Fourier coefficients of the square function.

Code:

Code for figure 1

```
clear
clc

for i=1:1:16
if i<9
   f(i) = 1;
else
   f(i) = -1;
end
end

n=16;
A=fft(f)/n;
U=fftshift(A);
UU=abs(U);

for i=1:1:n
 k(i)=-n/2+i-1;
end

stem(k,UU,'LineStyle','-.',...
    'MarkerFaceColor','red',...
    'MarkerEdgeColor','green')

xlabel('k')
ylabel('l$$\hat{f}$$(k)l','Interpreter','Latex')
```

Question 2 :

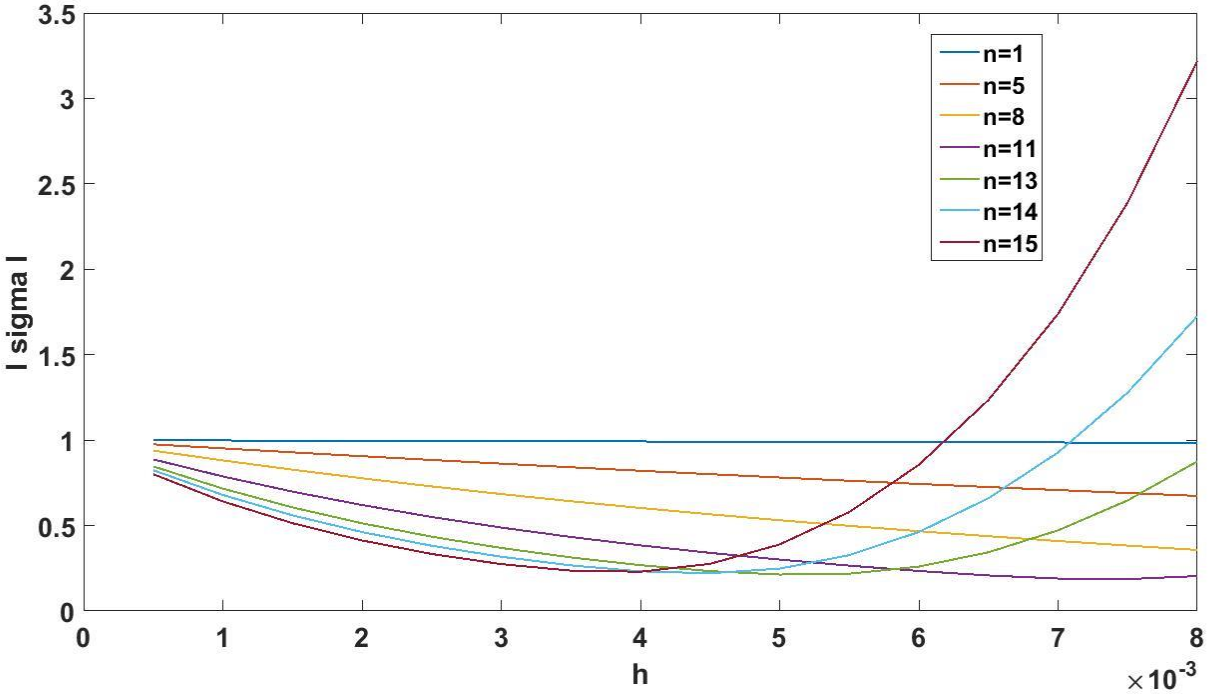

Figure 2 $|\sigma|$ versus h for $k = 2\pi n$, n = 1, 5, 8, 11, 13, 14, 15.

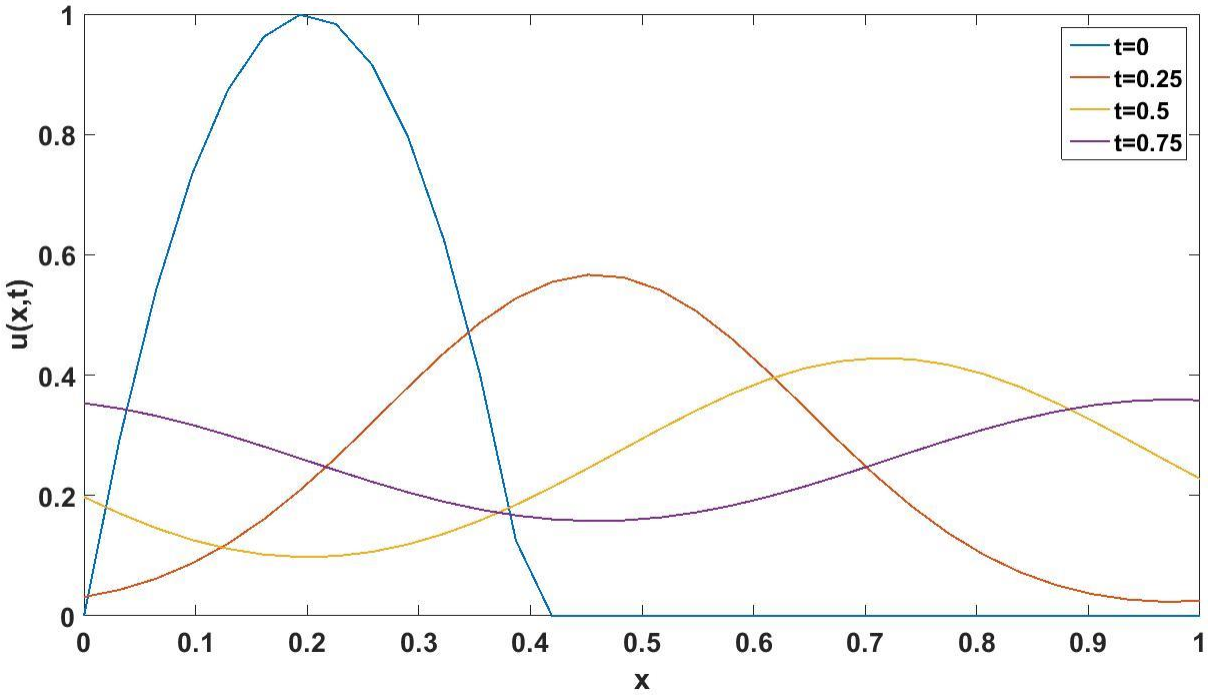

Figure 3 Numerical solution of the convective–diffusion equation.

Code:

Code for figure 2

```
clc
clear
N=32;
for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=2;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=6;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=9;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=12;
```

```
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=14;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=15;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;

   for b=1:1:N/2
    h(b)=2*8e-3/N*(b);
    j=16;
    k(b)=2*pi*(j-1);
    landa(b) = -(i*k(b)+0.05*k(b)^2);
    sigma(b) = abs(1 + (landa(b)*h(b)) + ((landa(b)*h(b))^2)/2 + ((landa(b)*h(b))^3)/6 +
((landa(b)*h(b))^4)/24);

end
   plot(h,sigma);
   hold on;


   xlabel('h')
   ylabel('l sigma l')
```

Code for figure 3

```
clc
clear
N=32;
h=0.001;
for b=1:1:N
   x(b)=1/31*(b-1);
end

for b=1:1:N
  if x(b)<0.4
     uu_0(b)=1-25*(x(b)-0.2)^2;
  else
   uu_0(b)=0;
  end
end
u_0=fft(uu_0);
uf0 = ifft(u_0,N);

for b=1:1:N/2
   k(b)=2*pi*(b-1);
   landa(b) = -(i*k(b)+0.05*k(b)^2);
end
for b=N/2+1:1:N
   k(b)=2*pi*(+b-N-1);
   landa(b) = -(i*k(b)+0.05*k(b)^2);
end

for b = 1:1:N
    uu1(b)=ode45(@(t,ut) landa(b).*ut,[0:h:0.25],u_0(b));
end

for b = 1:1:N
    u1(b) = uu1(b).y(end);
end
u1(N/2+1)=0;
uf1 = ifft(u1);


for b = 1:1:N
    uu2(b)=ode45(@(t,ut) landa(b).*ut,[0.25:h:0.5],u1(b));
end

for b = 1:1:N
    u2(b) = uu2(b).y(end);
end
u2(N/2+1)=0;
uf2 = ifft(u2);
```

```
for b = 1:1:N
    uu3(b)=ode45(@(t,ut) landa(b).*ut,[0.5:h:0.75],u2(b));
end

for b = 1:1:N
    u3(b) = uu3(b).y(end);
end
u3(N/2+1)=0;
uf3 = ifft(u3);

plot(x,uf0);
hold on;
plot(x,uf1);
hold on;
plot(x,uf2);
hold on;
plot(x,uf3);
xlabel('x')
ylabel('u(x,t)')
```