4 Bretschneider Spectrum Definition

The formula for the Bretschneider (one-sided) ocean wave spectrum is

$$S(\omega) = \frac{5}{16}\frac{\omega_m^4}{\omega^5} H_{1/3}^2 e^{-5\omega_m^4/4\omega^4}$$

where ω is frequency in radians per second, ω_m is the modal (most likely) frequency of any given wave, and $H_{1/3}$ is the significant wave height. Make a single figure that shows the Bretschneider spectrum (S as a function of ω) for these cases:

SeaState	$2\pi/\omega_m$, sec	$H_{1/3}$, m
2	6.3	0.3
3	7.5	0.9
4	8.8	1.9
5	9.7	3.3
6	12.4	5.0

Here is the MATLAB code I used and the resulting figure:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% 2.017 Homework 1.  Bretschnieder Spectrum.
% FSH MIT Mechanical Engineering

clear all;
figure(1);clf;hold off; hold on; % note:  hold is on so we can overlay
                                 % figures

% show the data from the table in the problem
SSvec = [2 3 4 5 6] ; % sea states
wmvec = 2*pi*ones(size(SSvec)) ./ [6.3 7.5 8.8 9.7 12.4] ;
                                           % modal frequencies
Hsigvec = [0.3 0.9 1.9 3.3 5.0] ; % significant wave heights

% vector of frequencies for the spectrum calculation
wvec = [.1:.01:2];

% step through the different seastates
for i = 1:length(wmvec),

   wm = wmvec(i) ;
   Hsig = Hsigvec(i) ;
   SS = SSvec(i) ;
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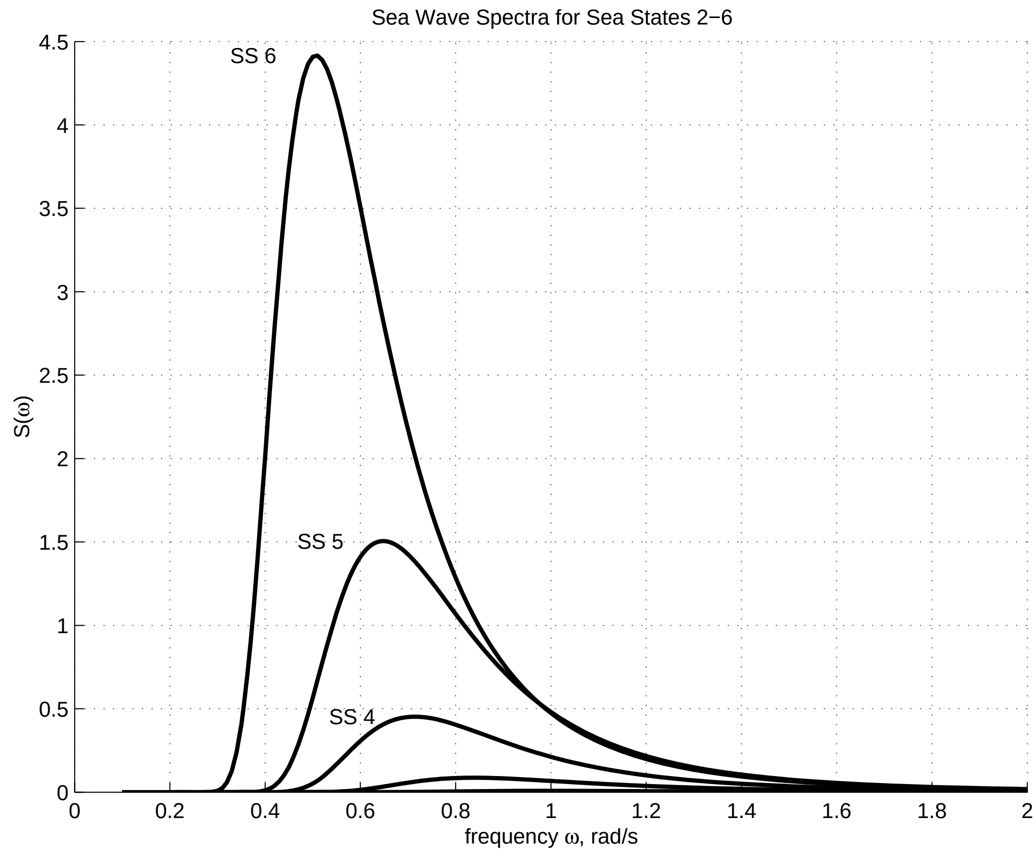
```
   for j = 1:length(wvec),
      w = wvec(j) ;
      S(j) = 5/16 * wm^4 / w^5 * Hsig^2 * exp(-5 * wm^4 / 4 / w^4) ;
   end;

   % check that we got the right formula!
   disp(sprintf(...
      'Square Root of Integral of Area of S:  %g;  4*Hsig:  %g', ...
      sqrt(sum(S)*mean(diff(wvec))), 1/4*Hsig));

   % add on the curves and some labels
   plot(wvec,S,'LineWidth',2);
   if SS > 3,
      text(wm-.18,max(S),sprintf('SS %g', SS));
   end;
end;

% finish off the plot
grid;
title('Sea Wave Spectra for Sea States 2-6');
xlabel('frequency \omega, rad/s');
ylabel('S(\omega)');

print -deps hw1_bret.eps
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```


Sea Wave Spectra for Sea States 2−6
SS 6
SS 5
SS 4
S(ω)
frequency ω, rad/s
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0.2
0.4
0.6
0.8
1.2
1.4
1.6
1.8