Question #1 \_ a

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** |
| **X[n]** | **5** | **0** | **2** | **0** | **-1** | **0** | **1** | **0** | **2** | **0** | **4** | **0** | **6** | **0** | **0** | **0** | **0** |
| **h[n]** | **0.5** | **1** | **0.5** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| h[0]\*x[n] | 2.5 | 0 | 1 | 0 | -0.5 | 0 | 0.5 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | - | - | - |
| h[1]\*x[n] | - | 5 | 0 | 2 | 0 | -1 | 0 | 1 | 0 | 2 | 0 | 4 | 0 | 6 | 0 | - | - |
| h[2]\*x[n] | - | - | 2.5 | 0 | 1 | 0 | -0.5 | 0 | 0.5 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | 0 |
| **X[n]\*h[n]** | **2.5** | **0.5** | **3.5** | **0** | **0.5** | **-1** | **0** | **1** | **1.5** | **2** | **3** | **4** | **5** | **6** | **3** | **0** | **0** |

$$X\left[n\right]\*h\left[n\right]=\left\{2.5, 0.5, 3.5, 0, 0.5, -1, 0, 1, 1.5, 2, 3, 4, 5, 6, 3\right\}$$

Question #4

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| **x[n]** | **-1.2** | **0.4** | **1.2** | **1.6** | **2.4** | **0** | **-3.2** | **0.4** | **0.8** | **0** | **-0.8** | **1.2** | **0** | **0** | **0** | **0** | **0** | **0** |
| **y[n]** | **10** | **10** | **-10** | **-10** | **10** | **10** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** |
| y[0]\*x[n] | -12 | 4 | 12 | 16 | 24 | 0 | -32 | 4 | 8 | 0 | -8 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| y[1]\*x[n] | -- | -12 | 4 | 12 | 16 | 24 | 0 | -32 | 4 | 8 | 0 | -8 | 12 | 0 | 0 | 0 | 0 | 0 |
| y[2]\*x[n] | -- | -- | 12 | -4 | -12 | -16 | -24 | 0 | 32 | -4 | -8 | 0 | 8 | -12 | 0 | 0 | 0 | 0 |
| y[3]\*x[n] | -- | -- | -- | 12 | -4 | -12 | -16 | -24 | 0 | 32 | -4 | -8 | 0 | 8 | -12 | 0 | 0 | 0 |
| y[4]\*x[n] | -- | -- | -- | -- | 12 | -4 | -12 | -16 | -24 | 0 | 32 | -4 | -8 | 0 | 8 | -12 | 12 | 0 |
| y[5]\*x[n] | -- | -- | -- | -- | -- | 12 | -4 | -12 | -16 | -24 | 0 | 32 | -4 | -8 | 0 | 8 | -12 | 12 |
| **x[n]\*y[n]** | **-12** | **-8** | **28** | **36** | **36** | **4** | **-88** | **-76** | **4** | **12** | **12** | **24** | **8** | **-12** | **-4** | **-4** | **0** | **12** |

$$crosscorrelation\left(y\left[n\right],x\left[n\right]\right)=\left\{-12, -8, 28, 36, 36, 4, -88, -76, 4, 12, 12, 24, 8, -12, -4, -4, 0, 12\right\}$$

$$given: x\left[n\right]=αy\left[n-d\right]+e\left[n\right];d≔integer delay, e\left[n\right]≔noise, α≔constant$$

$$estimated delay: d≅16;since the cross correlation becomes zero at it.$$