VI / SEM / E & TC / 2019 (W) **[03-12-19, EX-REG]**

DIGITAL SIGNAL PROCESSING

Full Marks: **80** Sub Code – **ETT 603** Time: **3** Hours

Answer any **FIVE** Questions including Q. No. 1 & 2

The figures in the right-hand margin indicate marks

[GROUP-A]

1. Answer the following: [10 X 2]

a) Define sampling Theorem.

b) Differentiate between discrete signal and digital signal.

c) What is an LTI system?

d) Define ROC.

e) Write down any two properties of Z- transform.

f) What is the condition for system stability?

g) What is Zero padding?

h) Distinguish between DFT& DTFT.

i) Define Twiddle factor.

j) Define causal & non causal system

[GROUP-B]

2. Answer any **FIVE** questions: [5 X 5]

a) Determine the system described by y (n) = [x (n) + 1/x(n)] is linear or non linear, where x (n) & y (n) are input and output respectively.

b) Write down the properties of Z-transform.

c) Find the 4-point DFT of the sequence x(n)= {**1**, 2, 1, 1}

d) Sketch the block diagram representation of discrete time system described by the input, output output relation **y(n) = 2y(n-1) + 3y(n+1) + x(n) + [1/2x(n+1)] + [1 /4x(n-2)],** where x(n)is the input sequence & y(n) is the output sequence.

e) Determine the Power and Energy of Unit step signal.

f) Compare the advantage of digital signal processing over analog signal processing.

g) Explain the properties of recursive and non recursive discrete time system

[GROUP-C]

3. Define the term signal and signal processing, Explain the digital signal processing system with neat block diagram.

4. Determine the Z-transform and ROC of the signal: $\mathbf{x(n)= a^{n} u(n) + b^{n} u(- n - 1)}$

5. Determine the circular convolution of the sequences $\mathbf{x_1 (n) = \{2, 1, 2, 1\}}$ & $\mathbf{x_2 (n) = \{1, 2, 3, 4\}}$

6. Find 8-point DFT of the sequence is given by x(n)={ **2**, 1, 2, 1, 1, 2, 1, 2} by radix-2 DIT-FFT.

7. Write down the properties of DFT.

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[DIGITAL SIGNAL PROCESSING] VI / SEM / ETC / 2019 (S) [28-06-19, REG]

1. (*a*) Define Region of convergence. 2

(*b*) Differentiate between circular convolution and linear convolution. 5

(*c*) Determine the *z* transform and ROC of the following finite duration signals

$x(n) = \{1, 2, 3, \underset{\uparrow}{-1}, 2, 3, 4\}$ 7

2. (*a*) What is zero padding ? 2

(*b*) Discuss the properties of DFT. 5

(*c*) Compute 4 point DFT of the following sequences using DIF algorithm

$x(n) = \{4, 5, 1, 2\}$. 7

3. (*a*) Define DFT. 2

(*b*) Obtain the circular convolution of the following sequences

$x_1(n) = \{2, 4, -1, 2\}$

$x_2(n) = \{-1, 4, 2, -3\}$

using concentric circle method. 5

(*c*) By using partial fraction expansion method find the inverse *z* transform of

$$H(z) = \frac{z^2 - 3z + 8}{(z-2)(z+2)(z+3)}.$$ 7

4. (*a*) Define periodic and Aperiodic signals. 2

(*b*) Explain the various properties of *z*-transform. 5

(*c*) Find the impulse response of the system described by differential equation

$y(n) - 5y(n-1) + 6y(n-2) = x(n)$ using *z*-transform. 7

5. (*a*) What are Deterministic and Non-deterministic signals ? 2

(*b*) Write down the advantages of digital signal processing over analog signal processing. 5

(*c*) Compute the 4 point DIT-FFT of the following sequence

$x(n) = \{0, 2, 4, 3\}$ 7

6. (*a*) What is Radix 2 FFT ? 2

(*b*) Write down the algorithm of DIF-FFT. 5

(*c*) Two finite duration sequences are

$h(n) = \{1, 0, 1\}$ and $x(n) = \{-1, 2, -1, 0, 1, 3, -2, 1, -3, -2, -1, 0, -2\}$

use overlap add method for finding $y(n) = x(n) * h(n)$. 7

7. (*a*) Define Time Variant and Time Invariant Signals. 2

(*b*) Find the 4 point DFT of the sequence

$x(n) = \{2, 0, 10\}$. 5

(*c*) Determine the *z*-transform and ROC of the following equation.

$x(n) = r^n \cdot \cos n\theta \cdot u(n)$. 7

VI / SEM / E & TC / 2018 (W) [11-12-18, EX-REG]

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1) [2 +5 + 7]

a) What is multichannel signal?

b) What are advantages of DSP over ASP?

c) Classify different signal and explain briefly.

2) [2 +5 + 7]

a) What is shifting operation on discrete time signal?

b) What are the elementary of discrete time signal and explain?

c) Classify discrete time system and explain them briefly.

3) [2 +5 + 7]

a) What is quantization?

b) Determine the system function & unit sample response of the system? **y(n) = ½ y(n-1)+2x(n)**

c) Show the graphical representation of the signal, If ***x*(n) = {2, 1, 0, 2, 1, 3},** find **x(- n - 2)**

4) [2 +5 + 7]

a) What is ROC?

b) Discuss various properties of Z-transform.

c) Compute the Z-transform and ROC of $\mathbf{x(n) = 2^n u(n) + 3^n u(- n - 1).}$

5) [2 +5 + 7]

a) What is signal processing? Give any two application of it?

b) Determine the inverse z-transform of the sequence using long division method

$$\mathbf{X(z) = \frac{1 + 2z^{-1}}{1 - 2z^{-1} + z^{-2}}}\ ; \qquad \text{if x(n) is causal.}$$

c) Compute 4-point DFT of the following sequence, **x(n) = {0, 1, 2, 3}**

6) [2 +5 + 7]

a) Find the Z-transform and ROC of **x(n) = {2, 3, 0, 1, 3}**

b) Verify whether the following systems are time variant or time invariant

(i) $\mathbf{Y(n) = X(-n)}$ **(ii)** $\mathbf{Y(n) = X(n) + X(n-1)}$

c) Determine the circular convolution of the given sequence using concentric circle method:

X(n) = {1, 2, 3, 0} and **Y(n) = {1, 2, 1, 1}** [2 +5 + 7]

7)

a) Draw the basic butterfly diagram for DIF-FFT.

b) Compute poles, zeros and system response of the following: **Y(n) = 2 y(n - 1) + 3x(n)**

c) Determine the DFT of the sequence using DIT-FFT algorithm: **x(n) = {1, 2, 3, 4}**

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VI / SEM / E & TC / 2018 (S) **[10-05-18, REG]**

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1) [2 +5 + 7]

a) Verify whether $y(n) = x(n/2)$ is a time invariant system.

b) Determine the value of power and energy of x(n) = Sin (nπ/4).

c) Find the convolution of $x(n) = \begin{Bmatrix} n/2, 0 \le n \le 5 \\ 0, elsewhere \end{Bmatrix}$ & $h(n) = \delta(n) - \delta(n-1) + \delta(n-2) - \delta(n-3)$.

2) [2 +5 + 7]

a) Define correlation.

b) Determine the z-transform and ROC of the signal x (n) = {2, 4, **5**, 7, 0, 1} with the starting index of the sequence is equal to -2.

c) Find the z-transform and ROC of $x(n) = (n + 0.5)(1/3)^n u(n)$

3) [2 +5 + 7]

a) State sampling theorem.

b) If the signal x (n) = {1, 2, 6, 4, 3 ,7, 5} then find x(2n), x(n/2), x(n+2), x(3-n), 3x(n-1)

c) Find the IDFT of the sequence x(n) = {1, 1-2j, -1 , 1+2j}

4) [2 +5 + 7]

a) What are the properties of frequency response of an LTI system?

b) What is twiddle factor and define zero padding with example.

c) Plot the pole-zero pattern and determine the stability of the system : -

$$y(n) = 0.7y(n-1) - 0.1y(n-2) + 2x(n) - x(n-2)$$

5) [2 +5 + 7]

a) Define the pole and zero of a system function.

b) Define Linear Convolution. State its properties.

c) Find the DFT of a sequence x (n) = {1 for $0 \le n \le 2$; 0 otherwise} for N = 4.

6) [2 +5 + 7]

a) What do you mean by time domain aliasing?

b) Differentiate between analog and digital filter.

c) Find the Inverse z transform of $X(Z) = \dfrac{1 + 3z^{-1}}{1 + 3z^{-1} + 2z^{-2}}$.

7) [2 +5 + 7]

a) How many complex additions and multiplications are required for a 16 bit sample in DIT-FFT algorithm?

b) Compute 4 point DFT of a sequence x (n) = {0, 1, 2, 3} using DIF-FFT algorithm.

c) Define circular convolution. Find the circular convolution of {1, 2, 2, 1} and {1, 2, 3, 1} using circular convolution.

VI / SEM / E & TC / 2017(W), **[11-12-17, BACK]**

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1. **(a)** What is Sampling Theorem? **[2]**

(b) Classify Different Signals. **[5]**

(c) Explain basic elements of Digital Signal Processing. **[7]**

2. **(a)** What is Quantization? **[2]**

(b) **y(n) = 2x(n) +** $\frac{1}{x\,(n-1)}$ is Linear or Nonlinear System verify. **[5]**

(c) Draw block diagram of Discrete Time System. **[7]**

3. **(a)** What is ROC? **[2]**

(b) Determine Z-Transform and ROC of Signal $\mathbf{x(n) = a^n\, u(n)}$. **[5]**

(c) Find Inverse Z-Transform of **x(z) =** $\frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$ **[7]**

4. **(a)** Write down properties of Convolution. **[2]**

(b) Explain recursive and non-recursive discrete time system. **[5]**

(c) Determine solution of difference equation **y(n) = 5/6 y(n-1) -1/6 y(n-2) + x(n) for** $\mathbf{x(n) = 2^n u(n)}$. **[7]**

5. **(a)** Define a stable system. **[2]**

(b) Describe parallel connection of systems. **[5]**

(c) Find circular convolution of two finite duration sequence

$x_1(n) = \{1, -1, -2, 3, -1\}$ and $x_2(n) = \{1, 2, 3\}$. **[7]**

6. **(a)** Relate DFT to Z-Transform. **[2]**

(b) Describe different properties of DFT. **[5]**

(c) Find DFT of a sequence **x (n) = {1, 0, 0}.** **[7]**

7. **(a)** What are the advantages of FIR Filters? **[2]**

(b) Compute DFT of a sequence **x (n) = {1, -1, 1, -1}** using DIT Algorithm. **[5]**

(c) What are different steps required for radix-2 DIF-FFT algorithm? **[7]**

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VI / SEM / E & TC / 2017(S) <APR, REG>

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1. (a)What is the difference between Domestic and Random signal? [2]

(b) What is signal processing? Draw block diagram & explain digital signal processing system [5]

(c) **$x(n) = e^{2n}u(n)$.** Determine the signal is Energy signal or Power signal. [7]

2. (a) Determine **x(n) = u(n+1)** is a casual signal or non-casual signal. [2]

(b) If $x(n) = \begin{cases} 1, \text{ for } n = -1, 0, 2, 3 \\ -1, \text{ for } n = -2, 1 \\ 0, \text{ otherwise;} \end{cases}$ Then find out **x (n+2), x (-n), x (-n+3), x (-n-1).** [5]

(c) Define linear & non-linear system & prove y(n)=2x(n)+1/x(n-1) is linear or non-linear system.

3. (a) What are the necessary conditions for stable system? [2]

(b) Draw and explain principle of Analog to Digital Converter. [5]

(c) Find out the Convolution between two signals [7]

$$x(n) = \begin{cases} 1, \text{ for } n = -2, 0, 1 \\ 2, \text{ for } n = -1 \\ 0, \text{ elsewhere and } \mathbf{h(n) = \delta(n) - \delta(n-1) - \delta(n-2) - \delta(n+1).} \end{cases}$$

4. (a) Write down the properties of convolution. [2]

(b) Find the z-transform and ROC of a system **$x(n) = a^n u(n) - b^n u(n)$.** [5]

(c) Write down all the properties of z-transform with proof. [7]

5. (a) Write down all methods are used for find out inverse z-transform. [2]

(b) Determine the Inverse z-transform of **$X(z) = 1/1 - 1.5z^{-1} + 0.5z^{-2}$**

Where **(i)** ROC : $|z| > 1$ **(ii)** ROC : $|z| < 0.5$ **(iii)** ROC : $0.5 < |z| < 1$ [5]

(c) Find out the forced response of the system described by the equation:

$y(n) = 0.6y(n - 1) – 0.08y(n - 2) + x(n)$ [7]

6. (a) Define DFT. [2]

(b) Explain the relation of DFT to the other transform. [5]

(c) Find out the 4-point DFT of **$x(n) = (-1)^n$.** [7]

7. (a) Write down the periodicity and time reversal properties of DFT. [2]

(b) Derive an expression for DFT in Radin-2 DFT-FFT and justify in case of DIT-FFT the total sequence is contain equal no. of even part and odd part. [5]

(c) Find the 8-point DFT of the sequence given by x (n) = {2, 2, 2, 2, 1, 1, 1, 1} by using Radix -2 DIT-FFT algorithm. [7]

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VI / SEM / E & TC / 2016(W), <DEC, BACK>

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1. (a) Define Zero Padding. [2]

(b) Discuss the properties of the DFT. [5]

(c) Find the 4 point DFT of the sequence ***x* (n) = {1, 0, 1, 0}** [7]

2. (a) Define ROC. [2]

(b) Write down the advantages of Digital Signal Processing over analog signal processing. [5]

(c) By using partial fraction expansion method, find the inverse z transform of,

$$X(z) = \frac{z(z^2 - 4z + 5)}{(z-1)(z-2)(z-3)}$$ [7]

3. (a)What is z transform? [2]

(b) Discuss various properties of z-transform. [5]

(c) Compute 4 point DFT of the following sequences using DIT algorithm: ***x*(n) = {4, 3, 2, 1}** [7]

4. (a) Define DFT. [2]

(b) Determine z-transform & ROC of the finite duration signals: ***x*(n) = {1, 0, 3, -1, 2}** [5]

(c) Obtain the circular convolution of the following sequencers. [7]

***x*$_1$(n) = {1, 2, 2, 1}** & ***x*$_2$(n) = {1, 2, 3, 1}**

5. (a) What is circular convolution? [2]

(b) Discuss the algorithm of DIT - FFT. [5]

(c) Compute a 4 point DFT of the sequences ***x* (n) = {1, 0, 0, 1}** using DIF algorithm. [7]

6. (a) Draw the basic butterfly diagram for DIF – FFT. [2]

(b) Differentiate between linear and circular convolution. [5]

(c) Compute the z-transform and ROC of ***x* (n) = 2^n u (n)** [7]

7. (a) State the applications of FFT algorithm. [2]

(b) Draw the reduced flow graph for 4 point DIF – FFT. [5]

(c) Determine the Convolution of the two sequences. [7]

***x*$_1$ (n) = {2, 1, 0, 0, 5}** & ***x*$_2$ (n) = {2, 2, 1, 1}**

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VI / SEM / E & TC / 2016(S) <APR, REG>

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1. (a) Define Time variant and Time invariant system [2]

(b) Explain the different properties of z transform. [5]

(c) Determine the causal signal *x*(n) having the z transform $\boldsymbol{x(z) = \frac{1}{(1-2z^{-1})(1-z^{-1})^2}}$ using partial fraction expansion method. [7]

2. (a) What is Twiddle Factor? [2]

(b) Find *H*(z), the system function for the following:

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

ii. y(n) = x(n) + x(n-1) - 2x(n-2) + 3x(n-3) [5]

(c) Find the z transform and ROC of the sequence $\boldsymbol{x\,(n) = 2^n.\sin\frac{n\pi}{4}.\,u\,(n)}$ [7]

3. (a) Define Zero Padding. [2]

(b) Compute the Convolution y (n) correlation r (n) for the given signals:

$\boldsymbol{x_1(n) = \{\underline{1}, 2, 3, 4\}}$ & $\boldsymbol{x_2(n) = \{1, 2, 3, \underline{4}\}}$ [5]

(c) Find the Circular Convolution of two finite duration sequences

$\boldsymbol{x_1(n) = \{1, 1, -1, 2\}}$ & $\boldsymbol{x_2(n) = \{2, 0, 1, 1\}}$ [7]

4. (a) What is the need of signal processing and give any two applications. [2]

(b) Find the step response of the following differential equation:

$\boldsymbol{y\,(n) - 5y\,(n-1) + 6y\,(n-2) = x(n)}$ [5]

(c) Compute the inverse z transform of $\boldsymbol{x\,(z) = \frac{z\,(1-e^{-T})}{(z-1)(z-e^{-T})}}$ [7]

5. (a) Draw the basic butterfly diagram for DIT – FFT and DIF-FFT. [2]

(b) Find the z transform and ROC of $\boldsymbol{x\,(n) = (0.4)^n\,u(n) + (0.3)^n\,u(n-4)}$ [5]

(c) Compute a 4 point DFT of the sequence $\boldsymbol{x\,(n) = \{0, 2, 4, 6\}}$ [7]

6. (a) Define Periodic and Aperiodic signals. [2]

(b) Verify whether the following systems are linear or non-linear:

i. y(nT) = x(nT+T) + x(nT - T) **ii.** y(n) = x(n+7) [5]

(c) Determine the DFT of the sequence $\boldsymbol{x(n) = \{1, 2, -1, 1\}}$ using DIT-FFT algorithm. [7]

7. (a) What is Discrete Fourier transform? [2]

(b) Determine the IDFT of $\boldsymbol{X\,(K) = \{1, 0, 1, 0\}}$ [5]

(c) Using property find the z-transform and ROC of $\boldsymbol{x(n) = n.\,u(n-1)}$ where, x(n) is causal. [7]

VI / SEM / E & TC / 2014 (S)

DIGITAL SIGNAL PROCESSING

Sub Code – **THEORY-4**

Full Marks: 80

Time: 3 Hours

Answer any **FIVE** Questions

The figures in the right-hand margin indicate marks

1. (a) Define signal and system. [2]

(b) What are the different types of signal representation? Explain with examples. [6]

(c) Compute the convolution of the discrete time signals,

x(n) = {1, 0, 2, 5, 4}, h(n) = {1, -1, 1, -1} [8]

2. (a) Define periodic and aperiodic signals. [2]

(b) Verify whether the following systems are causal or non-causal.

$\mathbf{y_1(n) = x(2n),\ y_2(n) = x(n+1) + \frac{1}{x(n-1)}}$ [6]

(c) State the advantages of digital signal processing over analog signal processing. [8]

3. (a) State the difference (any four) between FIR and IIR systems. [2]

(b) Show the graphical representation of the signals,

x(n-2), x(n+3), x(-n-2), and x(-n+3) where **x(n) = {1, 2, 1, 2, 1}** [6]

(c) Determine the impulse response of the causal system,

y(n) + y(n-1) + 2y(n-2) = x(n-1) + 2x(n-2) [8]

4. (a) Define z-transform and where it is used? [2]

(b) Find the system function of the system described by the difference equation

y(n) = x(n) + 2x(n-1) – 4x(n-2) + x(n-3) [6]

(c) Find the z-transform and ROC of the sequence $\mathbf{x(n) = (4)^n\, u(-n-1)}$ [8]

5. (a) Define poles and zeros of a system. [2]

(b) State the time shifting and time reversal property of z-transform. [6]

(c) Find the inverse z-transform of $\mathbf{X(z) = \frac{1+\frac{1}{2}z^{-1}}{1+3z^{-1}+2z^{-2}}}$ [8]

6. (a) Name number of complex multiplications & additions required to compute N point DFT. [2]

(b) Find the circular convolution of two finite duration sequence

$\mathbf{x_1(n) = \{1, 2, 3, 4\}}$ **&** $\mathbf{x_1(n) = \{4, 3, 2, 1\}}$ [6]

(c) Compute the four point DFT of the sequence **x(n) = {1, 1, 1, 1}** [8]

7. (a) Define twiddle factor. [2]

(b) State the difference between analog filter and digital filter. [6]

(c) Determine the DFT of the sequence **x(n) = {1, 2, 1, 1, 0, 1, 1, 1}** using DIT-FFT algorithm. [8]

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VI / SEM / E & TC / 2013 (S)

DIGITAL SIGNAL PROCESSING

Sub Code – **THEORY-4**

Full Marks: 80

Time: 3 Hours

Answer any **FIVE** Questions including Q. No. 1 & 2

The figures in the right-hand margin indicate marks

[GROUP-A]

8. Answer the following: [10 X 2]

k) What is signal processing?

l) What are the major classifications of digital signals?

m) Distinguish between energy and power signal.

n) What is LTI system? Give one example.

o) Why is folding of a signal required in convolution of two signals?

p) Is the system described by the differential equation $\frac{dy(t)}{dt} + 5y(t) + 2 = x(t)$ is linear?

q) Define Fourier transform pair.

r) What are twiddle factors of the DFT?

s) State direct and inverse z-transform.

t) What is circular convolution?

u) Write one advantages of FIR filter over IIR filter.

[GROUP-B]

9. Answer any **FIVE** questions: [5 X 5]

a) What are the various types of realization structure for FIR and IIR filter?

b) Give the frequency response characteristics of Butterworth filter.

c) State and explain symmetry property of DFT.

d) Find the z-transform of $u(n) = \cos\omega_0 n$ for $n \geq 0$.

e) State and explain time reversal and time shifting properties of Z-transform.

f) Give the frequency response characteristics of Butterworth filters.

g) Discuss the radix-4 FFT algorithm.

[GROUP-C]

10. Given $x(n) = 2^n$ and N = 8. Find x (k) using DIF-FFT algorithm. [10]

11. Find the discrete-time Fourier transform of $x(n) = \left(\frac{1}{2}\right)^{-n} . u(-n-1)$ [10]

12. Determine the z-transform of the sequence given by,

$$x(n) = \begin{cases} 2^n, n < 0 \\ \left(\frac{1}{2}\right)^n, n = 0,2,4 \\ \left(\frac{1}{3}\right)^n, n = 1,3,5 \end{cases}$$ [10]

13. Write short notes on any TWO: [5 X 2]

a) What is signum function? Give its plot.

b) Discuss causal and non-causal LTI systems with example.

c) State and explain sampling theorem.

--- ALL THE BEST --- ALL THE BEST ---

VI / SEM / E & TC / 2012 (S)

DIGITAL SIGNAL PROCESSING

Sub Code – **THEORY-4**

Full Marks: 80

Time: 3 Hours

Answer any **FIVE** Questions including Q. No. 1 & 2

The figures in the right-hand margin indicate marks

[GROUP-A]

1. Answer the following: [10 X 2]

a) What is discrete-time signal?

b) Define multichannel and multidimensional signal.

c) State sampling theorem and why it is essential?

d) Distinguish between causal and non-causal system with examples.

e) Define recursive discrete time system.

f) State convolution theorem.

g) Find the z-transform of the sequence **x(n) = {-1, 3, 3, 1, 0, 2}**

h) What do you mean by N-point DFT?

i) What are digital filters?

j) Define poles and zeroes of a discrete time system.

[GROUP-B]

2. Answer any FIVE questions: [6 X 5]

a) What are the advantages of digital signal processing over analog signal processing?

b) Determine whether the system is time-invariant or time variant of the system. $\mathbf{y(n) = x\left(\frac{n}{2}\right)}$

c) Write the expression to determine energy and power of discrete time signals.

d) Find the convolution sum of the signals $\mathbf{x(n)} = \begin{cases} \mathbf{1, n = -2, 0, 1} \\ \mathbf{2, n = -1} \\ \mathbf{0\ elsewhere} \end{cases}$

e) Determine the z-transform of the signal $\mathbf{x(n) = a^n u(n)}$

f) Explain the linear property of Discrete Time Fourier Transform.

g) Compute DFT of the given signal sequence $\mathbf{x(n)} = \begin{cases} \frac{1}{3}\ \mathbf{for\ 0 \le n \le 2} \\ \mathbf{0\ elsewhere} \end{cases}$

[GROUP-C]

3. Find the Inverse z-transformation $\mathbf{X(z) = \frac{-4+8z}{1+6z^{-1}+8z^{-2}}}$ [10]

4. Express the signal **x(n) = {1, -2, 3, 0, 1, -5, 2, 1}** in even and odd signal. [10]

5. Find out the impulse response of the system $\mathbf{y(n) - \frac{5}{2}y(n-1) + y(n-2) = x(n) - x(n-1)}$ [10]

6. (a) Determine the linearity of the system described by the input output equation $\mathbf{y(n) = x(n^2)}$ [5]

(b) Differentiate between continuous valued and discrete valued signals. [5]

7. Describe DFT and FFT algorithm and write the computational formula. [10]

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VI / SEM / E & TC / 2011 (S)

DIGITAL SIGNAL PROCESSING

Sub Code – **THEORY-4**

Full Marks: 80

Time: 3 Hours

Answer any **FIVE** Questions including Q. No. 1 & 2

The figures in the right-hand margin indicate marks

[GROUP-A[]

1. Answer the following: [10 X 2]

a) Name the basic elements of a digital signal processing system.

b) What is a static system?

c) What is discrete time signal?

d) What do you mean by symmetric signal?

e) Define unit ramp signal.

f) Define continuous time and discrete time.

g) What do you mean by DFT?

h) What do you mean by quantization of a sinusoidal signal?

i) What are digital filter?

j) What is the advantage of FFT algorithm over DFT algorithm?

[GROUP-B]

2. Answer any **FIVE** questions: [6 X 5]

a) Write the advantage of digital signal processing.

b) Discuss the properties of a discrete time sinusoidal signals.

c) Compute DFT of the four point sequence **x(n) = {0, 1, 2, 3}**

d) Write the properties of z-transform.

e) Find the z-transform of x(n) where x(n) = **3 cos 2000 µt + 5 sin 6000 µt + 10 cos 12000 µt.** What is the Nyquist rate for this signal?

[GROUP-C]

3. Explain poles and zeros. Determine the pole zero plot for the signal $X(n) = a^nU(n)$. [10]

4. With a neat block diagram explain different parts of digital to analog converter. [10]

5. State and explain inverse z-transform. Determine the inverse z-transform of

$$\mathbf{X(z) = \frac{1}{1-1.5z^{-1}+0.5z^{-2}}}$$ [10]

6. Design a linear phase FIR filter using windows. [10]

7. Write the algorithm for divide and conquer approach for computation of discrete Fourier transform. [10]

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Collected By:-

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VI / SEM / E & TC / 2010 (S)

DIGITAL SIGNAL PROCESSING

Sub Code – **ETT-603**

Full Marks: 70

Time: 3 Hours

Answer any **FIVE** Questions including Q. No. 1 & 2

The figures in the right-hand margin indicate marks

1. Answer the following: [10 X 2]

a) Define discrete time signal and system.
b) Show the graphical representation of 4(n+2).
c) Write four operations that are performed on discrete time signals.
d) Compute the convolution if x(n) = h(n) = 1, 0, 1}
e) What is the z transform of unit impulse?
f) Define energy and power signal.
g) What is the advantage of digital signal processing?
h) What is the basic element of DSP?
i) Define FIR and IIR system.
j) What is meant by Radix – 2 FFT?

2. Answer any Six questions: [6 X 5]

a) Compare three properties of continuous & discrete time sinusoidal signal.
b) Discuss the basic parts of analog to digital (AD) converter.
c) Define convolution. Compute the convolution of following signals
x(n) = {1, 0, 2, 5, 4}, h(n) = {1, -1, 1, -1}
d) Determine the z transform and ROC of signal **$x(n) = \{\cos \omega_0 n\}u(n)$.**
e) Describe the properties of z transform.
f) Determine the pole and zero for the signal **$x(n) = n\, a^n\, u(n)$**
g) Determine if the following systems are causal or non causal.
i. $y(n) = x(n) + \frac{1}{x(n)}$ **(ii)** $y(n) = x(n^2)$
h) Find the circular convolution of the two sequence. $x_1(n) = \{1, -1, 2, 3\}$; $x_2(n) = \{0, 1, 2, 3\}$

3. Find the inverse z transform
i. $X(z) = \frac{z(z^2-4z+5)}{(z-3)(z-1)(z-2)}$ for ROC $|z| > 3$ **(ii)** $X(z) = \frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$ $|Z| > 2$ [5]

4. (a) Determine time variant and time invariant system. [4]
(b) Determine whether the following system is time invariant: [6]
i. $y(n) = n\, x(n)$ (ii) $y(n) = \cos x(n)$ (iii) $y(n) = e^{x(n)}$

5. (a) Write the properties of DFT. [5]
(b) Find the DFT of the sequence x(n) = {1, 1, 0, 0} [5]

6. (a) State and explain sampling theorem. [5]
(b) An analog signal is represented by $x_a(t) = \sin(480\pi t) + 3\sin(720\pi t)$. What is the Nyquist rate.

7. (a) What is the relationship of DFT with z-transform? [5]
(b) Compute 4-point DFI of a sequence x(n) = {0, 1, 2, 3} using Radix-2 algorithm. [5]

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