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Question Paper Code : 81237

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth Semester

Electronics and Communication Engineering

EC 3492 — DIGITAL SIGNAL PROCESSING

(Common to Electronics and Telecommunication Engineering/Medical Electronics)

(Regulations 2021)

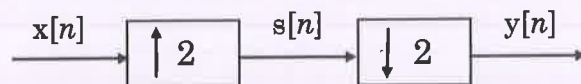
Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define twiddle factor.
2. Bring out the differences between DTFT and DFT.
3. List out the properties of Butterworth filter.
4. Mention the limitations of Bilinear Transformation technique.
5. How to avoid Gibb's phenomenon in an FIR filter design?
6. Write the characteristics of Blackman window.
7. What is meant by "perturbation error"?
8. Given $H(z) = \frac{0.5 + 0.4z^{-1}}{1 - 0.312z^{-1}}$ is the transfer function of a digital filter, find the scaling factor to avoid overflow error.
9. List out any four applications of multirate signal processing.
10. Determine the DTFT of output $s(n)$ and $y(n)$ for the system given below



PART B — (5 × 13 = 65 marks)

11. (a) Use DFT-IDFT method to determine the response of the system with impulse response $h(n) = \{1, 2, 3\}$ to the input sequence $x(n) = \{2, 4\}$.

Or

- (b) Compute the 8-point DFT of the sequence $x(n) = \sin(3\pi/8)n$; $0 \leq n \leq 7$ using in place radix-2 decimation in frequency algorithm.

12. (a) Design and digital Butterworth filter using bilinear transformation to meet the following requirements

$$0.707 \leq |H(e^{j\omega})| \leq 1, \quad 0 \leq |\omega| \leq \pi/2$$

$$|H(e^{j\omega})| \leq 0.2, \quad 3\pi/4 \leq |\omega| \leq \pi$$

Obtain the canonic realization for the designed filter.

Or

- (b) Using Bilinear Transformation, design a recursive digital filter which exhibits equiripple behaviour in the passband with the following specifications:

$$0.8 \leq |H(j\omega)| \leq 1 \quad \text{for } 0 \leq |\omega| \leq 0.2\pi$$

$$|H(j\omega)| \leq 0.2 \quad \text{for } 0.6 \leq |\omega| \leq \pi$$

Obtain the Direct form-II realization for the designed filter.

13. (a) Design a FIR filter with the following specification using Hanning window

$$H_d(e^{j\omega}) = e^{-j3\omega}; \quad |\omega| \leq \pi/4$$

$$0; \quad |\omega| > \pi/4$$

Also draw the efficient realization structure for the obtained transfer function of the designed filter.

Or

- (b) Determine the coefficients of a linear-phase FIR filter of length $m = 15$ which has a symmetric unit sample response and a frequency response

$$\text{that satisfies the conditions } H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1 & k = 0, 1, 2, 3 \\ 0.6 & k = 4 \\ 0 & k = 5, 6, 7 \end{cases}$$

14. (a) Explain the characteristics of a limit oscillation with respect to the system described by the difference equation $y(n) = x(n) + (3/4)y(n-1)$, where input $x(n) = (15/16)\delta(n)$. Determine the deadband of the filter.

Or

- (b) The output signal of an A/D converter is passed through a lowpass filter, with transfer function given by $H(z) = H_1(z)H_2(z)$, where $H_1(z) = \frac{1}{1 - 0.75z^{-1}}$ and $H_2(z) = \frac{1}{1 - 0.5z^{-1}}$. Find the output noise power due to quantization at the output of the digital filter for

(i) direct form II

(ii) cascade realization

(7 + 6)

Assume $b = 4$ (including sign bit).

15. (a) With neat sketches, briefly explain about the time domain and frequency domain characteristics of a decimator with a decimation factor, D .

Or

- (b) With a neat diagram, explain the architecture of TMS320C5x series Digital Signal Processor.

PART C — ($1 \times 15 = 15$ marks)

16. (a) (i) State Sampling Theorem and also explain the process of sampling and reconstruction of signal. (8)
- (ii) Consider an analog signal $x(t) = 5 \cos 200\pi t$. Examine the minimum sampling rate to avoid sampling. If sampling rate $F_s = 400 \text{ Hz}$, what is the Discrete time signal after sampling? (7)

Or

- (b) A casual LTI system is described by the difference equation, $y(n) - 0.166y(n-1) - 0.166y(n-2) = x(n)$. Determine the frequency response and impulse response of the system. Also comment on the stability of the system.

