

Faculty of Engineering

End Semester Examination May 2025

EE3EL16 Digital Signal Processing

Programme	:	B.Tech.	Branch/Specialisation	:	EE
Duration	:	3 hours	Maximum Marks	:	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))				Marks CO BL
Q1. Which of the following is a classification of discrete-time signals?				1 1 1
<input type="radio"/> Continuous-time signals		<input checked="" type="radio"/> Random signals		
<input type="radio"/> Periodic signals		<input type="radio"/> All of the above		
Q2. What condition must hold for a Linear Time-Invariant (LTI) system to be considered stable?				1 1 1
<input checked="" type="radio"/> Output remains bounded for bounded input		<input type="radio"/> Output is zero for all time		
<input type="radio"/> System function has no poles		<input type="radio"/> System function is a polynomia		
Q3. What is the main property of the Discrete Fourier Transform (DFT)?				1 1 1
<input type="radio"/> Time-shifting property		<input type="radio"/> Frequency-shifting property		
<input type="radio"/> Linearity property		<input checked="" type="radio"/> All of the above		
Q4. The Fast Fourier Transform (FFT) is primarily used to-				1 1 1
<input type="radio"/> Increase the sampling rate of signals		<input checked="" type="radio"/> Reduce computation time for DFT		
<input type="radio"/> Increase the duration of signals		<input type="radio"/> None of the above		
Q5. Which type of filter is characterized by a transfer function that can be expressed as a ratio of two polynomials?				1 1 1
<input type="radio"/> FIR filter		<input checked="" type="radio"/> IIR filter		
<input type="radio"/> All-pass filter		<input type="radio"/> Band-pass filter		
Q6. The Chebyshev filter is known for:				1 1 1
<input type="radio"/> Having a flat frequency response		<input checked="" type="radio"/> Ripple in the passband		
<input type="radio"/> Steep roll-off		<input type="radio"/> Limited phase distortion		
Q7. The main advantage of FIR filters over IIR filters is-				1 1 1
<input type="radio"/> Higher order requirements		<input checked="" type="radio"/> Linear phase response		
<input type="radio"/> Computational complexity		<input type="radio"/> None of the above		
Q8. Which technique is typically used for FIR filter design?				1 1 1
<input type="radio"/> Butterworth approximation		<input checked="" type="radio"/> Windowing techniques		
<input type="radio"/> Chebyshev approximation		<input type="radio"/> Bilinear transformation		
Q9. The process of removing redundant data points in a discrete signal is known as:				1 1 1
<input checked="" type="radio"/> Decimation		<input type="radio"/> Interpolation		
<input type="radio"/> Sampling		<input type="radio"/> Quantization		
Q10. What is the primary application of multirate signal processing?				1 1 1
<input type="radio"/> Speech recognition		<input type="radio"/> Data compression		
<input checked="" type="radio"/> Sampling rate conversion		<input type="radio"/> Image processing		

Section 2 (Answer all question(s))**Marks CO BL****Q11.** Explain the concept of stability in Linear Time-Invariant (LTI) systems.

2 2 2

Rubric	Marks
concept 2 marks	2

Q12. Describe the concept of invertibility for LTI systems.

3 2 2

Rubric	Marks
Full concept 3 marks	3

Q13. (a) Solve the difference equation $y[n] - 0.5y[n-1] = x[n]$ using Z-transforms.

5 3 3

Rubric	Marks
Each step 1 mark	5

(OR)**(b)** Explain the concept of the frequency domain representation of discrete-time signals.

Rubric	Marks
Each step 1 mark	5

Section 3 (Answer all question(s))**Marks CO BL****Q14.** Derive the relationship between the Discrete Fourier Series (DFS) and the Discrete Fourier Transform (DFT).

3 3 3

Rubric	Marks
DFS and DFT equal marks 1.5 each	3

Q15. (a) Describe the properties of the Discrete Fourier Transform (DFT) and provide examples.

7 2 2

Rubric	Marks
Each property 4 marks and example 3 marks	7

(OR)**(b)** Discuss linear filtering methods based on DFT and their applications.

Rubric	Marks
Method 4 marks and application 3 marks	7

Section 4 (Answer all question(s))**Marks CO BL****Q16.** Explain the key differences between analog and digital filter designs.

3 2 2

Rubric	Marks
Three differences (1x3)	3

Q17.(a) Design of IIR digital filters from analog filters can be performed using which techniques?
Describe one with steps.

7 3 3

Rubric	Marks
Technique- 2 marks, Design Steps 1x5	7

(OR)

(b) Discuss linear filtering methods based on DFT and their applications.

Rubric	Marks
Methods—5 marks, Applications- 2 marks	7

Section 5 (Answer all question(s))

Marks CO BL

Q18. Describe the characteristics of FIR filters with linear phase. How they affect frequency response?

3 2 2

Rubric	Marks
characteristics 1.5 marks and affect 1.5 marks	3

Q19.(a) Compare and contrast IIR and FIR filters with respect to stability, phase response, and implementation complexity.

7 2 2

Rubric	Marks
Each compare equal marks	7

(OR)

(b) Briefly describe the frequency sampling technique for FIR filter design.

Rubric	Marks
Sampling Technique Steps...1x7	7

Section 6 (Answer any 2 question(s))

Marks CO BL

Q20. Explain the process of interpolation in multirate digital signal processing, including its applications.

5 2 2

Rubric	Marks
process 3.5 marks and application 1.5 marks	5

Q21. Define decimation and explain its significance in digital signal processing.

5 1 1

Rubric	Marks
definition 3 marks and significance 2 marks	5

Q22. Describe the implementation of sampling rate converters and their impact on signal quality.

5 2 2

Rubric	Marks
describe 3 marks and impact on signal quality 2 marks	5
