

University Electrical Engineering

Name: _____ Score: _____

1. $h = [1, 2, 1]$ and $x = [1, 1]$. What is y ?
☐ 1, 3, 4, 3, 1
☐ 1, 2, 1
☐ 2, 4, 2
☐ 1, 3, 3, 1
2. The DFT treats its N samples as one period of a signal that repeats for ever.
☐ True ☐ False
3. How many operations does a direct 256-point DFT take?

4. An FIR filter is stable whatever its tap values.
☐ True ☐ False
5. A biquad has three numerator coefficients and three denominator coefficients, one of which is normalised to 1. How many coefficients must be stored?

6. 48 kHz audio is decimated by 4. Below what frequency must it be low-passed first, in kHz?
_____ kHz
7. A specification line the design fails should be left out of the report.
☐ True ☐ False
8. A system with $h[n] = 1.1^n$ for $n \geq 0$ is BIBO stable.
☐ True ☐ False
9. A 256-point DFT runs at $f_s = 8$ kHz. What frequency is bin 32, in Hz?
_____ Hz
10. How many butterfly stages does a 512-point FFT have?

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1. **1, 3, 3, 1**

$y[0] = 1$; $y[1] = 2 + 1 = 3$; $y[2] = 1 + 2 = 3$; $y[3] = 1$. The output is $\text{len}(h) + \text{len}(x) - 1 = 4$ samples long.

2. **True**

Sampling the spectrum makes the time signal periodic. That is where leakage comes from.

3. **65536**

$$256^2 = 65\,536.$$

4. **True**

Its impulse response is a finite list, so the sum of $|h[n]|$ is always finite.

5. **5**

Three numerator plus two denominator coefficients. The 67-tap FIR stores 67.

6. **6 kHz**

The new rate is 12 kHz, so its Nyquist frequency is $48/(2 \times 4) = 6$ kHz.

7. **False**

Every line gets its measured value, failures included. Silent goals hide exactly what a reader needs to know.

8. **False**

The terms grow, so their sum diverges. A step input would drive the output without limit.

9. **1000 Hz**

$$32 \times 8000/256 = 1000 \text{ Hz}.$$

10. **9**

$\log_2 512 = 9$ stages, each of 256 butterflies.