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Question#2:

 **3 cases for the convolution of h1[n] and h2[n]**:

1. **N>M**

$$h\_{1}\left[n\right]\*h\_{2}\left[n\right]=\left\{\begin{array}{c}\sum\_{k=0}^{n}a^{k};0\leq n\leq M\\\sum\_{k=n-M}^{n}a^{k};M\leq n\leq N\\\sum\_{k=n-M}^{N}a^{k};N\leq n\leq M+N\end{array};and zero otherwise.\right.$$

1. **N=M**

$$h\_{1}\left[n\right]\*h\_{2}\left[n\right]=\left\{\begin{array}{c}\sum\_{k=0}^{n}a^{k};0\leq n\leq M\\\sum\_{k=n-M}^{N}a^{k};N\leq n\leq M+N\\0 ;elsewhere\end{array}\right.$$

1. **N<M**

$$h\_{1}\left[n\right]\*h\_{2}\left[n\right]=\left\{\begin{array}{c}\sum\_{k=0}^{n}a^{k};0\leq n\leq N\\\sum\_{k=0}^{N}a^{k};N\leq n\leq M\\\sum\_{k=n-M}^{N}a^{k};M\leq n\leq M+N\end{array};and zero otherwise.\right.$$

Question#3:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **N** | **0** | **1** | **2** | **3** | **4** |
| **H[n]** | **1** | **½** | **¼** | **1/8** | **1/16** |
| **X[n]** | **A** | **B** | **C** | **D** | **E** |
| H[0]X[n] | A | B | C | D | E |
| H[1]X[n] | - | A/2 | B/2 | C/2 | D/2 |
| H[2]X[n] | - | - | A/4 | B/4 | C/4 |
| H[3]X[n] | - | - | - | A/8 | B/8 |
| H[4]X[n] | - | - | - | - | A/16 |
| * H[n]\*X[n]
 | A | B+A/2 | C+B/2+A/4 | D+C/2+B/4+A/8 | E+D/2+C/4+B/8+A/16 |
| * Y[n]
 | 1 | 2 | 2.5 | 3 | 3 |
| **X[n]** | **1** | **1.5** | **1.75** | **1.625** | **1.5** |

* By solving H[n]\*X[n] = Y[n] and solving for the coefficients.

Question#4:

$$h\left[n\right]=h\_{1}\left[n\right]\*\left(h\_{2}\left[n\right]+h\_{3}\left[n\right]\*h\_{4}\left[n\right]\right)$$

$$\rightarrow h\_{3}\left[n\right]\*h\_{4}\left[n\right]=-u\left[n\right]\*δ\left[n-4\right]=-u\left[n-4\right]$$

$$\rightarrow h\_{2}\left[n\right]+h\_{3}\left[n\right]\*h\_{4}\left[n\right]=u\left[n\right]-u\left[n-4\right]=\left\{1, 1, 1, 1, 1\right\} ;0\leq n\leq 4$$

$$\rightarrow h\left[n\right]=h\_{1}\left[n\right]\*\left(h\_{2}\left[n\right]+h\_{3}\left[n\right]\*h\_{4}\left[n\right]\right)$$

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| **H2[n]+H3[n]\*H4[n]** | **1** | **1** | **1** | **1** | **1** | **0** | **0** |
| **H1[n]** | **½** | **¼** | **½** | **0** | **0** | **0** | **0** |
| 0 | ½ | ½ | ½ | ½ | ½ |  |  |
| 1 | - | ¼ | ¼ | ¼ | ¼ | ¼ |  |
| 2 | - | - | ½ | ½ | ½ | ½ | ½ |
| **H[n]** | **½** | **¾** | **5/4** | **5/4** | **5/4** | **¾** | **½** |

* **h[n] = { ½, ¾, 5/4, 5/4, 5/4, ¾, ½ }**

$$X\left[n\right]\*h\left[n\right]=h\left[n+2\right]+3h\left[n-1\right]-4h\left[n-3\right]$$

* Shifted scaled h[n]’s added

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **-2** | **-1** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| h[n+2] | ½ | ¾ | 5/4 | 5/4 | 5/4 | ¾ | ½ | 0 | 0 | 0 | 0 |
| 3h[n-1] | 0 | 0 | 0 | 3/2 | 9/4 | 15/4 | 15/4 | 15/4 | 9/4 | 3/2 | 0 |
| -4h[n-2] | 0 | 0 | 0 | 0 | -4/2 | -12/4 | -20/4 | -20/4 | -20/4 | -12/4 | -4/2 |
| **x[n]\*h[n]** | **½** | **¾** | **5/4** | **11/4** | **6/4** | **6/4** | **-3/4** | **-5/4** | **-11/4** | **-6/4** | **-4/2** |

Question#5:

* Even n; $\left|a\right|<1$
* Odd n; $0\leq a<1$

Question#6:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **n** | **0** | **1** | **2** | **3** | **4** | **5** | **6** |
| **X[n]** | **1** | **2** | **1** | **1** | **0** | **0** | **0** |
| X[0]X[n] | 1 | 2 | 1 | 1 | 0 | 0 | 0 |
| X[1]X[n] | - | 2 | 4 | 2 | 2 | 0 | 0 |
| X[2]X[n] | - | - | 1 | 2 | 1 | 1 | 0 |
| X[3]X[n] | - | - | - | 1 | 2 | 1 | 1 |
| X[n]\*X[n] | 1 | 4 | 6 | 6 | 5 | 2 | 1 |