Questions for DTSP practical exam

1. Write a python code to determine y[n] the linear convolution of two sequences x[n] and h[n] using formula given below and hence verify your answer

$$y[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

a. x[n] = [1, 2, 3, 4] *and* h[n] = [1, 1, 3, 2]

b. x[n] = [1, 2, 3, 0, 5] *and* h[n] = [1, 0, 2]

2. Design a Lowpass Butterworth IIR filter using Bilinear transformation to satisfy the following specifications for T=0.1 sec

$$0.9 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le 0.35\pi$$
$$\left|H(e^{j\omega})\right| \le 0.1 \qquad 0.8\pi \le \omega \le \pi$$

3. Design a High pass Butterworth digital IIR filter using Bilinear Transformation assuming T=0.1s to satisfy the following specifications:

$$0.9 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0.8\pi \le \omega \le \pi$$
$$\left|H(e^{j\omega})\right| \le 0.1 \qquad 0 \le \omega \le 0.35\pi$$

4. Design a Lowpass Chebyshev digital IIR filter using Bilinear Transformation assuming T=0.1s to satisfy the following specifications:

$$0.9 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le 0.35\pi$$
$$\left|H(e^{j\omega})\right| \le 0.1 \qquad 0.8\pi \le \omega \le \pi$$

5. Design an FIR low-pass filter using Hanning window with the following specifications:
   Length: 9
   Cutoff frequency: π/2.

6. Design a FIR digital filter using window method for following specification

$$H(e^{j\omega}) = e^{-j3\omega} \qquad 0 \le |\omega| \le \frac{3\pi}{4}$$
$$= 0 \qquad \text{Otherwise}$$

Use Hamming window of length 7.

7. Design a Bandpass FIR filter using Blackman window for the following specifications

Length of the filter: 11

cutoff frequencies :0.3π and 0.6π.

8. Design a Bandstop FIR filter using Blackman window for the following specifications

Length of the filter 11

cutoff frequencies :0.3π and 0.6π

9. Design a High pass Chebyshev digital IIR filter using Bilinear Transformation assuming T=0.1s to satisfy the following specifications:

$$0.9 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0.8\pi \le \omega \le \pi$$
$$\left|H(e^{j\omega})\right| \le 0.1 \qquad 0 \le \omega \le 0.35\pi$$

10. Write a python code to determine $y[n]$ the circular convolution of two sequence $x[n]$ and $h[n]$ using time domain method and hence verify your result .

a. x[n] = [1, 2, 3, 4] and $h[n]$ = [1, 1, 3, 2]

b. x[n] = [1, 2, 3, 0, 5] and $h[n]$ = [1, 0, 2]

11. Write a python code to determine DFT of the following sequence and hence verify your result.

a. x_1[n] = [1,0,2,0]

b. x_2[n] = [1, 2, 3]

12. Write a python code to determine DFT of the following sequence and hence verify your result.

    a. $x_1[n] = [1,2]$

    b. $x_2[n] = [1+j,2+j,3+3j,4+4j]$

13. Write a python code to determine IDFT of the following sequence and hence verify your result.

    a. $X_1[k] = [10, -2+2j, -2, -2-2j]$

    b. $X_2[k] = [16, 0, 0, 0]$

14. Write a Python code to implement circular convolution of two sequence using DFT/IDFT method and hence verify your result.

    a. $x[n] = [1, 2, 3, 4\ ]\ and\ h[n] = [1, 1, 3, 2]$

    b. $x[n] = [1, 2, 0, 5\ ]\ and\ h[n] = [1, 0, 2,1]$

15. Write a Python code to prove linearity property of DFT and hence verify your result for following sequences.

    a. $x1[n] = [1, 2, 3, 4\ ]\ and\ x2[n] = [1, 1, 3, 2]$

    b. $x1[n] = [1, 2, 0, 5\ ]\ and\ x2[n] = [1, 0, 2,1]$

16. Write a Python code to generate basic signals
    (Unit Ramp signal and Unit step signal). And solve the following problem.

    The unit sample response of a system is h(n) = {3, 2, 1} use overlap-add method of linear

    filtering to determine output sequence for the repeating input sequences

    x(n) = {2, 0, -2, 0, 2, 1, 0, -2, -1, 0}

17. Write a Python code to compute SPECTRUM of signal using DFT .
    And solve the following problem.

    The unit sample response of a system is h(n) = {3, 2} use overlap-save method of linear filtering to determine output sequence for the repeating input sequences

    x(n) = {2, 0, -2, 0, 2, 1, 0, -2, -1, 0}