Hall Ticket No | | | | | | | | | | | Question Paper Code: AEC012

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER

B.Tech VI Semester End Examinations, April - 2020
Regulation: IARE-R16
DIGITAL SIGNAL PROCESSING
(Electronics and Communication Engineering)

Time: 3 Hours **Max Marks: 70**

Answer any ONE question from each Unit
All questions carry equal marks
All parts of the question must be answered in one place only

UNIT – I

1 a) Determine whether the following system is [7M]

i. Linear
ii. Causal
iii. Stable
iv. Time invariant

$y(n) = \log_{10} |x(n)|$. Justify your answer.

b) Determine the convolution of the pairs of signals by means of z-transform $X1(n)=(1/2)^n u(n)$, $X2(n)= \cos\pi n\, u(n)$. [7M]

2 a) Determine the impulse response and the unit step response of the systems described by the difference equation , $y(n) = 0.6y(n-1)-0.08\, y(n-2) + x(n)$. [7M]

b) Obtain the i) Direct forms ii) cascade iii) parallel form realizations for the following systems $y(n) = 3/4(n-1) – 1/8\, y(n-2) + x(n) +1/3\, x(n-1)$ [7M]

UNIT – II

3 a) Derive the complete DIF FFT for 8-point sequence and draw signal flow graph. [7M]

b) compute the linear convolution of finite duration sequences h (n) = {1, 2} and x(n) = {1, 2, -1, 2,3, -2, -3, -1, 1, 1, 2, -1 } by overlap add method. [7M]

4 a) Find DFT of following sequence for N=4 and N=8 and plot magnitude of DFT X(k) and comments on results obtained. [7M]

$$x(n) = \begin{cases} 1 & \text{for } 0 \le n \le 2 \\ 0 & \text{for other wise} \end{cases}$$

b) What are the differences and similarities between DIT and DIF FFT algorithms [7M]

UNIT – III

5 a) Discuss and Explain Analog Low pass Chebyshev Filters including type I and type -II [7M]

b) Design an analog Butterwoth filter has a -2db passband attenuation at a frequency of 20 rad/sec. and at least -10db stop band attenuation at 30 rad/sec. [7M]

6 a) Apply bilinear transformation to H(s)=2/(s+1) (s+2) with T is 1 sec, find H(z). [7M]

b) Discuss & Explain Transformation of Analog filters into equivalent digital filters using Bilinear transformation method [7M]

UNIT – IV

7 a) What are the important features of FIR filter and explain advantages and disadvantages of FIR filters over IIR flters [7M]

b) Design a high pass filter using hamming window with a cut-off frequency of 1.2radians/second and N=9 [7M]

8 a) Using frequency sampling method design a band pass filter with following specifications [7M]
Sampling frequency F=8000Hz
Cut off frequency fc1=1000Hz fc2=3000Hz
Determine the filter coefficients for N=7

b) Explain optimized design of FIR filter using least mean square error method. [7M]

UNIT – V

9 a) Explain the limit cycle oscillations due to product round off and overflow errors [7M]

b) i. Discuss the various common methods of quantization. [7M]
ii. Explain the finite word length effects in FIR digital filters.

10 a) Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation $y(n) = 0.45y(n - 1) + x(n)$ when the product is quantized to 5 – bits by rounding. The system is excited by an input $x(n) = 0.75$ for $n = 0$ and $x(n) = 0$ for $n \neq 0$. Also determine the dead band of the filter. [7M]

b) Two first order filters are connected in cascaded whose system functions of the individual sections are $H1(z)=1/(1-0.8z^{-1})$ and $H2(z)=1/(1-0.9z^{1})$. Determine the overall output noise power. [7M]

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COURSE OBJECTIVES:

The course should enable the students to:

I	Provide background and fundamental material for the analysis and processing of digital signals and to familiarize the relationships between continuous-time and discrete-time signals and systems.
II	Study fundamentals of time, frequency and z-plane analysis and to discuss the inter-relationships of these analytic method and to study the designs and structures of digital (IIR and FIR) filters from analysis to synthesis for a given specifications.
III	Introduce a few real-world signal processing applications.
IV	Acquaint in FFT algorithm, multi-rate signal processing techniques and finite word length effects.

COURSE OUTCOMES (COs):

CO1	Interpret, represent and process discrete/digital signals and systems
CO2	Understanding of time domain and frequency domain analysis of discrete time signals and systems.
CO3	Understand DFT for the analysis of digital signals & systems
CO4	Demonstrate and analyze DSP systems like FIR and IIR Filter
CO5	Understand multi rate signal processing of signals through systems.

COURSE LEARNING OUTCOMES:

AEC012.01	Understand how digital to analog (D/A) and analog to digital (A/D) converters operate on a signal and be able to model these operations mathematically.
AEC012.02	Define simple non-periodic discrete-time sequences such as the impulse and unit step, and perform time shifting and time-reversal operations on such sequences.
AEC012.03	Given the difference equation of a discrete-time system to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI (linear time-invariant) systems.
AEC012.04	Given the impulse response of a causal LTI system, show whether or not the system is bounded-input/bounded-output (BIBO) stable.
AEC012.05	Perform time, frequency and Z-transform analysis on signals.
AEC012.06	From a linear difference equation of a causal LTI system, draw the Direct Form I and Direct Form II filter realizations.
AEC012.07	Knowing the poles and zeros of a transfer function, make a rough sketch of the gain response.
AEC012.08	Define the Discrete Fourier Transform (DFT) and the inverse DFT (IDFT) of length N.
AEC012.09	Understand the inter-relationship between DFT and various transforms.
AEC012.10	Understand the significance of various filter structures and effects of round-off errors.
AEC012.11	Understand the fast computation of DFT and appreciate the FFT Processing.
AEC012.12	Design of infinite impulse response (IIR) filters for a given specification.
AEC012.13	Design of finite impulse response (FIR) filters for a given specification.
AEC012.14	Compare the characteristics of IIR and FIR filters.
AEC012.15	Understand the tradeoffs between normal and multi rate DSP techniques and finite length word effects.

AEC012.16	Understand the signal interpolation and decimation, and explain their operation
AEC012.17	Explain the cause of limit cycles in the implementation of IIR filters.

MAPPING OF SEMESTER END EXAMINATION TO COURSE LEARNING OUTCOMES:

SEE Question No.		Course Learning Outcomes		COs	Blooms Taxonomy Level
1	a	AEC012.02	Define simple non-periodic discrete-time sequences such as the impulse and unit step, and perform time shifting and time-reversal operations on such sequences.	CO 1	Understand
	b	AEC012.03	Given the difference equation of a discrete-time system to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI (linear time-invariant) systems.	CO 1	Understand
2	a	AEC012.03	Given the difference equation of a discrete-time system to demonstrate linearity, time-invariance, causality and stability, and hence show whether or not a given system belongs to the important class of causal, LTI (linear time-invariant) systems.	CO 1	Understand
	b	AEC012.06	From a linear difference equation of a causal LTI system, draw the Direct Form I and Direct Form II filter realizations.	CO 1	Understand
3	a	AEC012.11	Understand the fast computation of DFT and appreciate the FFT Processing.	CO 2	Understand
	b	AEC012.11	Understand the fast computation of DFT and appreciate the FFT Processing.	CO 2	Understand
4	a	AEC012.11	Understand the fast computation of DFT and appreciate the FFT Processing.	CO 2	Understand
	b	AEC012.11	Understand the fast computation of DFT and appreciate the FFT Processing.	CO 2	Remember
5	a	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 3	Understand
	b	AEC012.14	Compare the characteristics of IIR and FIR filters.	CO 3	Remember
6	a	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 3	Understand
	b	AEC012.14	Compare the characteristics of IIR and FIR filters.	CO 3	Understand
7	a	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 4	Understand
	b	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 4	Understans
8	a	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 4	Understand
	b	AEC012.13	Design of finite impulse response (FIR) filters for a given specification.	CO 4	Understand
9	a	AEC012.17	Explain the cause of limit cycles in the implementation of IIR filters.	CO 5	Understand
	b	AEC012.16	Understand the signal interpolation and decimation, and explain their operation	CO 5	Remember
10	a	AEC012.14	Compare the characteristics of IIR and FIR filters.	CO 5	Understand
	b	AEC012.14	Compare the characteristics of IIR and FIR filters.	CO 5	Remember

Signature of Course Coordinator **HOD, ECE**