Code: 13A04602 **R13**

B.Tech III Year II Semester (R13) Regular & Supplementary Examinations May/June 2017

DIGITAL SIGNAL PROCESSING

(Common to ECE and EIE)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What are the various methods of representing discrete time signal? Give examples.

(b) Define the frequency response of a discrete-time system.

(c) Why FFT is needed?

(d) Draw the flow graph of a two-point radix-2 DIF-FFT.

(e) Realize $y(n) + y(n+1) + \frac{1}{4}y(n-2) = x(n)$ in cascade form network.

(f) Write the procedure for FIR system design by frequency sampling method.

(g) Compare IIR filter and FIR Filter.

(h) List the characteristics of FIR filters designed using windows.

(i) What is the need for multistage structure implementation?

(j) Name the various methods of FIR filter design.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Compute the DFT of a sequence $(-1)^n$ for N = 4.

(b) Define the terms (i) Linearity. (ii) Time invariance. (iii) Causality as applied to a discrete time system.

OR

3 Determine and sketch the magnitude and phase sequence of $y(n) = \frac{1}{2}\{x(n) + x(n-2)\}$.

UNIT – II

4 Given $X(n) = 2^n$ and N = 8, find X(k) using DIT-FFT algorithm.

OR

5 Let x(n), 0 ≤ n ≤ N-1 be a sequence with an N-point DFT X(k), 0 ≤ k ≤ N -1

(a) if x(n) is symmetric satisfying the condition x(n) = x(N -1- n), show that $X(\frac{N}{2})$ = 0 for N even.

(b) if x(n) is antisymmetric satisfying the condition x(n) = -x(N -1- n), show that $X(0)$ = 0 for N even.

UNIT – III

6 Obtain the direct form I, direct form II and cascade form from realization for the system:

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

OR

7 Given the system function $H(z) = \frac{2+8z^{-1}+6z^{-2}}{1+8z^{-1}+12z^{-2}}$ realize using ladder structure.

UNIT – IV

8 Convert the analog filter with system function $H_a(s)$ into digital filter using bilinear transformation.

$$H_a(s) = \frac{S+0.3}{(S+0.3)^2+16}$$

OR

9 Determine the coefficients of a linear-phase FIR filter of length N=15 which has a symmetric unit sample response and a frequency response that satisfies the conditions

$$H\left(\frac{2\pi k}{15}\right) = \begin{cases} 1 & ; \text{ for } k = 0,1,2,3 \\ 0.4 & ; \text{ for } k = 4 \\ 0 & ; \text{ for } k = 5,6,7 \end{cases}$$

UNIT – V

10 (a) Write notes on filter design and implementation for sampling rate conversion.

(b) State the advantages of multi rate digital signal processing.

OR

11 Implement a two-stage decimator for the following specifications,

Sampling rate of the input signal = 20000 Hz, M = 100,

Pass band = 0 to 40 Hz, Transition Band = 40 to 50 Hz

Pass band ripple = 0.01 and Stop band ripple = 0.002.

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Code: 9A04603

R09

B.Tech III Year II Semester (R09) Supplementary Examinations May/June 2017

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC and ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 (a) Describe the digital signal processing system.

(b) Sketch the following signals and its even and odd parts:

$x(n) = 8(0.5)^n u(n)$

2 (a) The first five points of the eight-point DFT of a real and even sequence are:

X(k)= {5,1,0,2,3}.

Determine the remaining three points.

(b) State and prove duality property of DFT.

3 Find the 8-point DFT of a sequence x(n) = (1,2,3,4,4,3,2,1) using DIT-FFT radix-2 algorithm. Also sketch magnitude and phase of DFT coefficients.

4 (a) State and prove time shifting property of z-transform.

(b) Determine z-transform, ROC and pole-zero locations of:

$x(n) = \alpha^n u(n) + \beta^n u(-n-1)$

5 Discuss the approximation of IIR filter design using derivatives.

6 (a) Discuss about characteristics of linear phase FIR filters.

(b) What are the effects of windowing?

7 (a) Why sampling rate conversion is required in practical applications.

(b) Sketch the following signals:

$x_1(n) = n^2 \quad n > 0$

$= 0 \quad$ otherwise

Also sketch decimated and interpolated version of above signal with factor of ‘4’.

8 (a) Discuss about musical sound.

(b) With necessary block diagrams, explain about Discrete Multi Tone transmitter.

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Code: 9A04603

R09

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations May/June 2015

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC and ECE)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 (a) Explain the advantages of digital signal processing over analog signal processing.

(b) Let x(n) = {-6, 4, -2, 2} and sketch the following signals and find their energy:

(i) f(n) = x(n+2) (ii) g(n) = x(-n+4)

2 Determine the DFT of $x_p(n)$ if:

$x_p(n) = 1$ for $2 \le n \le 6$

$= 0$ for $n = 0,1,7,8,9$

Assume N=6

Sketch amplitude and phase spectrum.

3 (a) Compare DIT and DIF FFT algorithms.

(b) Explain how IDFT is obtained using FFT.

4 (a) Discuss the realization of FIR filter structures.

(b) Realize FIR filter with system function in cascade form:

$H(z) = 1 + (5/2)z^{-1} + 2z^{-2} + 2z^{-3}$

5 (a) Discuss the characterization of IIR filter.

(b) Using backward difference method obtain H(z) for following:

$H(s) = 1/(s + 3)$

6 A low pass filter has the desired frequency response as given by:

$H_d(e^{j\omega}) = e^{-j6\omega}$ $0 \le \omega \le \pi/3$

$= 1$ $\pi/3 \le \omega \le \pi$

Determine the filter coefficients h(n) for M = 7, using type – II frequency sampling technique.

7 (a) What are the advantages of multi rate signal processing?

(b) Sketch the following signals:

$x_1(n) = 3n$ $n > 0$

$= 0$ otherwise

Also sketch decimated and interpolated version of above signal with factor of '4'.

8 Analyze the spectrum of following signal:

$X[n] = (1/2)\sin(2\pi f_1 n) + \sin(2\pi f_2 n)$ $0 \le n \le N-1$

Consider $f_1 = 0.22$, $f_2 = 0.34$ and N = 16 and length of DFT is 16. Sketch the obtained spectrum.

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Code: 9A04603

R09

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations June 2014

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC & ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

*****

1 (a) Explain the classification discrete signals.
(b) With mathematical expressions, sketch the elementary discrete signals.

2 Obtain the DFT of:
(a) $x(n) = \delta(n - n_0)$.
(b) $x(n) = u(n) - u(n - N_0)$.

3 Find the 8-point DFT of a sequence x (n) = (1, 2, 3, 4, 4, 3, 2, 1) using DIT-FFT radix-2 algorithm. Also sketch magnitude and phase of DFT coefficients.

4 Realize system with following difference equation in direct form - I, direct form - II, cascade and parallel:
$y(n) = -0.1\,y(n-1) + 0.2\,y(n-2) + 3\,x(n) + 3.6\,x(n-1) - 0.252\,x(n-2)$.

5 Discuss the approximation of IIR filter design using derivatives.

6 (a) What are the advantages and disadvantages of digital filters over analog filters?
(b) Sketch and explain the frequency response of non-ideal digital low pass filter.

7 Discuss the concept of interpolation in detail.

8 (a) Discuss about spectral analysis of non stationary signal considering an example.
(b) Write short notes on transmultiplexer.

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Code: 9A04603

1

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC & ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 State and Prove following properties DTFT:
(i) Periodicity.
(ii) Time-shifting.
(iii) Multiplication by' n' in time domain.

2 (a) Show that DFS of periodic sequence $x_p(n)$ is periodic with same period.
(b) State and prove duality property of DFS.

3 Write short notes on the following:
(i) Butterfly computation.
(ii) Goertzel algorithm.
(iii) In place computations.
(iv) Bit reversal.

4 Obtain the direct form realization of following system functions with minimum number of multipliers:
(i) $H(z) = (1/2) + (1/4)z^{-1} + (1/4)z^{-2} + (1/2)z^{-3}$.
(ii) $H(z) = [(1-z^{-1}) [(1/2) - (1/4)z^{-1} + (1/2)z^{-2}]]$.

5 (a) Compare the backward and forward difference methods of digital filter approximations.
(b) Convert following analog filter transfer function into digital filter transfer function using backward difference method $H(s) = 1/(s + 2)^2 + 16$.

6 (a) Explain characterization of FIR filters.
(b) Sketch and explain the frequency response of non ideal digital high pass filter.

7 The signal x(n) is up sampled by factor 2, then it is passed through ideal low pass filter with cutoff frequency of F_C and down sampled by factor by 3. Sketch the input and output spectrum for the case (X(F) = tri(4F) with $F_C = 0.15$.

8 (a) Discuss about spectral analysis of sinusoidal signals.
(b) With necessary block diagrams explain about discrete multi tone receiver.

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Code: 9A04603

2

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC & ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 Discuss the classification discrete systems with the help of examples.

2 Determine the DFT of a sequence x(n) = {1,1,0,0} and check the validity of answer by calculating IDFT.

3 Explain radix 2 DIT-FFT algorithm in detail. Explain how calculations are reduced.

4 If H(z) has zeros at $z_1 = 0.707 + j0.707$, $z_2 = 2$,determine the lowest order degree H(z) that has linear phase. Also realize it in Direct form – II and in Cascade form.

5 (a) Explain the features of Butterworth approximation.

(b) Discuss the location of pole for Butterworth filter.

6 Discuss the type I and II frequency sampling methods of FIR filter design.

7 The signal x(n) is decimated by N to obtain the signal y(n). Sketch X(F) and Y(F) over $-3 \le F \le 3$ for the following cases.

(i) x(n) = sinc (0.4 n) N = 2

(ii) X(F) = tri(4 F) N = 2

(iii) X(F) = tri(6 F) N = 3

8 (a) Discuss about spectral analysis of non stationary signals.

(b) Discuss about frequency response of typical band limited channel.

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Code: 9A04603

3

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC & ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 Check the following systems described with difference equations for linearity, shift invariance, memory and causality

(i) $y(n) - y(n-1) = x(n)$.

(ii) $y(n) - 2^n y(n) = x(n)$.

2 (a) Discuss the relationship of DFT with z-transform.

(b) State and prove periodicity property of DFT.

3 (a) What is the need for FFT?

(b) Find DFT of sequence using DIF-FFT $x(n) = \{1,1,1,1\}$.

4 (a) Explain transposed form realization.

(b) Realize following filter system function in cascade form

$H(z) = (1-z^{-1})^3/(1-0.5z^{-1})(1-0.25z^{-1})$.

5 Obtain the analog filter transfer corresponding to filter order of 3 and 4, Consider Butterworth approximation.

6 (a) Explain the type – II frequency sampling method of designing FIR filter.

(b) Explain the process of windowing using illustrations

7 Compare the single stage and two stage realization of decimator with the following specifications. Sampling rate of a signal has to be reduced from 10 KHz to 500 Hz. The decimation filter H(z) has the pass band edge of 150 Hz, stop band edge of 180 Hz, pass band ripple of 0.002 and stop band ripple of 0.001.

8 (a) Explain about STFT.

(b) Discuss the need for signal compression.

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Code: 9A04603

4

B.Tech III Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

DIGITAL SIGNAL PROCESSING

(Common to EIE, E.Con.E, ECC & ECE)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 Check for causality and stability of following systems

(i) $y(n) = x(n-1) + x(n) + x(n+1)$.

(ii) $y(n) – 2y(n-1) + y(n-2) = x(n) – x(n-3)$.

2 Given the two sequences

(a) $x_1(n) = 1 \quad 0 \le n \le 3$

(b) $x_2(n) = (-1)^n \quad 0 \le n \le 3$

Find circular convolution of above sequences. Also verify the answer with DFT method.

3 (a) Explain how many complex computations are required to compute N-point DFT.

(b) Find DFT of sequence using DIT-FFT $x(n) = \{1/2,1/2,0,0\}$.

4 Discuss the following:

(i) IIR filter structures.

(ii) FIR filter structures.

(iii) Canonic and Non-canonic structures.

5 (a) Discuss the mapping s-domain to z-domain using backward difference method.

(b) Convert following analog filter transfer function into digital filter transfer function using backward difference method $H(s) = 1/(s^2 + 0.9)$.

6 (a) What is the linear phase filter? Give the conditions under which FIR system will have linear phase.

(b) What are the desirable features of windowing functions?

7 Implement a two stage decimator for the following specifications. Sampling rate of the input signal = 21,000 Hz

M = 100

Pass band = 0 to 50 Hz

Transition band = 50 to 70 Hz

Pass band ripple = 0.01

Stop band ripple = 0.002

8 Discuss in detail about time domain operations used in musical sound processing.

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Code: 13A04602 **R13**

B.Tech III Year II Semester (R13) Regular Examinations May/June 2016

DIGITAL SIGNAL PROCESSING

(Common to ECE and EIE)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Define energy & power signals.

(b) Consider a finite duration sequence X(n) = {2, 4, 0, 3}.Resolve the sequence into sum of weighted impulses.

(c) What is FFT?

(d) Draw the direct form-II realization of two people resonator from Goertzel algorithm.

(e) Define signal flow graph.

(f) Draw the direct form-I realization structure of IIR filter.

(g) What is realization.

(h) Distinguish between Recursive & non recursive realization.

(i) Define the terms decimation and Interpolation.

(j) What are the applications of multi rate signal processing?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 Explain about classification of discrete time systems briefly.

OR

3 (a) Discuss about linearity, periodicity properties of DFT.

(b) Perform circular convolution of two sequences given by $X_1(n) = \{1, 2, 3, 4\}$ $X_2(n) = \{-1, 3, -5, 7\}$.

UNIT – II

4 Implement the decimation in time FFT algorithm for N = 16.

OR

5 Write short notes on the following: (i) Split-radix FFT. (ii) Applications of Goertzel algorithm. (iii) Quantization errors. (iv) Radix -4 FFT Algorithm. (v) Chirp-Z transforms.

UNIT – III

6 Obtain the direct form-I, direct form-II, cascade and parallel realization for the following system:

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

OR

7 (a) Determine the direct form-II and transposed direct form –II for the given system:

$Y(n) = \frac{1}{2}y(n-1) - \frac{1}{4}y(n-2) + x(n) + x(n-1)$

(b) An FIR filter is given by the difference equation:

$y(n) = 2x(n) + \frac{4}{5}x(n-1) + \frac{3}{2}x(n-2) + \frac{2}{3}x(n-3)$. Determine its Lattice form.

UNIT – IV

8 Design a digital Butterworth filter satisfying the following constrains:

$0.707 \le |H(e^{jw})| \le 1$ for $0 \le \omega \le \pi/2$

$|H(e^{jw})| \le 0.2$ for $3\pi/2 \le \omega \le \pi$

With T = 1sec using bilinear transformation.

OR

9 Design a filter with:

$Hd(e^{jw}) = e^{-j3w} \quad -\pi/4 \le w \le \pi/4$

$= 0 \quad \pi/4 < w \le \pi/4$ using Hamming window with N = 7.

UNIT – V

10 Sketch the following signals:

$X_1(n) = n, \ n > 0$

$= 0$ otherwise

$X_2(n) = n^2, \ n > 0$

$= 0$ otherwise

Also sketch decimator and interpolated version of above systems with a factor of '2'.

OR

11 With the help of block diagram explain in detail about multistage implementation of sampling rate conversion by rational factor I/D.

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