



Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025 Digital Signal Processing

Max. Marks: 100

Note : Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Find the 16 point DFT of a signal

$$x(n) = \begin{cases} \frac{1}{2} & n \leq 0 \\ 1 & 1 \leq n \leq 15 \end{cases}$$
(08 Marks)
- b. With neat diagram, explain frequency domain sampling and reconstruction of discrete time signals. (08 Marks)
- c. The first five values of an 8 point DFT of real valued sequence are $(4, 1-j1, 0, 1+j2, 0)$. Find the remaining values of the DFT. (04 Marks)

OR

- 2 a. Determine 8 point DFT of $x(n) = [1, 1, 1, 1, 0, 0, 0, 0]$. (10 Marks)
- b. Determine 4 point circular convolution between $x_1(n) = [1, 2, 2, 1]$ and $x_2(n) = [1, 1]$ using DFT and IDFT method. (10 Marks)

Module-2

- 3 a. State and prove Parseval's theorem in DFT. (06 Marks)
- b. Using overlap save method, compute $y(n)$ of a FIR filter with impulse response $h(n) = [3, 2, 1]$ to an input $x(n) = [2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1]$. Use only 8-point circular convolution. (08 Marks)
- c. For the sequences $x_1(n) = \cos\left(\frac{2\pi n}{N}\right)$ and $x_2(n) = \sin\left(\frac{2\pi n}{N}\right)$, $0 \leq n \leq N-1$, determine N point circular correlation of $x_1(n)$ and $x_2(n)$. (06 Marks)

OR

- 4 a. Using overlap add method, compute $y(n)$ of a FIR filter with impulse response $h(n) = [1, 2, 1]$ to an input sequence $x(n) = [1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 1]$, use only 6-point circular convolution. (10 Marks)
- b. Find the DFT of a sequence $x(n) = [1, 2, 3, 4, 4, 3, 2, 1]$ using radix 2 DIT – FFT algorithm. (10 Marks)

Module-3

- 5 a. Design a FIR filter with a desired frequency response

$$H_d(e^{jw}) = \begin{cases} e^{-j3w}; & -\frac{3\pi}{4} \leq w \leq \frac{3\pi}{4} \\ 0; & \frac{3\pi}{4} < |w| < \pi \end{cases}$$
 Also obtain the frequency response. (10 Marks)
- b. A FIR filter is given by difference equation

$$y(n] = x(n) + \frac{2}{5}x(n-1) + \frac{3}{4}x(n-2) + \frac{1}{3}x(n-3)$$
 Draw the corresponding direct Form – I and lattice structure. (10 Marks)

OR

- 6 a. Given $H(z) = (1 + 0.6z^{-1})^5$. Realize in direct form and cascade of first and second order sections. (10 Marks)
- b. Determine filter coefficients $h(n)$ of a FIR filter with a desired frequency response.

$$H_d(w) = \begin{cases} e^{-2jw} & -\pi/4 \leq w \leq \pi/4 \\ 0 & \pi/4 \leq |w| \leq \pi \end{cases} \text{ use Hamming window.} \quad (10 \text{ Marks})$$

Module-4

- 7 a. Derive the expression for the order of Butterworth filter. (06 Marks)
- b. The system function of the analog filter is given as $H_a(S) = \frac{S+0.1}{(S+0.1)^2 + 16}$. Obtain the system function of the digital filter using bilinear transformation. Assume $T = 2$ seconds. (06 Marks)
- c. Design a digital Butterworth filter with a maximum pass band attenuation 3.01 dB at pass band edge frequency 500Hz and stop band attenuation of 15 dB at stop band edge frequency 750 Hz. Sampling rate of 2 KHz. (08 Marks)

OR

- 8 a. A system is specified by its transfer function
- $$H(z) = \frac{(z-1)(z-2)(z+1)z}{[z - (\frac{1}{2} + j\frac{1}{2})][z - (\frac{1}{2} - j\frac{1}{2})][z - j\frac{1}{4}][z + j\frac{1}{4}]}$$
- realize the system in the direct form - I and direct form - II. (10 Marks)
- b. A Butterworth low pass filter has to meet the following specifications :
- Pass band ripple and edge frequency of 1dB, 100π rad/sec.
 - Stop band attenuation and edge frequency of 35 dB, 1000π rad/sec respectively at the sampling rate of 2000 samples/sec. Applying BLT technique, determine $H(z)$. (10 Marks)

Module-5

- 9 a. With a neat diagram, explain the Harvard architecture used in DS processors. (07 Marks)
- b. Explain dedicated MAC computation in DSP processor with a block diagram. (05 Marks)
- c. Convert the following decimal numbers into the floating point representation :
- 0.640492×2^{-2}
 - -0.638454×2^5
- Use 4 bits to represent exponent and 12 - bits for mantissa. (08 Marks)

OR

- 10 a. With a neat diagram, explain basic architecture of TMS320C54X family digital signal processors. (10 Marks)
- b. Describe the IEEE single precision floating point format used in DSP processors. (05 Marks)
- c. Find the signed Q - 15 representation for the decimal number 0.560123. (05 Marks)

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