

# Faculty of Engineering

## End Semester Examination May 2025

### EC3CO26 Digital Signal Processing

<b>Programme</b>	:	B.Tech.	<b>Branch/Specialisation</b>	:	EC
<b>Duration</b>	:	3 hours	<b>Maximum Marks</b>	:	60

**Note:** All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.  
 Notations and symbols have their usual meaning.

#### Section 1 (Answer all question(s))

- |  | <b>Marks</b>   | <b>CO</b> | <b>BL</b> |
|--|--|-----------|-----------|
| <b>Q1.</b> Which of the following is false?  | 1    2    2  |           |           |
| <input type="radio"/> DFT is sampled version of DTFT<br><input type="radio"/> Multiplication of two length N sequences is equivalent to convolution of the corresponding DFT | <input checked="" type="radio"/> Zero padding to sequences leads to better frequency resolution in the case of DFT<br><input type="radio"/> FFT is an efficient algorithm for calculation of DFT |           |           |
| <b>Q2.</b> Which is not a basic property of DFT?   | 1    2    1  |           |           |
| <input type="radio"/> Circular symmetry<br><input type="radio"/> Linearity   | <input type="radio"/> Periodicity<br><input checked="" type="radio"/> Summation  |           |           |
| <b>Q3.</b> The prime reason to implement linear convolution via circular convolution is-   | 1    2    2  |           |           |
| <input type="radio"/> Simplicity<br><input type="radio"/> Easy hardware implementation   | <input checked="" type="radio"/> Computational efficiency because of use of FFT algorithm<br><input type="radio"/> No specific reason  |           |           |
| <b>Q4.</b> Computational complexity refers to the number of-   | 1    2    2  |           |           |
| <input type="radio"/> Additions<br><input type="radio"/> Multiplications   | <input checked="" type="radio"/> Arithmetic operations<br><input type="radio"/> None of the mentioned above  |           |           |
| <b>Q5.</b> The structure which uses less number of delay elements is-  | 1    2    2  |           |           |
| <input type="radio"/> Direct form-I<br><input type="radio"/> Cascade form  | <input checked="" type="radio"/> Direct form-II<br><input type="radio"/> Parallel form   |           |           |
| <b>Q6.</b> The number of multipliers required for the realization of FIR systems is reduced if we choose-  | 1    2    2  |           |           |
| <input type="radio"/> Direct form<br><input type="radio"/> Parallel form   | <input type="radio"/> Cascade form<br><input checked="" type="radio"/> Linear phase realization  |           |           |
| <b>Q7.</b> In Bilinear transformation, analog frequencies from $-\infty$ to $+\infty$ are mapped into digital frequencies from $-\pi$ to $+\pi$ as-                          | 1    2    2  |           |           |
| <input type="radio"/> One-to-many<br><input checked="" type="radio"/> One-to-one   | <input type="radio"/> Many-to-one<br><input type="radio"/> Many-to-many  |           |           |
| <b>Q8.</b> Hanning window has-   | 1    2    2  |           |           |
| <input checked="" type="radio"/> Less side lobes<br><input type="radio"/> Short width of main lobe   | <input type="radio"/> More side lobes<br><input type="radio"/> None of the above   |           |           |
| <b>Q9.</b> Which is the architectural feature of DSP Processors?   | 1    1    1  |           |           |
| <input type="radio"/> Separate memory for program and data<br><input type="radio"/> Pipelining   | <input type="radio"/> Specialized instruction set<br><input checked="" type="radio"/> All of the above   |           |           |

**Q10.** In ideal case, a 3-stage pipelined machine is how many times faster than non-pipelined machine?

1 2 2

- 3
- 6
- 9
- 12

### Section 2 (Answer all question(s))

**Q11.** Write formulas for N-point DFT and IDFT.

Marks CO BL  
2 1 1

Rubric	Marks
Formula for N-point DFT, Formula for N-point IDFT. (1+1)	2

**Q12.** Correlate DTFT and DFT.

3 2 2

Rubric	Marks
Formula comparision, Two correlations	3

**Q13. (a)** Classify signals. Give and explain one example of each energy signal, power signal, even signal and odd signal.

5 3 3

Rubric	Marks
Signal Classification in at least 6 categories, ( 3 Marks) One example of each Energy signal, Power signal, Even signal and Odd signal each 0.5 marks	5

(OR)

**(b)** Explain the physical significance of DFS. Correlate the complex exponential form of DFS with DFT.

Rubric	Marks
Explanation of the physical significance of DFS, (2.5 Marks) Correlation of the complex exponential form of DFS with DFT (2.5 Marks)	5

### Section 3 (Answer all question(s))

Marks CO BL

**Q14.** Why is Z-Transform required when DFT already exists?

2 2 2

Rubric	Marks
Explanation by giving mathematical relationship	2

**Q15.** Describe all the steps involved in calculating linear convolution with an example.

3 2 2

Rubric	Marks
Description all the 5 steps (Duumy time introduction, time reversal of one sequence, shifting of time-reversed sequence, multiplication, summation) involved in calculating Linear Convolution with an example.	3

**Q16. (a)** State and prove time shifting, frequency shifting, scaling and convolution properties of DFT.

5 3 3

Rubric	Marks
Mathematical statement of time shifting, frequency shifting, scaling and convolution properties of Z-transform. Proof of time shifting, frequency shifting, scaling and convolution properties of Z-transform (1 mark each)	5

(OR)

- (b)** What are FFT algorithms? Explain the Decimation-in-time algorithm to calculate Radix-2 N point DFT.

Rubric	Marks
Role of FFT algorithms (1 Marks), Explanation of the Decimation-in-time algorithm to calculate Radix-2 N point DFT with final diagram for computation( 4 Marks)	5

#### Section 4 (Answer all question(s))

Marks CO BL

**Q17.** What is the relationship between impulse response and convolution sum?

2 2 2

Rubric	Marks
Relationship between Impulse Response and Convolution Sum	2

**Q18.** Why are the parallel form structures considered the most stable forms of realisation? Differentiate IIR and FIR filters.

3 2 2

Rubric	Marks
Reason for the parallel form structures considered the most stable forms of realisation (1 Marks) and At least four differences between IIR and FIR filters (0.5 mark for each difference)	3

**Q19. (a)** A discrete system is described by difference equation  $y(n)+2y(n-1)-y(n-2)=x(n)$ . Realize the system and draw the structures in direct and cascade forms.

5 3 3

Rubric	Marks
Realisation of the system and draw the structures in Direct forms(3 Marks) and Realisation of the system and draw the structures in Cascade form. (2 Marks)	5

(OR)

- (b)** A discrete system is described by transfer function  $H(z)= \frac{(3+1.2z^{-1})}{(1+0.75z^{-1}+0.125z^{-2})}$ . Realize the system and draw the structures in Direct and parallel forms.

Rubric	Marks
Realisation of the system and draw the structures in Direct forms. (3 Marks), Realisation of the system and draw the structures in Parallel form. (2 Marks)	5

#### Section 5 (Answer all question(s))

Marks CO BL

**Q20.** Why do quantisation and round-off errors play a crucial role in digital filter design? How can they be minimised?

2 2 2

Rubric	Marks
Reason (1 Marks), Ways to minimise (1 Marks)	2

**Q21.** Explain the concept and the process of Windowing in both time-domain and frequency-domain.

3 3 3

Rubric	Marks
Explanation with the help of diagrams and equations	3

**Q22. (a)** Describe impulse invariant method and bilinear transformation methods of discretization of Butterworth and Chebyshev filters. Which is preferred between two?

5 4 4

Rubric	Marks
Describe Impulse Invariant method.(2 marks), Describe Bilinear Transformation method.(2 Marks), Which is preferred between two? (1 Marks)	5

**(OR)**

- (b)** Compare Rectangular, Barlett, Hanning and Hamming windows based on different desired parameters.

Rubric	Marks
Comparision on 5 desired parameters (one mark for each desired parameter)	5

### Section 6 (Answer any 2 question(s))

Marks CO BL

**Q23.** Why do most DSP processors have a MAC (Multiply and Accumulate) instruction in their instruction set? Explain Pipelining. What are the advantages of pipelining in DSP processors?

5 3 3

Rubric	Marks
Reason for the most DSP processors have a MAC (Multiply and Accumulate) instruction in their instruction set (1 Marks), Explain Pipelining (2 Marks), Advantages of pipelining in DSP processors (2Marks)	5

**Q24.** Write any four applications of DSP processors. Give reasons with examples of why DSP processors are required in those applications.

5 3 3

Rubric	Marks
Four applications of DSP processors. (4 Marks), Give reasons with examples of why DSP processors are required in those applications. (1 Marks)	5

**Q25.** Draw and explain the main building blocks of the architecture of DSP processor TMS320C6748.

5 3 3

Rubric	Marks
Draw the architecture. (2.5 Marks), Explain the architectur (2.5 Marks)	5

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