Code No : 20EC6T03 **R20**

III B. TECH II SEMESTER REGULAR EXAMINATIONS APRIL - 2023
DIGITAL SIGNAL PROCESSING
(ELECTRONICS AND COMMUNICATION ENGINEERING)

Time: 3 hours Max. Marks: 70

Note: Answer **ONE** question from each unit **(5 × 14 = 70 Marks)**

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UNIT-I

1. a) Make the step by step convolution $y(n) = x(n) * h(n)$ of the following signals (i) $x(n) = \{1,1,4\}, h(n) = \{1,1,1,1,1\}$ and (ii). $x(n) = \{1,2,-1\}, h(n) = x(n)$. [7M]

   b) By first differentiating $X(z)$ and then using appropriate properties of the z –Transform. Determine $x(n)$ for the following transforms. (i) $X(z) = \log(1-4z)\,, |z| < \frac{1}{2}$ and (ii) $X(z) = \log(1-2z^{-1})\,, |z| < \frac{1}{4}$ [7M]

(OR)

2. a) Determine whether or not each of the following signals is periodic. In case a signal is periodic, Specify its fundamental period. (i). $x(n) = 8\cos(4n + \frac{\pi}{8})$ and (ii). $y(n) = 4\cos\left(\frac{\mathrm{n}}{4}\right)\cos(\frac{\pi n}{4})$ [8M]

   b) Determine all possible signals x(n) associated with the z-transform given here $X(z) = \frac{8z^{-1}}{(1-4z^{-1})(6-z^{-1})}$ [6M]

UNIT-II

3. a) Compute the eight point circular convolution for the given sequences here. $x_1(n) = \left(\frac{1}{4}\right)^n \quad 0 \le n \le 7$ *and* $x_2(n) = \cos\left(\frac{3\pi}{8}\right)n \quad 0 \le n \le 7$ [7M]

   b) Construct a flow graph for a 16-point radix-2 decimation-in-time FFT algorithm. Label all multipliers in terms of powers of W_{16} , and also label any branch transmittance that are equal to -1. Label the input and output nodes with the appropriate values of the input DFT sequence, respectively. Determine the number of real multiplications and the number of real additions required to implement the flow graph. [7M]

(OR)

4. a) Derive the signal flow graph for the $N = 8$ point, radix-2 decimation-in-frequency FFT algorithm in which the input sequence is in digit-reversed order and the output DFT is in the normal order. [6M]

   b) From the given sequences and their 5-point DTFs consideration, Determine the sequence $y(n)$ so that $Y(K) = X_1(k)X_2(k)$. [8M]

$$x_1(n) = \{\underset{\uparrow}{0}, 1, 2, 3, 4\} \qquad x_2(n) = \{\underset{\uparrow}{0}, 1, 0, 0, 0\}$$
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UNIT-III

5. a) Convert the analog filter with given system function $H(s) = \frac{s+0.2}{(s+0.2)^2+8}$ in to digital IIR filter by means of the impulse invariance method. [7M]

b) Design a digital low-pass Butterworth filter with a 3dB cut-off frequency of 2 kHz and minimum attenuation of 30 dB at 4.25 kHz for a sampling rate of 10 kHz. (Design of IIR filter) [7M]

(OR)

6. a) List the advantages of digital filters over analog filters. [6M]

b) Using the given system function H(s), convert the analog band pass filter into a digital IIR filter by use of the backward difference for the derivative. $H(s) = \frac{1}{(s+0.2)^2+6}$ [8M]

UNIT-IV

7. a) Describe the steps involved in the design of FIR filters using windowing techniques. Draw and give the expressions of any four windowing functions. [8M]

b) Compare and contrast FIR and IIR digital filters. [7M]

(OR)

8. a) Compute the coefficients of a linear-phase FIR filter of length M =15 which has a symmetric unit sample response and a frequency response that satisfies the conditions $H(\frac{2\pi k}{15}) = \begin{cases} 1, & k = 0, 1, 2, 3 \\ 0.4, & k = 4 \\ 0 & k = 5, 6, 7 \end{cases}$ [7M]

b) Describe the symmetric and antisymmetric FIR Filter designing method. [7M]

UNIT-V

9. a) Design and give an expression for a low pass filter for sampling rate conversion implementation [7M]

b) Explain clearly the roles of each of the following in a multi-rate processing system: Decimating filter and down sampler. [7M]

(OR)

10. a) Explain clearly the roles of each of the following in a multi-rate processing system: Decimation factor D and Interpolation by a factor I. [7M]

b) Discuss the multistage implementation of sampling rate conversion and list the advantages of multi-rate processing. [7M]

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