Assignment

EE23010: Probability and Random Processes
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Question: For a real signal, which of the following is/are valid power spectral density/-densities?

1) $s_X(w) = \frac{2}{9+w^2}$

2) $s_X(w) = e^{-w^2}cos^2w$

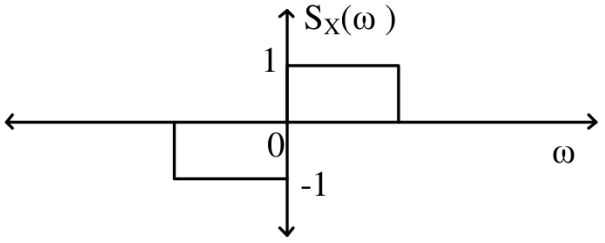

Fig. 3. Figure1

3)

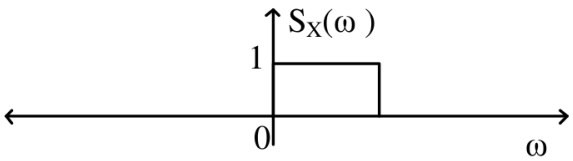

Fig. 4. Figure2

4)

Solution:
For a real signal, power spectral density(PSD) should satisfy the following properties:

$$Im(s_X(w)) = 0 \tag{1}$$

$$s_X(-w) = s_X(w) \tag{2}$$

Now, checking for option (1)

$$Im(\frac{2}{9+w^2}) = 0 \tag{3}$$

$$\tag{4}$$

Also,

$$\frac{2}{9+w^2} = \frac{2}{9+(-w)^2} \tag{5}$$

So, it is a valid PSD
Now, for option (2)

$$Im(e^{-w^2}cos^2w) = 0 \tag{6}$$

And,

$$e^{-w^2}cos^2w = e^{-(-w)^2}cos^2(-w) \tag{7}$$

It is also a valid PSD.
Similarly, checking for (3) and option (4) doesn't satisfy the properties. So, it is not a valid PSD.
$\therefore$ Option (1) and (2) are correct.