M.TECH/ECE/2ND SEM/ECEN 5202/2021

ADVANCED DSP AND APPLICATIONS
(ECEN 5202)

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) Linear Phase system have a constant
(a) Phase (b) Group Delay
(c) Magnitude (d) Phase and magnitude.

(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) Energy of given signal $x(n) = e^{j(\pi/2\, n + \pi/8)}$ is
(a) 0 (b) 1 (c) α (d) n

(v) A rational system function with all its poles inside the unit circle and all zeros outside the unit circle is said to have
(a) Linear phase (b) Minimum phase
(c) Rational Phase (d) Maximum phase.

(vi) As the length of window increases in designing a FIR filter, the width of main lobe
(a) Does not change (b) Is Zero
(c) Increase (d) Decreases.

(vii) Zero padding means
(a) Value of a sequence X(k) is zero (b) Zero values appearing in X(k)
(c) Padding dummy values zero in X(k) (d) None of these.

(viii) Down sampler is usually preceded by a LPF. This combination is called
(a) Decimator (b) Rational sampling rate converter
(c) Interpolator (d) None of these.

(ix) Out of all the windows available, the one which has the narrowest main lobe for a given length is

(a) Rectangular (b) Hanning

(c) Blackman (d) Hamming

(x) In bilinear transformation method, relationship between ω and Ω is given by;

(a) $\Omega = \frac{2}{T_s}\tan\frac{\omega}{2}$ (b) $\Omega = \tan\frac{\omega}{2}$

(c) $\Omega = \frac{1}{T_s}\tan\frac{\omega}{2}$ (d) $\Omega = \frac{1}{T_s}\tan\frac{\omega}{4}$.

Group – B

2. (a) Two discrete time signals 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 10 y(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) A linear time invariant system is describe by following difference equation y(n) = ay(n-1) +bx(n); . Determine the magnitude and phase of frequency response H (w) of system.

5 + 4 + 3 = 12

3. (a) Write down the properties of Cross correlation and auto correlation.

(b) Compute the auto correlation of the signal $x(n) = a^n u(n)$ $0< a <1$.

(c) A linear time invariant system is characterized by the system function $H(z) = (3 - 4 z^{-1})/(1- 3.5 z^{-1}+1.5z^{-2})$

Specify the ROC of H(z) and determine h(n) for the following condition.

(i) The system is stable.

(ii) The system is causal.

(iii) The system is anti-causal.

3 + 3 + 6 = 12

Group – C

4. A linear time invariant system is described by the following difference equation y(n) = ay(n-1) + bx(n) ; $0< a <1$

(i) Determine the magnitude and phase of the frequency response H(w) of the system.

(ii) Choose the parameter b so that the maximum value |H(w) is unity.

(iii) Determine the output of the system to the input signal $x(n) = 5+ 12 \sin(\pi/2)n$.

4 + 3 + 5 = 12

5. (a) State the invertibility of linear time invariant system.

(b) Determine the inverse of the system having impulse response h(n) = δ(n) - δ(n-1).

(c) What is the input signal x(n) that will generate the output sequence y(n) = {1,5,10,11,8,4,1} for a system having impulse response h(n) ={1,2,1}?

(d) What do you mean by Homomorphic deconvolution?

2 + 4 + 4 + 2 = 12

Group – D

6. (a) Why is there a need for windowing technique?

(b) Design a ideal low pass FIR filter with frequency response using Fourier series method:

$H_d(e^{jw}) = 1$ for $-\pi/2 \le w \le \pi/2$

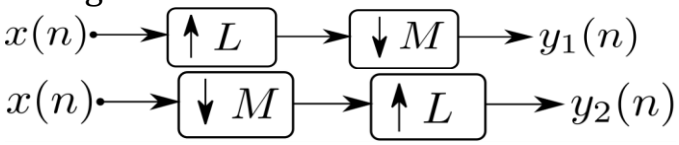
$= 0$ $\pi/2 \le w \le \pi$

Find the value of h(n) for N=11and also H(z) .

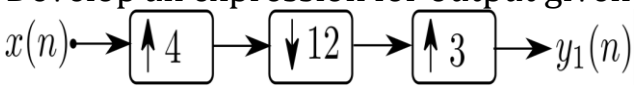
3 + 9 = 12

7. (a) What do you mean by decimator and interpolator? Why up sampler is usually followed by low pass filter?

(b) Consider the system shown below if M=L, show that the output of two configuration are different.



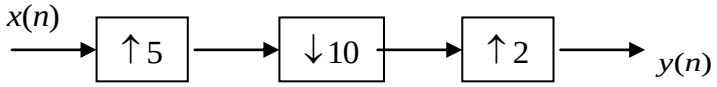
(c) Develop an expression for output given below.



4 + 4 + 4 = 12

Group – E

8. (a) A multirate system is shown in the following figure:



Develop an expression for the output $y(n)$ as a function of the input $x(n)$.

(b) What is the need for anti-aliasing filter prior to down sampling?

(c) Consider a sample sequence $x(n)$ = { 0, 3, 6, 9, 12 }. Using linear interpolation method increase the sampling rate for L=2.

5 + 2 + 5 = 12

9. Write short notes on any two of following.
   (i) Window technique for FIR design.

(ii) Multirate Signal Processing.
(iii) Wavelet Transform.
(iv) Kalman filter.

(6 + 6) = 12

Department & Section	Submission Link
ECE	https://classroom.google.com/c/MzQyNTc0NzUyMTIy/a/MzcxNjc0MzU4OTM0/details