**Department of Information and Communication Engineering**

**Pabna University of Science and Technology**

B.Sc. (Engineering) 2nd Year 2nd Semester Examination-2020

Session: 2018-2019

Course Code: **ICE-2205** Course Title: **Signals and Systems**

NB: 1. Answer any **SIX (THREE from each PART)** questions.
2. Figures in the right margin indicate marks.
3. Parts of the same question should be answered together and in the same sequence.

**Time: 3 Hours (For Part A and Part B)** **Total Marks: 70**

## PART-A

1. a) Define one dimensional and multi-dimensional signals. 2

   b) Classify signal. Define each of them with suitable examples. $6\frac{2}{3}$

   c) Determine whether the following signal is energy or power signal. Also determine average power and energy of the signal. 3

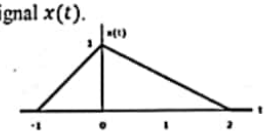
2. a) Write the steps of A/D conversion. Explain each of them with examples. $3\frac{2}{3}$

   b) Classify each of the following as periodic or non-periodic. If periodic, find the fundamental period of that signal. 4

   i) $x[n] = 5sin(2n)$
   ii) $x[n] = \sin(\frac{2\pi}{3})n$
   iii) $x[n] = 5sin(0.2\pi n)$
   iv) $x[n] = e^{j5\pi n}$

   c) Explain the operations performed on independent variable of a signal. 4

3. a) Find $x(2t-1)$ of the given signal $x(t)$. $2\frac{2}{3}$



   b) Define the following elementary signals: i) Ramp Signals, (ii) Exponentially Damped Sinusoidal Signals. 2

   c) Define Impulse Response. Explain following properties of systems: (i) Memory, (ii) Time invariance, and (iii) Linearity with examples. 4

   d) Determine the following systems are time-invariant or not: i) $y(t) = tx(t)$, and ii) $y(t) = x(4t)$. 3

4. a) Prove that the recursive system defined by the difference equation $v(n) = av(n-1) + x(n)$ is linear. 5

   b) What do you mean by circular convolution? Using circle method write the steps for computing circular convolution of two data sequences. 4

   c) Find the circular convolution of two data sequences $x_1(n) = \{1, 2, -3, 4, -5\}$; $x_2(n) = \{-2, 4, 6\}$ using matrix method. $2\frac{2}{3}$

## PART-B

5. a) What do you understand by Fourier representation of signals? 2

   b) Explain DTFS. Also find its pair. 3

   c) Consider the following signal $6\frac{2}{3}$

$$x(n) = \{\ldots\ 0.5\ \ 1\ \ -0.5\ \ 0\ \ 0\ \ 0.5\ \ \underset{\uparrow}{1}\ \ -0.5\ \ 0\ \ 0\ \ 0.5\ \ 1\ \ -0.5\ \ldots\}.$$

   Find the DTFS of the signal $x(n)$.

6. a) Explain DTFT of a Rectangular Pulse. $6\frac{2}{3}$

   b) Find the DTFT of the sequences: i) $x(n) = \alpha^n u(n), where\ \alpha = 0.5$, and (ii) $x(n) = 2(3)^n u(-n)$. 5

7. a) Briefly explain the periodicity, linearity, and symmetry properties of DFT.

   b) Find the convolution of the sequences i) $h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $x(n) = \left(\frac{1}{3}\right)^n$ ii) $h(n) = \alpha^n u(n), |\alpha| < 1$, and $x(n) = \beta^n u(n), |\beta| < 1$ using convolution prope DTFT.

8. a) Explain DFT and Its Inverse. $4\frac{1}{3}$

   b) Describe matrix representation of DFT. 5

   c) Find 4-point DFT and IDFT for the given data sequence $x(n) = \{0, 1, 2, 3\}$.

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**Department of Information and Communication Engineering**
**Pabna University of Science and Technology**
Faculty of Engineering and Technology
B.Sc. (Engineering) 2nd Year 2nd Semester Examination 2019
Session: **2017-2018**

Course Code: **ICE-2205** Course Title: **Signals and Systems**

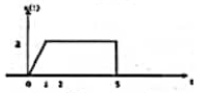
NB:
1. Answer any SIX (THREE from each PART) questions.
2. Figures in the right margin indicate marks.
3. Parts of the same question should be answered together and in the same sequence.
4. Separate answer script must be used for answering the question of PART-A and PART-B.

**Time: 3 Hours** **Total Marks: 70**

## PART-A

1. a) Define signal. What are the major classifications of signal? 1.67
   b) Define energy and power of a signal. Find the energy and power of the signal, $x(t) = r(t) - r(t-2)$. 5
   c) What is digital signal processing? Write down the advantages of digital signal processing over analog signal processing. 5

2. a) Explain the operations performed on dependent variable of a signal. 6.67
   b) Define ramp function. Express the following signal with unit step and ramp function. 2



   c) Sketch the all possible representation following the output-input relationship 2
   $y[n] = \frac{1}{3}(x[n] + x[n-1] + x[n-2])$.
   d) Write the precedence rule for performing time-shifting and time scaling of a signal. 1

3. a) What do you understand by LTI system? 1.67
   b) Express the given signal sequences as a time-shifted impulse. 3

$$(i)\ x(n) = \left\{1,\ -2,\ 8,\ \underset{\uparrow}{4},\ 5,\ -3,\ 7\right\}$$

$$(ii)\ x(n) = \left\{2,\ 3,\ \underset{\uparrow}{0},\ 7,\ 8,\ -15,\ 18,\ 20\right\}$$

   c) An LTI system has impulse response $h(n)$.Determine the output for this system in response to $x(n)$ using direct approach, where 5

$$h(n) = \begin{cases} 1, & n = \pm 1 \\ 2, & n = 0 \\ 0, & \text{Otherwise} \end{cases} \quad \text{and} \quad x(n) = \begin{cases} 2, & n = 0 \\ 3, & n = 1 \\ -2, & n = 2 \\ 0, & \text{Otherwise} \end{cases}$$

   d) Write the Invertibility property of the system with an example. 2

4. a) Let $x(t) = 2u(t-1) - 2u(t-3)$ and $h(t) = u(t+1) - 2u(t-1) + u(t-3)$. Find the convolution integral of the sequences. 6
   b) What do you mean by circular convolution? Using the Circle method write the steps for computing circular convolution of two data sequences. 3
   c) Find the circular convolution of two data sequences $x_1(n) = \{1, 2, -3, 4, -5\}$; $x_2(n) = \{-2, 4, 6\}$ using matrix method. 2.67

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## PART-B

5. a) Explain DTFS. Deduce its pair expression. 3
   b) Find the DTFS of the signal $x(n) = \left\{\underset{\uparrow}{0.5},\ 1, -4, 0, 0\right\}$. 3
   c) Deduce the expression for DTFT. 5.67

6. a) Explain how aperiodic signals can be represented by Fourier ~~series~~ transform. 4
   b) Find the DTFT of the sequences i)$x(n) = a^n u(n)$, *where* $a = 0.5$, and 4
   (ii) $x(n) = 2(3)^n u(-n)$.
   c) What is meant by sampling? State sampling theorem. 3.67

7. a) Find the convolution of the sequences $h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $x(n) = \left(\frac{1}{3}\right)^n u(n)$, using convolution property of DTFT. 3.67
   b) Write the process of performing Fourier transform of an analog signal $x(t)$ by using digital computers. 4
   c) Deduce the DIT algorithm for a 4-point sequence, i.e., $N = 4$.

8. a) Explain DFT and its Inverse
   b) Describe matrix representation of DFT. 4.6
   c) Find 4-point DFT and IDFT for the given data sequence $x(n) = \{1, 2, 1, 1\}$. 5

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Department of Information and Communication Engineering
Pabna University of Science and Technology
Faculty of Engineering and Technology
B.Sc. (Engineering) 2nd Year 2nd Semester Examination-2018
Session: 2016-2017

Course Code: ICE-2205 Course Title: Signals and Systems

NB
1. Answer any SIX (Three from each PART) from following questions.
2. Figures in the right margin indicate marks.
3. Parts of the same question should be answered together and in the same sequence.
4. Separate answer script must be used for answering the question of PART-A and PART-B.

Time: 3 Hours Total Marks: 70

## PART-A

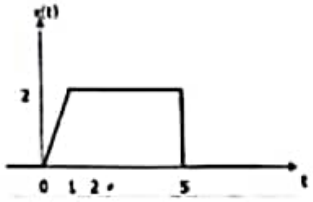
1) a) Define signal. Explain advantages of digital signal processing over analog signal processing. $2\frac{2}{3}$

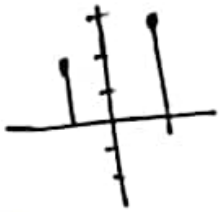
b) Explain the following terms: (i) Continuous-time and Discrete-time Signals and (ii) Deterministic and Random Signals. 3

c) Define even and odd signal. Develop the Even and Odd decomposition of x(t). 4



d) Express the following signal with unit step and ramp function. 2

2. a) Represent the following discrete signal using impulse signals, mathematically and graphically. 3
$x(n) = \{1, 2, 3, 4, -1\}$.
↑

b) Mention different types of operations on dependent variables of a continuous-time signal with example. 3

c) What is system? Draw the block diagram of the following moving average system $y[n] = \frac{1}{5}(x[n] + x[n-1] + x[n-2] + x[n-3])$. $3\frac{2}{3}$

d) What is causal and invertible system? Explain these two systems with example. 2

3) a) Define Impulse Response. Explain following Properties of Systems: (i) Stability, (ii) Causality, and (iii) Linearity. 6

b) Write the steps of Graphical Estimation procedure of convolution integral. $2\frac{2}{3}$

c) Compare convolution sum and convolution integral. 3

4) a) Perform the convolution of the two sequences $x(n) = \{1, -2, 3, -2\}$; $h(n) = \{2, -3, 4\}$.
↑ ↑ 5

b) What do you mean by circular convolution? Using Circle method write the steps for computing circular convolution of two data sequences. 4

c) Find the circular convolution of two data sequences $x_1(n) = \{1, 2, -3, 4, -5\}$ and $x_2(n) = \{-2, 4, 6\}$ using matrix method. $2\frac{2}{3}$

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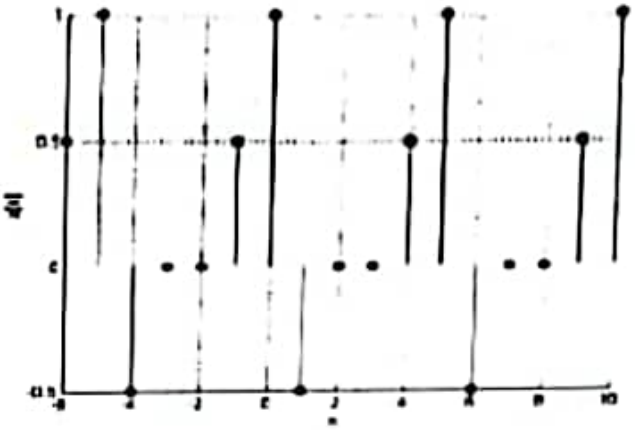
## PART-B

5. a) Why do we need Fourier Representation of signals? 2

   b) Find the DTFS of the following signal. $5\frac{2}{3}$



   c) Prove that DFT is periodic with period N. 4

6. a) With suitable figure derive necessary equations of DTFT. $5\frac{2}{3}$

   b) Find the DTFT of (i) $x(n) = \alpha^n u[n]$, *where* $\alpha = 0.5$ and (ii) $x(n) = 2(3)^n u(-n)$ 6

7. a) Explain the periodicity and linearity properties of DFT. 4

   b) A discrete time signal x(n) = {1,0,1,2,3,2} find the total energy $E_t$ of the signal. 3

   c) Find the DFT for the following finite length sequence, $x(n) = \{\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\}$. $4\frac{2}{3}$

8. a) Explain Matrix Representation of the DFT. $5\frac{2}{3}$

   b) What is FFT? Why it is needed? 2

   c) Write the DIT Algorithm for N = 4. Also draw the Signal Flow Graph. 4

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4. Parts of the same question should be used for answered together and in the same sequence.

**Time: 3 Hours (For Part A and Part B)** **Total Marks: 70**

## PART-A

1. a) Define following terms: i) Unit ramp, ii) Unit step and iii) Unit impulse. 3

   b) What is the basic difference between discrete-time signal and digital signal? 2

   c) Give that $X(n) = \{1, -2, \underset{\uparrow}{8}, 4, 5, -3, 7\}$ 3

   Find i) $y(n) = \frac{1}{3}[x(n+1) + x(n-1)]$ ii) $y(n) = \frac{1}{2}[x(-n)]$.

   d) Consider the analog signal: $x_a(t) = 3cos400\pi t + 10sin300\pi t - cos100\pi t$ $3\frac{2}{3}$

   i) What is the Nyquest rate for this signal? ii) Suppose that the signal is sampled at the rate $F_s$=100 $H_z$ .What is the discrete-time signal obtained after sampling?

2. a) Consider the system shown in Fig 2.b. Determine whether it is a) memoryless, b) causal, c) linear, d) time-invariant, and e) stable. 5

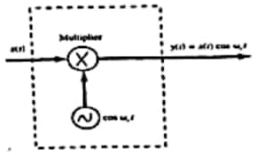


Fig-2.b

   b) An LTI system has an impulse response $h(n) = u(n+1) - u(n-10)$. Determine the output of the system when the input, $x(n) = -u(n) + 2u(n-3) - u(n-6)$. $6\frac{1}{3}$

3. a) Determine if the systems described by the following input-output equations are linear or nonlinear. $y(n) = x^2(n)$. 3

   b) What do you mean by time-invariant system and linear system? Explain with example. 5

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   c) Express the given signal sequence as a time-shifted impulse. $X(n)$={ 1, -2, 8, 4, 5, -3, 7}.

4. a) 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 with impulse response h(n)= { 1, 2, 1}. $6\frac{2}{3}$

   b) Determine the cross-correlation sequence of the sequences x(n)= {1, 2, 3, 4,5} and y(n)= { 5,6, 7, 8, 9}. 5

## PART-B

5. a) Derive the equations for exponential Fourier series. 3

   b) Find the Fourier coefficients of the given signal 5

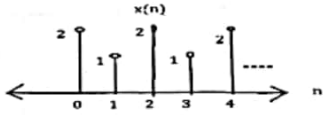
   $X(t) = 1 + sin2\omega_0 t + 2cos2\omega_0 t + cos(3\omega_0 t + \frac{\pi}{3})$.

   c) Drive the expression for power density spectrum of periodic signals. $3\frac{2}{3}$

6. a) Determine the Fourier transform of the signal $x(t) = e^{-at}sin\omega_0 t\, u(t)$. 3

   b) Calculate the power density spectrum for given signal using Fourier series as complex form. 5

   x(n) = [2 1 2 1 2 1 2 1 2 1----------]




   c) Determine the Fourier transform of the signal $x(t) = e^{-at}u(t)$ where a > 0. Plot the magnitude and phase spectrum. $3\frac{2}{3}$

7. a) Derive synthesis and analysis equations of continuous time Fourier transform. $5\frac{2}{3}$

   b) Prove the following properties for Discrete Fourier transform- 6

   i)Time scaling , ii) Frequency shifting , and iii) Time reversal.

8. a) Distinguish between Fourier series analysis and Fourier transform. $3\frac{2}{3}$

   b) Compute the IDFT of the four point sequence $X(\omega) = (4, 3 + j3, 2, 3 - j3)$. 4

   b) Determine the 4-point DFT of the given signal 4

$$x(n) = \begin{cases} 1, & 0 \le n \le 3 \\ 0, & elsewher \end{cases}.$$

## PART-B

| | | | |
|---|---|---|---|
| 5. | a) | Explain DTFS. Deduce its pair expression. | 3 |
| | b) | Find the DTFS of the signal $x(n) = \{\underset{\uparrow}{0.5}, 1, -4, 0, 0\}$. | 3 |
| | c) | Deduce the expression for DTFT. | 5.67 |
| 6. | a) | Explain how aperiodic signals can be represented by Fourier ~~series~~ Transform | 4 |
| | b) | Find the DTFT of the sequences i) $x(n) = \alpha^n u(n)$, *where* $\alpha = 0.5$, and (ii) $x(n) = 2(3)^n u(-n)$. | 4 |
| | c) | What is meant by sampling? State sampling theorem. | 3.67 |
| 7. | a) | Find the convolution of the sequences $h(n) = \left(\frac{1}{2}\right)^n u(n)$ and $x(n) = \left(\frac{1}{3}\right)^n u(n)$, using convolution property of DTFT. | 3.67 |
| | b) | Write the process of performing Fourier transform of an analog signal $x(t)$ by using digital computers. | 4 |
| | c) | Deduce the DIT algorithm for a 4-point sequence, i.e., $N = 4$. | 4 |
| 8. | a) | Explain DFT and Its Inverse | 2 |
| | b) | Describe matrix representation of DFT. | 4.67 |
| | c) | Find 4-point DFT and IDFT for the given data sequence $x(n) = \{1, 2, 1, 1\}$. | 5 |

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