

**DIGITAL SIGNAL PROCESSING & APPLICATIONS
(ECEN 3202)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The unit step response of an LTI system with impulse response $h(n) = \delta(n) - \delta(n-1)$ is
(a) $\delta(n-1)$ (b) $u(n-1)$ (c) $\delta(n)$ (d) $u(n)$.
 - (ii) Energy of given signal $x(n) = e^{j(\pi/2 n + \pi/8)}$ is
(a) 0 (b) 1 (c) n (d) α
 - (iii) A system characterized by the system function $H(z) = \frac{1}{2} (1 - z^{-1})$ is a
(a) low pass filter (b) high pass filter
(c) band pass filter (d) band stop filter.
 - (iv) Direct evaluation of N point DFT require
(a) N^2 multiplication and N^2 addition
(b) $N(N-1)$ multiplication and N^2 addition
(c) N multiplication and N addition
(d) N^2 multiplication and $N(N-1)$ addition.
 - (v) The ROC of Z-transform of the signal $2^n u(n) - 3^n u(-n-1)$ is
(a) $|z| < 2$ (b) $2 < |z| < 3$ (c) $|z| > 3$ (d) none of these.
 - (vi) Overlap save method used to determine
(a) Circular convolution (b) linear convolution
(c) DFT (d) FFT.
 - (vii) The mapping from analog to digital domain in impulse invariant method is
(a) One to many (b) One to one
(c) Many to many (d) Many to one.
 - (viii) Down sampler is usually preceded by a LPF. This combination is called
(a) Rational sampling rate converter (b) Interpolator
(c) Band pass filter (d) Decimator.

- (ix) An FIR filter is always stable because of all of its poles are
 (a) at the origin (b) at the infinity
 (c) at the ROC (d) inside the unit circle.
- (x) As the length of window increases in designing a FIR filter, the width of main lobe
 (a) Does not change (b) Zero
 (c) Decreases (d) Increase.

Group – B

2. (a) Two discrete time signal $x(n)$ and $h(n)$ are both non zero only for $n = 0,1,2$ and are zero otherwise. It is given that $x(0) = 1$, $x(1) = 2$, $x(2) = 1$ and $h(0) = 1$. If $y(n)$ be the linear convolution of $x(n)$ and $h(n)$, then find the value of expression $10y(3) + y(4)$ where $y(1) = 3$ and $y(2) = 4$.
- (b) Find the impulse response of the system described by difference equation $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$ using z-transform.
- (c) Determine the z-transform of signal $x(n) = n^2 u(n)$.
- 5 + 4 + 3 = 12**
3. (a) Find the inverse z-transformation of $X(z) = z(z+1)/(z-1)(z-3)$ $1 < |z| < 3$ using
 (i) Partial fraction method
 (ii) Convolution method.
- (b) Find Inverse z-transformation of $X(z) = \log(1-az^{-1})$ using differentiation property.
- (c) Why the system will be stable if all poles will be lie inside unit circle?
- 6 + 3 + 3 = 12**

Group – C

4. (a) Prove the circular time shifting property of DFT $x((n-m)) = X(K) e^{-j2\pi km/N}$.
- (b) Using linear convolution, find $y(n) = x(n) * h(n)$ for the sequence $x(n) = \{2, -1, 0, 1, 2, 1, 0, 1, 3, 1\}$ and $h(n) = \{1, 2, -1\}$ and compare the result by solving problem using overlap save method for $N = 5$.
- 5 + 7 = 12**
5. (a) Determine the output response $y(n)$ if $h(n) = \{3, 2, 4\}$ and $x(n) = \{1, 1, 2, 4\}$ by Circular convolution using zero padding to obtain linear convolution.
- (b) Compute the DFT of sequence $x(n) = \cos(n\pi / 2)$ using radix 2 DIT-FFT and radix 2 DIF-FFT algorithm where $N=4$.
- (c) Why it is not possible to take the DFT of sequence having infinite length?
- 4 + 6 + 2 = 12**

Group – D

6. (a) What are the advantages of Bilinear transformation method over impulse invariance method.
- (b) For the given specifications design an Analog Butterworth filter.
 $0.9 \leq |H(j\Omega)| \leq 1 \quad 0 \leq \Omega \leq 0.2\pi$
 $|H(j\Omega)| \leq 0.2 \quad 0.4\pi \leq \Omega \leq \pi$
- (c) An LTI system with unit sample response $h(n) = 5\delta(n) - 7\delta(n-1) + 7\delta(n-3) - 5\delta(n-4)$ is a response of LPF, HPF or BPF and justify it.
- 3 + 6 + 3 = 12**
7. (a) What is warping effect? What is its effect on magnitude and phase response?
- (b) Design a ideal low pass FIR filter with frequency response using Fourier series method
 $H_d(e^{jw}) = 1 \quad \text{for } -\pi/2 \leq w \leq \pi/2$
 $= 0 \quad \pi/2 \leq w \leq \pi$
 Find the value of $h(n)$ for $N=11$ and also $H(z)$.
- 4 + 8 = 12**

Group – E

8. (a) Obtain the direct form II and parallel form realization for the system
 $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$
- (b) Show that the up sampler and down sampler are time variant systems.
- (c) What are the advantage of multirate signal processing over single rate processing
- 6 + 3 + 3 = 12**
9. (a) With the help of neat diagram describe the memory architecture of TMS320C54X and give the comparison between DSP processor and general purpose microprocessor.
- (b) What is the need for anti imaging filter prior to down sampling and anti imaging filter after up sampling a signal?
- 8 + 4 = 12**

Department & Section	Submission Link
ECE	https://classroom.google.com/u/0/w/MjI1NDI3NDg3Nzgy/tc/MzY0NTM4ODk1MzIz