Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (OLD) - EXAMINATION – SUMMER 2018

Subject Code:171003 Date:03/05/2018

Subject Name:Digital Signal Processing

Time:02:30 PM to 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** For the following systems, determine whether it is memoryless, stable, causal, or time invariant. **07**

(i) $y[n] = \sum_{k=-\infty}^{2n} x[k]$ **(04)**

(ii) $y[n] = x[n^2]$ **(03)**

(b) Perform the circular convolution of the following sequences using graphical method. **07**

x1[n] = {1 2,2}
↑

x2[n] = {1,2,3,4}
↑

Q.2 **(a)** A discrete time signal x[n] is defined as, **07**

$$x[n] = \begin{cases} 1 & -1 \le n \le 3 \\ \frac{1}{2} & n = 4 \\ 0 & otherwise \end{cases}$$

(i) Sketch the sequence

(ii) Sketch x[n-2]

(iii) Sketch x[n] u[2-n]

(iv) Sketch x[2n]

(b) Consider the difference equation **07**

$$y[n] - \frac{5}{6}y[n-1] + \frac{1}{6}y[n-2] = \frac{1}{3}x[n-1]$$

(a) What are the impulse response, and frequency response for the causal LTI system satisfying the difference equation? **(04)**

(b) What is the general form of the homogeneous solution of the difference equation? **(03)**

OR

(b) The continuous time signal **07**

$$x_c(t) = \sin(20\pi t) + \cos(40\pi t)$$

Is sampled with a sampling period T to obtain the discrete-time signal

$$x[n] = \sin\left(\frac{\pi n}{5}\right) + \cos\left(\frac{2\pi n}{5}\right)$$

(a) Determine a choice for T consistent with this information.

(b) Is your choice for T in part (a) unique? If so, explain why? If not, specify another choice of T consistent with the information given.

Q.3 **(a)** State and Prove the following properties of Z-Transform. **07**

(a) Time shifting

(b) Differentiation of X(z)

(b) A causal LTI system has the system function **07**

$$H(z) = \frac{1 + 2z^{-1} + z^{-2}}{\left(1 + \frac{1}{2}z^{-1}\right)(1 - z^{-1})}$$

Find the impulse response of the system, h[n].

OR

Q.3 **(a)** (a) Consider two LTI systems connected in series. Show that the overall system response does not depend on the order of interconnection. **07**
(b) Show that Forward difference system is inverse system of One-sample delay system.

(b) Find Z Transform and ROC of following signals. **07**

(a) $x[n] = na^n u[n]$

(b) $x[n] = \left(\frac{1}{2}\right)^n (u[n] - u[n-10])$

Q.4 **(a)** List the properties of DFT. Prove any two properties. **07**

(b) Consider a causal LTI system **S** with impulse response h[n] and system function **07**

$$H(z) = \frac{(1-2z^{-1})(1-4z^{-1})}{z\left(1-\frac{1}{2}z^{-1}\right)}$$

(a) Draw a direct form II flow graph for the system **S**.

(b) Draw the transposed form of the flow graph in Part (a).

OR

Q.4 **(a)** Write short note on structures for Linear Phase FIR system. **07**

(b) Compute 4-point DFT X[k] of a sequence x[n] = {0,1,2,3} **07**

Q.5 **(a)** Discuss Radix-2 Decimation In Time (DIT) FFT algorithm. **07**

(b) Design the symmetric FIR low pass filter for which desired frequency response is expressed as **07**

$$H_d(w) = \begin{cases} e^{-jw\tau} \; for \; |w| \leq \; w_c \\ 0 \qquad elsewhere \end{cases}$$

The length of the filter should be 7 and w_c = 1rad/sample. Make use of rectangular window.

OR

Q.5 **(a)** With help of block diagram explain architecture of TMS320C6XXX processor **07**

(b) Write short note on Design of IIR filter by the Bilinear Transformation Method. **07**

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