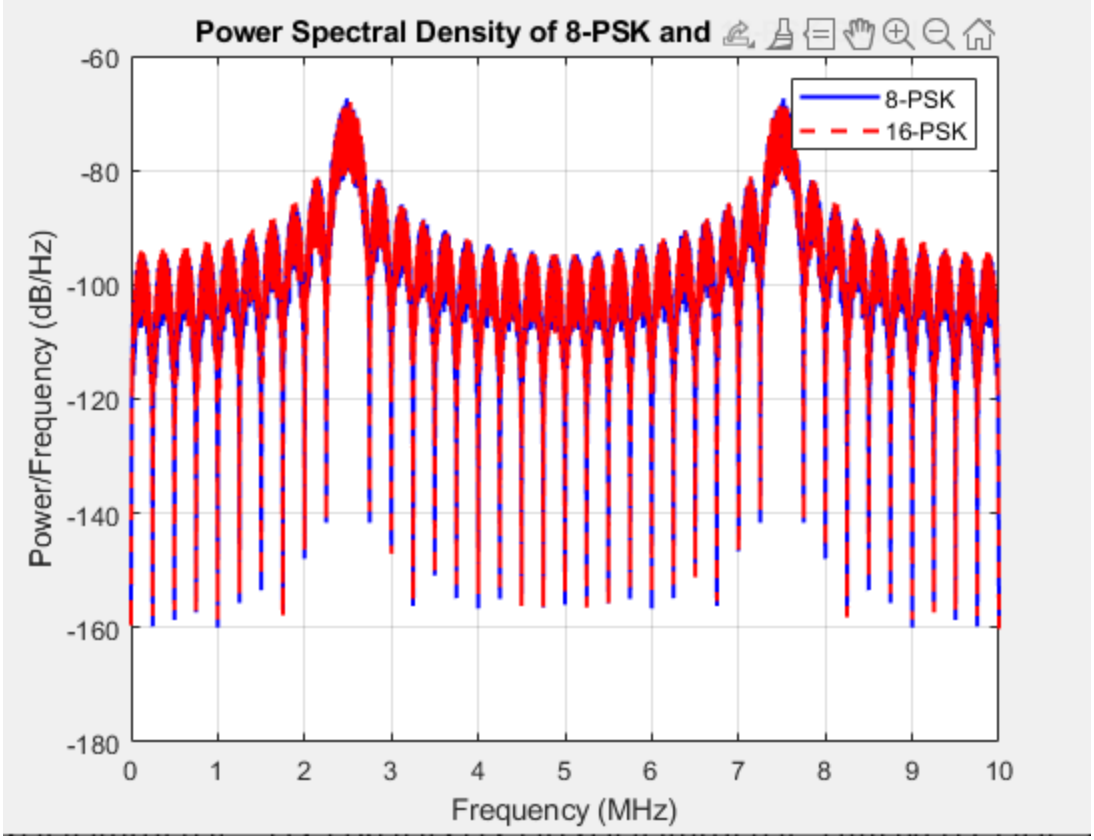
Question 5

Initially, after the signal modulation, the function pwelch is used to calculate the power spectral density (PSD) of the transmitted signal. It outputs the PSD values in dB/Hz and the corresponding frequency values.

```
%% Power Spectral Density Calculation using pwelch
[psd, f] = pwelch(s_t, [], [], [], Fs, 'twosided');  % Estimate the
power spectrum
psd_dB = 10*log10(psd);  % Convert to dB scale
```

A key observation is the bandwidth required for each modulation scheme. Higher-order modulation schemes, such as 16-PSK, typically require more bandwidth than lower-order ones, like 8-PSK. This is because they have more symbols to represent, leading to a denser constellation and consequently a wider spectrum. Another important feature is the main lobe and the side lobes. The main lobe represents the primary frequency content of the signal, while the side lobes contain secondary spectral components.

In general, as the modulation order increases, the width of the main lobe may broaden, and the side lobes may become more pronounced. Additionally, the power distribution differs between the two systems, with 16-PSK generally exhibiting a slightly more spread-out power spectrum due to the larger number of possible symbols that need to be transmitted. The 8-PSK, being a simpler modulation scheme, tends to have a more concentrated power distribution, which is reflected in a narrower spectral spread.


Power Spectral Density of 8-PSK and
8-PSK
16-PSK
Power/Frequency (dB/Hz)
Frequency (MHz)
-60
-80
-100
-120
-140
-160
-180
0
1
2
3
4
5
6
7
8
9
10