INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

Department of Electrical and Electronics Engineering

ASSIGNMENT QUESTIONS

Course Title	**DIGITAL SIGNAL PROCESSING**			
Course Code	**A70421**			
Regulation	**R15**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	**-**	**-**	**4**
Course Coordinator	Mr. A Naresh Kumar, Assistant Professor, EEE			
Team of Instructors	Mr. A Naresh Kumar, Assistant Professor, EEE			

OBJECTIVES

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited.

In line with this, Faculty of Institute of Aeronautical Engineering, Hyderabad has taken a lead in incorporating philosophy of outcome based education in the process of problem solving and career development. So, all students of the institute should understand the depth and approach of course to be taught through this question bank, which will enhance learner's learning process

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT - I **INTRODUCTION**		
	Part – A (Short Answer Questions)		
1	Define symmetric and anti symmetric signals.	Remember	1
2	Explain about impulse response?	Understand	7
3	Describe an LTI system?	Understand	6
4	List the basic steps involved in convolution?	Remember	2
5	Discuss the condition for causality and stability?	Understand	1
	Part – B (Long Answer Questions)		
1	Identify a causal system. a) $y(n)=x(2n)$ b) $y(n)=x(n)-x(n-1)$ c) $y(n)=nx(n)$ d) $y(n)=x(n)+x(n+1)$	Understand	1
2	Determine the impulse response and the unit step response of the systems described by the difference equation y(n) = 0.6y(n-1)-0.08 y(n-2) + x(n).	Remember	2
3	The impulse response of LTI system is h(n)={1 2 1-1} Determine the response of the system if input is x(n)={1 2 31}	Understand	1

4	Determine the output y(n) of LTI system with impulse response $h(n)= a^n u(n)$. $\lvert a \rvert<1$ When the input is unit input sequence that is x(n)=u(n)	Remember	2
5	Determine impulse response for cascade of two LTI systems havimg Impulse responses of $H_1(n)=(1/2)^n u(n)$ $H_2(n)=(1/4)^n u(n)$	Remember	1
6	a) Show that the fundamental period N_p of the signals $s_k(n)= e^{j2\pi kn/N}$ for k=0 2 ….. is given by N_p = N/GCD(k) where GCD is the greatest common divisor of k and N. b) What is the fundamental period of this set for N=7? c) What is it for N=16?	Remember	1
7	Consider the simple signal processing system shown in below figure. The sampling periods of the A/D and D/A converters are T=5ms and T'= 1ms respectively. Determine the output $y_a(t)$ of the system. If the input is $x_a(t)$ =3 cos 100πt + 2 sin 250πt (t in seconds)	Remember	1
8	The postfilter removes any frequency component above $F_s/2$. Determine the response *y(n)*	Understand	2
9	Consider the interconnection of LTI systems as shown below a) Express the overall impulse response in terms of $h_1(n)$ $h_3(n)$ and $h_4(n)$ b) Determine h(n) when $h_1(n)$={1/2 1/2} $h_2(n)=h_3(n)=(n+1)u(n)$ $h_4(n)=\delta(n-2)$ c) Determine the response of above system if x(n)= δ(n+2)+3 δ(n-1)-4 δ(n-3)	Remember	2
10	Use the one-sided Z-transform to determine y(n) n ≥ 0 in the following cases. (a) y(n)−1.5y(n−1) +0.5y(n−2) = 0; y(−1) = 1; y(−2) = 0 (a) Compute the 10 first samples of its impulse response. (b) Find the input-output relation. (c) Remember the input x(n) = {1 1. . . .} and compute the first 10 samples of the output. (d) Compute the first 10 samples of the output for the input given in part (c) by using convolution. (e) Is the system causal? Is it stable?	Understand	2
UNIT - II DISCRETE FORUIER SERIES			
Part – A (Short Answer Questions)			
1	Define discrete fourier series?	Remember	8
2	Distinguish DFT and DTFT	Understand	8
3	Define N-pint DFT of a sequence x(n)	Remember	8
4	Define N-pint IDFT of a sequence x(n)	Remember	8
5	State and prove time shifting property of DFT.	Remember	8
Part – B (Long Answer Questions)			
1	Determine the fourier series spectrum of signals i) x(n)=cos√2πn ii) cosπn/3 iii) x(n) is periodic with period N=4 and x(n)={1 1 0 0}	Remember	8
2	Determine fourier transform and sketch energy density spectrum of signal X(n)=|a|-1<a<1	Remember	8
3	Determine fourier transform and sketch energy density spectrum of signal X(n)= A 0≤n≤L-1 otherwise	Remember	8
4	Derive relation between fourier transform and z-transform	Remember	8
5	Let X(k) be a 14-point DFT of a length 14 real sequence x(n).The first 8 samples of X(k) are given by X(0)=12 X(1)=-1+j3 X(2)=3+j4 X(3)=1-j5 X(4)=-2+2j X(5)=6+j3 X(6)=-2-j3 X(7)=10.Determine the remaining samples	Understand	8

6	The linear convolution of length-50 sequence with a length 800 sequence is tobe computed using 64 point DFT and IDFT a) what is the smallest number of DFT and IDFT needed to compute the linear convolution using overlap-add method b) what is the smallest number of DFT and IDFT needed to compute the c) linear convolution using overlap-save method	Remember	8
7	The DTFT of a real signal x(n) is X(F). How is the DTFT of the following signals related to X(F). (a) y(n)=x(-n) (b) r(n)=x(n/4) (c) h(n) $=j^n x(n)$	Remember	8
8	Consider the sequences x1(n) = {0 1 2 3 4} x2(n) = {0 1 0 0 0} x3(n) = {1 00 0 0} and their 5 point DFT. (a) Determine a sequence y(n) so that Y(k) =X1(k) X2(k) Is there a sequence x3(n) such that S(k) =X1(k) X3(k)	Remember	8
9	Consider a finite duration sequence x(n) = {0 1 2 3 4} (a) Sketch the sequence s(n) with six-point DFT S(k) = w_2^k X(k) k=0 16 (b) Sketch the sequence y(n) with six-point DFT Y(k) = Re|X(k)| (c) Sketch the sequence v(n) with six-point DFT V(k) = Im|X(k)|	Remember	8
	UNIT - III **IIR DIGTAL FILTERS**		
	Part – A (Short Answer Questions)		
1	Give the magnitude function of butter worth filter. What is the effect of varying order of N on magnitude and phase response?	Understand	10
2	Give any two properties of butter worth low pass filter	Remember	10
3	What are properties of chebyshev filter	Remember	10
4	Give the equation for the order of N and cutoff frequency of butter worth filter	Remember	10
5	What is an IIR filter?	Remember	10
6	What is meant by frequency warping? What is the cause of this effect?	Remember	10
7	Distinguish between butter worth and chebyshev filter	Understand	10
8	How can design digital filters from analog filters	Understand	10
9	what is bilinear transformation and properties of bilinear transform	Remember	10
10	what is impulse invariant method of designing IIR filter	Remember	10
	Part – B (Long Answer Questions)		
1	Given the specification α_p=1dB, α_s=30dB,Ω_p=200rad/sec, $_s$=600rad/sec. Determine the order of the filter	Understand	10
2	Determine the order and the poles of lowpass butter worth filter that has a 3 dB attenuation at 500Hz and an attenuation of 40dB at 1000Hz	Remember	10
3	Design an analog Butterworth filter that as a -2dB pass band attenuation at a frequency of 20rad/sec and at least -10dB stop band attenuation at 30rad/sec	Understand	10
4	For the given specification design an analog Butterworth filter $0.9\leq\|H(j\Omega)\|\leq1$ for $0\leq\Omega\leq0.2\pi$ $\|H(j\Omega)\|\leq0.2\pi$ for $0.4\pi\leq\Omega\leq\pi$	Remember	10
5	For the given specifications find the order of butter worth filter α_p=3dB, α_s=18dB, f_p=1KHz, f_s=2KHz.	Understand	10
6	Design an analog butter worth filter that has α_p=0.5dB, α_s=22dB, f_p=10KHz, f_s=25KHz Find the pole location of a 6th order butter worth filter with Ω_c=1 rad/sec	Understand	10
7	Given the specification α_p=3dB, α_s=16dB, f_p=1KHz, f_s=2KHz. Determine the order of the filter Using chebyhev approximation. find H(s).	Understand	10

8	Obtain an analog chebyshev filter transfer function that satisfies the constraints $0 \le \lvert H(j\Omega) \rvert \le 1$ for $0 \le \Omega \le 2$.	Understand	10
9	Determine the order and the poles of type 1 low pass chebyshev filter that has a 1 dB ripple in the pass band and pass band frequency $\Omega_p = 1000\pi$ and a stop band of frequency of 2000π and an attenuation of 40dB or more.	Understand	10
10	For the given specifications find the order of chebyshev-I α_p=1.5dB, α_s=10dB, Ω_p =2rad/sec, Ω_s =30 rad/sec.	Understand	10

UNIT – IV
FIR DIGTAL FILTERS

Part – A (Short Answer Questions)

1	What is mean by FIR filter? and What are advantages of FIR filter?	Understand	13
2	What is the necessary and sufficient condition for the linear phase characteristic of a FIR filter?	Remember	13
3	List the well known design technique for linear phase FIR filter design?	Understand	13
4	For what kind of Remember, the symmetrical impulse response can be used?	Remember	13
5	Under what conditions a finite duration sequence h(n) will yield constant group delay in its frequency response characteristics and not the phase delay?	Understand	13

Part – B (Long Answer Questions)

1	Determine the frequency response of FIR filter defined by (n)=0.25x(n)+x(n-1)+.25x(n-2) Calculate the phase delay and group delay.	Understand	13
2	The frequency response of Linear phase FIR filter is given by $H(e^{jw})$=cos(w/2+1/2) + cos3w/2 . Determine the impulse response (n).	Remember	13
3	If the frequency response of a linear phase FIR filter is given by $H(e^{jw})= e^{-jw2}(.30+0.5\cos\omega+0.3\cos 2\omega)$ Determine filter coefficients.	Understand	13
4	Design an ideal highpass filter with a frequency respose $H_d(e^{jw})=1$ for $\pi/4 \le \lvert \omega \rvert \le \pi$ 0 for $\lvert \omega \rvert \le \pi/4$ Find the values of h(n) for N=11.Find H(z).plot magnitude response.	Remember	13
5	Design an ideal bandpass filter with a frequency respose $H_d(e^{jw})=1$ for $\pi/4 \le \lvert \omega \rvert \le 3\pi/4$ 0 for $\lvert \omega \rvert \le \pi/4$ Find the values of h(n) for N=11.Find H(z).plot magnitude response.	Understand	13
6	Design a filter with Hd(ejώ) = e- 3 jώ, $\pi/4 \le \omega \le \pi/4$ 0 for $\pi/4 \le \omega \le \pi$ using a Hamming window with N=7.	Understand	13
7	H (w) =1 for $\lvert \omega \rvert \le \pi/3$ and $\lvert \omega \rvert \ge 2\pi/3$ otherwise for N=11. and find the response	Remember	13
8	Design a FIR filter whose frequency response H (e jώ) = 1 $\pi/4 \le \omega \le 3\pi/4$ 0 $\lvert \omega \rvert \le 3\pi/4$. Calculate the value of h(n) for N=11 and hence find H(z).	Understand	13
9	Design an ideal differentiator with frequency response H (e jώ) = jw $-\pi \le \omega \le \pi$ using hamming window for N=8 and find the frequency response.	Remember	13
10	Design an ideal Hilbert transformer having frequency response H (e jώ) = j $-\pi \le \omega \le 0$ -j $0 \le \omega \le \pi$ for N=11 using rectangular window.	Understand	13

UNIT - V
MULTIRATE DIGITAL SIGNAL PROCESSING

Part – A (Short Answer Questions)

1	What is decimation by factor D	Understand	12
2	What is interpolation by factor I	Remember	12
3	Find the spectrum of exponential signal	Understand	12
4	Find the spectrum of exponential signal decimated by factor 2.	Remember	12

5	Find the spectrum of exponential signal interpolated by factor 2	Understand	12
Part – B (Long Answer Questions)			
1	Derive the expression for decimation by factor D	Understand	12
2	Derive the expression for interpolation by factor I	Remember	12
3	Write notes on sampling rate conversion by a rational factor I/D	Understand	12
4	Write notes on filter design and implementation for sampling rate conversion	Remember	12
5	Explain poly phase filter structures	Remember	12
6	a) Describe the decimation process with a neat block diagram. b) Consider a signal x(n)=sin(∏n)U(n). Obtain a signal with an interpolation factor of '2'	Understand	12
7	b) Why multirate digital signal processing is needed? c) Design a two state decimator for the following specifications. Decimation factor = 50 Pass band = 0<f<50 Transitive band = 50≤f≤ 55 Input sampling = 10 KHz Ripple = δ1=0.1,δ2=0.001.	Remember	12
8	a) What are the advantages and drawbacks of multirate digital signal processing b) Design a decimator with the following specification D = 5, δp=,0.025 δs=0.0035, ωs= 0.2∏ Assume any other required data.	Understand	12
9	Design one-stage and two-stage interpolators to meet the following Specification :*l=20* Input sampling rate: 10K Hz Passband: $0 \leq F \leq 90$ Transition band: $90 \leq F \leq 100$ Ripple: $\delta_1 = 10^{-2}$, $\delta_2 = 10^{-3}$	Remember	12
10	Design a linear pahse FIR filter that satisfies the following specifications based on a single- stage and two-stage multirate structure. Input sampling rate: 10K Hz Passband: $0 \leq F \leq 60$ Transition band: $60 \leq F \leq 65$ Ripple: δ1 =10-1,δ2 = 10-3	Remember	12

Prepared By: **Mr. A Naresh Kumar, Assistant Professor, EEE**

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