4.4. Compute the DTFT of the following discrete-time signals; plot the amplitude and the phase spectrum for each signal:

(b) $x[n] = (0.5)^n \cos 4n\, u[n]$

From Table 4.1, use the DTFT pair

$$a^n u[n] \longleftrightarrow \frac{1}{1-ae^{-j\Omega}} \qquad |a|<1$$

and, from Table 4.2, use the DTFT property multiply by $\cos\Omega_0 n$

$$x[n]\cos(\Omega_0 n) \longleftrightarrow \tfrac{1}{2}\left[X(\Omega+\Omega_0)+X(\Omega-\Omega_0)\right]$$

where $a = 0.5$ and $\Omega_0 = 4$ rad

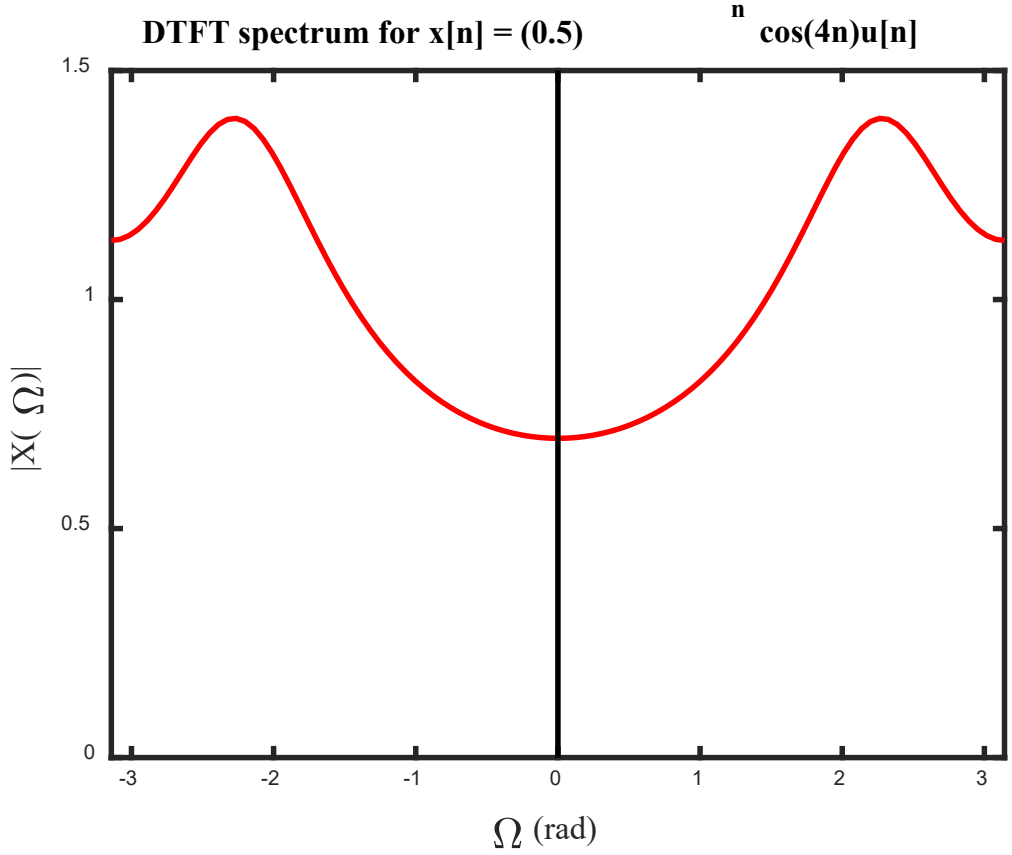
$$X(\Omega) = \tfrac{1}{2}\left[\left.\frac{1}{1-0.5e^{-j\Omega}}\right|_{\Omega=\Omega+4} + \left.\frac{1}{1-0.5e^{-j\Omega}}\right|_{\Omega=\Omega-4}\right]$$

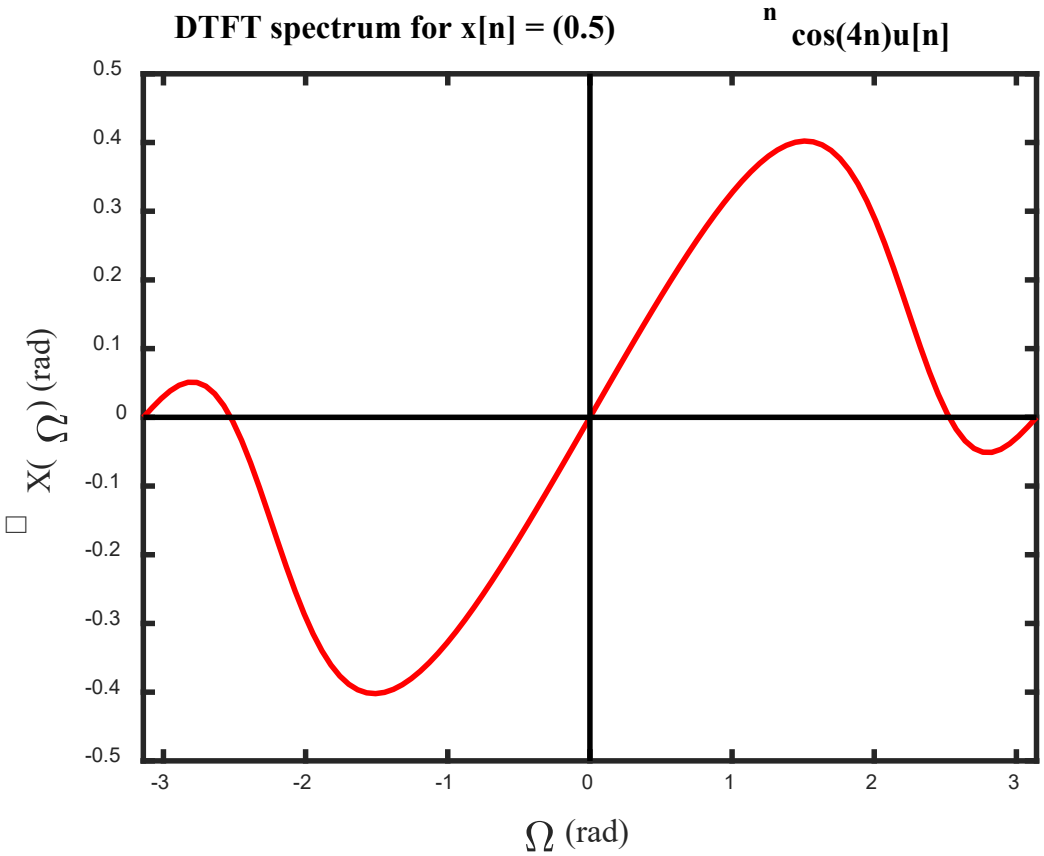
$$X(\Omega) = \tfrac{1}{2}\left[\frac{1}{1-0.5e^{-j(\Omega+4)}} + \frac{1}{1-0.5e^{-j(\Omega-4)}}\right]$$

or

$$X(\Omega) = \tfrac{1}{2}\left[\frac{e^{j(\Omega+4)}}{e^{j(\Omega+4)}-0.5} + \frac{e^{j(\Omega-4)}}{e^{j(\Omega-4)}-0.5}\right]$$

```
% Chapter 4 problem 4.4b (chap4_4_04b.m)
% Plot DTFT of x[n] = (0.5)^n*cos(4n)*u[n]
%
clear; clc; close all;
Omega = -pi:pi/50:pi;  % Define frequency vector
X1 = 0.5./(1 - 0.5*exp(-j*(Omega + 4)));
X2 = 0.5./(1 - 0.5*exp(-j*(Omega - 4)));
X = X1 + X2;
Xmag = abs(X); Xang = angle(X); % spectrum
% Plot amplitude and phase spectrum
plot(Omega,Xmag,'r-',[0 0],[0 1.5],'k-'), axis([-pi pi 0 1.5]),
xlabel('\Omega (rad)','fontsize',16,'fontname','times'),
ylabel('|X(\Omega)|','fontsize',16,'fontname','times'),
title('DTFT spectrum for x[n] = (0.5)^{n }cos(4n)u[n]',...
    'fontsize',16,'fontname','times'),
figure,
plot(Omega,Xang,'r-',[-pi pi],[0 0],'k-',[0 0],[-30 30],'k-'),
axis([-pi pi -0.5 0.5]),
xlabel('\Omega (rad)','fontsize',16,'fontname','times'),
ylabel('\angle X(\Omega) (rad)','fontsize',16,'fontname','times'),
title('DTFT spectrum for x[n] = (0.5)^{n }cos(4n)u[n]',...
    'fontsize',16,'fontname','times'),
set(findobj('type','line'),'linewidth',2)
set(findobj('type','axes'),'linewidth',2)
set(findobj('text','line'),'fontname','times')
```


DTFT spectrum for x[n] = (0.5)^n cos(4n)u[n]
|X(Ω)|
1.5
1
0.5
0
-3
-2
-1
0
1
2
3
Ω (rad)


DTFT spectrum for x[n] = (0.5)^n cos(4n)u[n]
X(Ω) (rad)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-3
-2
-1
0
1
2
3
Ω (rad)