Registration No.: | | | | | | | | | | |

Total Number of Pages: **Course: B.Tech**

Sub Code: REC5C001

5th Semester Back Examination: 2025-26

SUBJECT: DIGITAL SIGNAL PROCESSING

BRANCH(S): AEIE, ECE, ETC

MAX MARKS: 100

TIME: 3 HOURS

Q.Code: U128

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right-hand margin indicate marks.

Part- I

Q1 **Answer the following questions: (Answer All-10)** **(02 x 10)**

a) Among FIR and IIR digital filters, which is more stable and why?

b) Find the Discrete Fourier Transform of $\delta(n)-\delta(n-2)$.

c) Find the circular convolution of $x(n)=\{-5,-2_{\uparrow},-1\}$ and $k(n)=\{1_{\uparrow},2\}$.

d) Draw a radix-2, 2-point DIT-FFT structure and 2-point DIF-FFT.

e) What is superposition theorem to check linearity of a discrete time system?

f) Find Z-transform of $2\delta(n-1)+3u(n+2)$.

g) Define the discrete cosine transform as an orthogonal transform.

h) What is the major difference between Direct Form-I and Direct Form-II structures?

i) How many complex additions and multiplications are there in 8-point DFT and 8-point radix-2 DIF-FFT?

j) Differentiate between convolution and correlation for discrete time signals.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(06 x 08)**

a) Prove that the Discrete Cosine Transform be an orthogonal transform.

b) Determine the inverse Z-transform of by the partial fraction expansion method

$X(z)=\dfrac{z+2}{2z^2-7z+3}$, if the ROCs are (a) $|z|>3$ and (b) $\dfrac{1}{2}<|z|<3$.

c) Determine the direct form II realization for the IIR transfer function

$H(z)=\dfrac{0.28z^2+0.319z+0.04}{0.5z^3+0.3z^2+0.17z-0.2}$.

d) List and derive any 4 properties of DFT.

e) Differentiate between DCT and DFT.

f) For $X(k)=\{20,-5.828-j2.414,0,0.172-j0.414,0,-0.172+j0.414,0,-5.828+j2.414\}$ find $x(n)$ using FFT Algorithm.

g) Differentiate between impulse invariant and bilinear transform method for the design of IIR filters.

h) For a system defined as $y(n)=6x(n)-5x(n-1)-x(n-4)+\frac{1}{x(n-1)}$, Check if the system is LTI or not?

i) Show that for linear phase FIR filter $H(n)=H(N-1-n)$ and $\alpha=\frac{N-1}{2}$.

j) How system identification can be performed using the adaptive digital filters? Draw block diagram to support your answer.

k) Find the circular convolution of $x(n)=\{1,-1,1\}$ and $h(n)=\{-2,2,-2\}$ using DFT and IDFT method.

l) For an analog system response $H(S)=\frac{b}{S+a}$ prove that $H(Z)=\frac{b}{\frac{2}{T}\left(\frac{1-Z^{-1}}{1+Z^{-1}}\right)+a}$.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Explain the application of LMS adaptive algorithm for system identification. **(8 x 2)**

b) Find the expression for mean square error. How is adaptive line enhancer different than a system identification? Explain with suitable examples.

Q4 **a)** $x(n)=e^{-n}$, find $X(K)$ using radix-2 DIT-FFT algorithm for $0\le n<8$. **(8 x 2)**

b) From $X(K)$ get back $x(n)$ using the DIF-FFT algorithm.

Q5 Write short notes (any two) **(8 x 2)**

a) Impulse invariant method
b) Frequency sampling method for FIR filter design
c) FIR filter design vs IIR Filter Design

Q6 **a)** For an analog system response $H(S)=\frac{K}{S+M}$ prove that $H(Z)=\frac{M}{\frac{2}{T}\left(\frac{1-Z^{-1}}{1+Z^{-1}}\right)+K}$ using bilinear transform method. **(8)**

b) What do you mean by windows in FIR filter design and why are they useful? **(8)**