DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE – RAIGAD -402 103

Winter Semester Examination – December - 2019

Branch: Electronics and Telecommunication Engineering **Sem.:- V**

Subject: - Digital Signal Processing [BETXC504] **Marks: 60**

Date: - 16/12/2019 **Time: - 3 Hr.**

Instructions to the Students

1. Each question carries 20 marks.
2. Attempt **any five** questions of the following.
3. Illustrate your answers with neat sketches, diagram etc., wherever necessary.
4. If some part or parameter is noticed to be missing, you may appropriately assume it and should mention it clearly

(Marks)

Q.1. a) Explain the advantages of digital signal processing over analog signal processing. (06)

Q.1. b) State the sampling theorem for low pass signals. Explain the instantaneous sampling procedure with neat diagrams of signal before and after sampling and their respective spectra. (06)

Q.2. a) (i) Determine the DTFT of the following sequence (06)

$$y(n) = n.a^n u(n), \quad \text{where } |a| < 1$$

(ii) Perform circular convolution (4-point) of the following sequences using matrix method.

$$x_1(n) = \{1, 2, 2\}$$
$$x_2(n) = \{1, 2, 3, 4\}$$

Q.2. b) Compute 8-point DFT of the following sequence using DIT-FFT method. (06)

$$x(n) = \{0, 1, 2, 3, 4, 5, 6, 7\}$$

Q.3. a) Determine the inverse Z-transform of the following function using power series expansion (long division) method. (06)

$$X(z) = 1/(1-0.5z^{-1}) \quad |z| > 0.5$$

Q.3. b) A causal discrete LTI system is described by the following equation, (06)

$$y(n) - (3/4)y(n-1) + (1/8)y(n-2) = x(n)$$

where $x(n)$ and $y(n)$ are the input and the output of the system respectively. Determine the system transfer function $H(z)$ and impulse response $h(n)$ of the system.

Q.4. a) Transform the given analog transfer function into a digital filter $H(z)$ using the impulse invariant method(IIM) at $f_s = 2$Hz. (06)

$$H(s) = (4s + 7) / (s^2 + 5s + 4)$$

Q.4. b) Determine the equation of order (N) and the cut-off frequency (Ω_c) of Butterworth filter form the expression of magnitude response of the Butterworth filter. (06)

Q.5. a) Explain Gibbs phenomenon with neat diagram. (06)

Q.5. b) Consider a causal LTI system with system function given by, (06)

$$H(z) = 1 - (1/3)z^{-1} + (1/6)z^{-2} + z^{-3}$$

Draw the direct form and transposed form structure of the system.

Q.6. a) Explain downsampling with neat diagrams. Consider a sequence $x(n)$ with its Fourier pair $X(e^{jw})$ bandlimited to $(\pi/3)$ as shown in the figure 1 below. Let $y(n) = x(3n)$. Write the equation for $Y(e^{jw})$. Draw the input signal spectrum $X(e^{jw})$ as well as the downsampled signal spectrum $Y(e^{jw})$. (06)

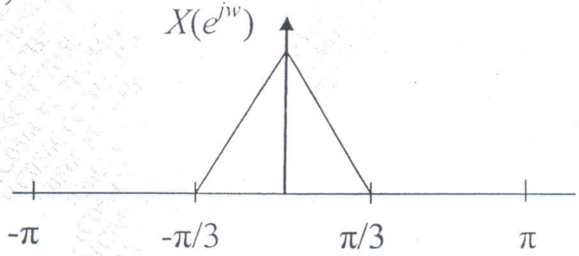

Fig.1

Q.6. b) Explain the aliasing effect of downsampling in frequency domain and importance of decimator with neat diagrams. (06)

**********End Paper**********