

Assignment 6

Pericherla Pranav Varma
CS21BTECH11044

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Question

Papoulis Pillai Ch5 Ex 5-46:

Show that, if $\phi(\omega) = E(e^{j\omega x})$ then for any a_i ,

$$\sum_{i=1}^n \sum_{j=1}^n \phi(\omega_1 - \omega_2) a_i a_j^* \geq 0.$$

Hint:

$$E \left\{ \left| \sum_{i=1}^n a_i e^{k\omega_i x} \right|^2 \right\} \geq 0$$

Solution

As we know that,

$$|Z|^2 = Z \cdot Z^*$$

and from given hint,

$$E \left\{ \left[\sum_{i=1}^n a_i e^{k\omega i x} \right] \cdot \left[\sum_{j=1}^n a_j e^{k\omega j x} \right]^* \right\} \geq 0$$

$$E \left\{ \left[\sum_{i=1}^n a_i e^{k\omega i x} \right] \cdot \left[\sum_{j=1}^n a_j^* e^{-k\omega j x} \right] \right\} \geq 0$$

$$E \left\{ \left[\sum_{i=1}^n a_i e^{k\omega i x} \right] \cdot \left[\sum_{j=1}^n a_j^* e^{-k\omega j x} \right] \right\} \geq 0$$

Solution

$$E \left\{ \sum_{j=1}^n \sum_{i=1}^n a_i a_j^* e^{k\omega(i-j)x} \right\} \geq 0$$

And Given : $\phi(\omega) = E(e^{i\omega x})$ \therefore on rearranging we get,

$$\sum_{i=1}^n \sum_{j=1}^n a_i a_j^* \phi(\omega_i - \omega_j) \geq 0.$$