

CS/B.TECH/EE/EVEN/SEM-6/EE-605A/2015-16



**MAULANA ABUL KALAM AZAD UNIVERSITY OF
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Paper Code : EE-605A

DIGITAL SIGNAL PROCESSING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any ten of the following : 10 × 1 = 10

i) The sampling frequency of the following analog signal $x(t) = 3\sin(150t) + 5\cos(200t)$ should be

- a) greater than or equal to 150 Hz
- b) greater than or equal to 200 Hz
- c) greater than or equal to 600 Hz
- d) less than or equal to 200 Hz.

[Turn over

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ii) A discrete-time system is said to be causal if and only if its impulse response $h[n]$ is

- a) zero for $n < 0$
- b) zero for $n > 0$
- c) zero at $n = 0$
- d) zero at $n = 0$.

iii) If $x[n]$ and $h[n]$ are two finite length sequences with length 6 and 5 respectively then their convolution has length

- a) 8
- b) 9
- c) 10
- d) 11.

iv) The value of the twiddle factor W_{16}^2 is given by

- a) $0 + j$
- b) $0.707 - j0.707$
- c) $0 - j$
- d) $-0.707 + j0.707$.

v) The first three points of a 4-point DFT of a real valued sequence are $\{6, -2 + j2, -2\}$. The remaining point in the DFT is

- a) $2 - j2$
- b) $2 + j2$
- c) $6 - 2j$
- d) $-2 - j2$.

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- vi) An increase in the length of the rectangular window function
- increases the main lobe width and computational burden
 - increases the main lobe width and decreases computational burden
 - decreases the main lobe width and computational burden
 - decreases the main lobe width and increase computational burden.
- vii) If $x[n] \leftrightarrow X(z)$, then
- $x[-n] \leftrightarrow X(-z)$
 - $x[-n] \leftrightarrow zX(z)$
 - $x[-n] \leftrightarrow X(z)/z$
 - $x[-n] \leftrightarrow X(1/z)$.
- viii) The digital system is $y(n) = x(n^2)$ is
- linear and causal
 - non-linear and causal
 - linear and non-causal
 - non-linear and non-causal.

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- ix) Zero padding of a signal
- reduces aliasing
 - increases frequency
 - increases time resolution
 - has no effect.
- x) The convolution of $u(n)$ with $u(n-4)$ at $n=5$ is
- 5
 - 2
 - 1
 - 0.
- xi) Stability criteria for discrete time LTI system is
- $h(n) > 1$
 - $h(n) < 1$
 - $h(n) = 1$
 - $h(n) = 0$.
- xii) The ROC of the z-transform causal sequence is
- the interior of circle
 - the exterior of circle
 - a rectangle
 - an annular region.
- xiii) For a 32 point sequence, radix 2 FFT algorithm involves
- 160 complex additions and 160 complex multiplications
 - 80 complex additions and 80 complex multiplications
 - 160 complex additions and 80 complex multiplications
 - 80 complex additions and 160 complex multiplications.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Determine the z-transform of the following sequence and find its ROC :

$$x(n) = (n + 0.5) \left(\frac{1}{3}\right)^n u(n)$$

3. Determine the Fourier transform of the signal

$$x(n) = 2^n u(-n) - 2^{-n} u(n).$$

4. Determine the convolution of the given sequences by z-transform to the input signal

$$h(n) = (0.5)^n u(n)$$

$$x(n) = 3^n u(-n).$$

5. If $x(n) = \{1, 3, 2\}$ and $y(n) = \{1, 2\}$, find the linear convolution $x(n) * y(n)$ using DFT based approach.

6. For the sequence $x(n) = \{1, 1, 0, -1, -1, 0, 0\}$, determine the 8-point DFT.

GROUP - C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Find the 8-point DFT using decimation in time FFT algorithm for a sequence $x(n) = \{1, 3, 5, 7, 2, 4, 6, 8\}$.
 b) What do you mean by zero padding ?
 c) Using linear convolution find $y(n) = x(n) * h(n)$ for the sequence $x(n) = \{1, 2, -1, -2, 0, 1, 3, -1\}$.
 Compare the result by solving the problem using
 i) overlap save method
 ii) overlap add method. $5 + 2 + 8$
8. a) Explain impulse invariant method of designing IIR digital filter.
 b) Design and realize a digital LPF using bilinear transformation method to satisfy the following specifications :
 i) Monotonic stop and pass band
 ii) -3dB cutoff frequency at 0.5π
 iii) Magnitude down to at least 15 dB at 0.75π .

9. a) Distinguish between FIR and IIR filters.
 b) What is warping effect in bilinear transformation ?
 How can you remove this effect ?
 c) The output and input of a recursive DTLTI system are related by the equation

$$y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2).$$

Derive and draw the direct form II structure of realizing the system.

- d) Check the stability of the system defined by
 $y(n) = x(n) + x(n-1)/2 + x(n-2)/4.$

$$3 + (2 + 2) + 5 + 3$$

10. a) Find out inverse z-transform of
 $X(z) = \log(1 - 0.5z^{-1}); |z| > 0.5$ using differential property. 5

- b) Determine whether the system is (i) causal, (ii) stable.

i) $h(n) = 2^n u(-n)$

ii) $h(n) = 8(n) + \sin nn.$ 4 + 4

- c) Define discrete Fourier series. 2

11. a) State and prove the time shifting property and differentiation property of z-transform.

- b) Find the z-transform and ROC of the sequence

$$x(n) = -(0.8)^n u(-n-1) - (1.3)^n u(-n-1).$$

$$4 + 4 + 7$$

12. Write short notes on any *three* of the following : 3 × 5

- a) Radix-2 DIF algorithm
 b) Mapping of s-plane into z-plane
 c) BIBO stability
 d) Causal and non-causal systems
 e) TMS320C 6713 architecture
 f) Odd & Even signal.