

510704

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B. Tech. V - Sem. (Main/Back) Exam., (Academic Session 2021- 2022)  
 Electronics & Communication Engineering  
 SEC4 - 04 Digital Signal Processing

Time: 3 Hours

Maximum Marks: 120  
 Min. Passing Marks:

**Instructions to Candidates:**

**Part - A:** Short answer questions (up to 25 words)  $10 \times 2$  marks = 20 marks.  
 All ten questions are compulsory.

**Part - B:** Analytical/Problem solving questions  $5 \times 8$  marks = 40 marks.  
 Candidates have to answer five questions out of seven.

**Part - C:** Descriptive/Analytical/Problem Solving questions  $4 \times 15$  marks = 60 marks.  
 Candidates have to answer four questions out of five.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination.  
 (Mentioned in form No. 205)

1. NIL2. NIL**PART - A**

- ~~Q.1~~ What is the difference between discrete time signal and digital signal? [2]
- ~~Q.2~~ What is Linear Time Invariant (LTI) system? [2]
- ~~Q.3~~ Consider a signal given by  $x(n) = [1, 2, 3, 4, 5]$ . Calculate  $y(n) = x(-n + 4)$ . [2]
- ~~Q.4~~ A system output  $y(n)$  and input  $x(n) = [1, 2, 3, 4, 5]$  is related by  $y(n) = x(n) + 5$ . Comment on linearity of the system. [2]

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Q.5 What is the difference between DTFT and DFT? [2]

Q.6 What is the Z-transform of  $\delta(n-1)$ ? Also, mention its ROC. [2]

Q.7 A signal  $x(t)$  is given by  $x(t) = \frac{\sin 400\pi t}{\pi} + \frac{\sin 600\pi t}{\pi}$ . What is the Nyquist sampling rate? [2]

Q.8 Explain any four properties of ROC of Z-transform. [2]

Q.9 What is the difference between DTFT and Z-transform? [2]

Q.10 What is the difference between Butterworth and Chebyshev filters? [2]

**PART - B**

Q.1 Consider a time sequence  $x(n) = [1, 0, -1, 2]$ . Calculate the DFT of the signal for  $x(n) [1, 0, -1, 2]$ ,  $k = 0, 1, 2, 3$ . [8]

Q.2 Calculate the Z-transform of the following signals. Also, mention ROC -

(i)  $x(n) = \left(\frac{1}{2}\right)^n u(n)$  [4]

(ii)  $x(n) = 2^{-|n|}$  [4]

Q.3 Consider an analog Filter Transfer function  $H(s) = \frac{s+1}{(s+3)(s+5)}$ . Obtain the digital filter transfer function using Impulse - Invariant Transformation method. [8]

Q.4 Explain the ideal filter characteristics of the followings - [2+2+2+2=8]

- (i) Low Pass Filter
- (ii) High Pass Filter
- (iii) Band Pass Filter
- (iv) Band Reject Filter

Q.5 Consider, three systems connected in cascade, and given by following difference equations - [4+4=8]

System  $S_1$  :  $y_1(n) = x_1(n) - x_1(n-1)$

System  $S_2$  :  $y_2(n) = x_2(n) + x_2(n-2)$

System  $S_3$  :  $y_3(n) = x_3(n-1) + x_3(n-2)$

Calculate -

- (i) Overall Transfer function  $H(z)$
- (ii) One difference equation relating input and output.

Q.6 Explain the Decimation-in-time Radix-2 FFT Algorithm. [8]

Q.7 Consider a discrete time signal  $x(n)$  given by  $x(n) = 4^n u(n)$ . The Z-transform of  $x(n)$  is  $X(z)$ . Another signal  $x_1(n)$  whose Z-transform is given by  $X_1(z) = X(2z)$ . Calculate  $x(n)$ . [8]

### PART – C

Q.1 (a) Explain the sampling process and sample and hold operation, used in analog to digital conversion. [4+4+4+3=15]

(b) What is Nyquist sampling theorem?

(c) What is Aliasing effect?

Q.2 Following specifications are given to design a Butterworth digital Low Pass Filter – [3+3+6+3=15]

(i) Pass band gain : 0.89

(ii) Frequency upto which pass band gain remain constant : 25 Hz

(iii) Amount of attenuation : 0.215

(iv) Frequency from which attenuation starts : 75 Hz

(v) Sampling Frequency : 300 Hz

Calculate the followings –

(a) Cut-off frequency

(b) Order of the filter

(c) Analog Filter Transfer function  $H(s)$

(d) Digital Filter Transfer function  $H(z)$

Q.3 Explain the different steps involved in the design of Elliptic Filter. [15]

Q.4 Explain the following structures for the implementation of FIR systems – [5+5+5=15]

(a) Direct Form

(b) Cascade Form

(c) Lattice Form

Q.5 What is multirate signal processing? What are the applications of multirate signal processing? Explain the up-sampling operation with suitable example. What is spectral image introduced by up-sampling and how it is removed? [2+3+6+2+2=15]