Register No : _____

# THE KAVERY ENGINEERING COLLEGE

*(An Autonomous Institution)*

B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

*Fourth Semester*

*Electronics and Communication Engineering*

EC3492–Digital Signal Processing

*Regulations - 2021*

*Duration : 3 Hrs* *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

| *Q.No* | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|
| 1. | Outline the analysis and synthesis equations of DTFT. | UN | 1 | 2 |
| 2. | Recall the properties of the twiddle factor. | RE | 1 | 2 |
| 3. | Why is prewarping needed during filter design? | RE | 2 | 2 |
| 4. | Identify the reason for preferring the Direct Form II realization technique over the Direct Form I realization. | AP | 2 | 2 |
| 5. | Define the terms group delay and phase delay. | RE | 3 | 2 |
| 6. | Summarize the desirable characteristics of windows in FIR filter design. | UN | 3 | 2 |
| 7. | Construct the decimal fraction 3/8 in Q-15 format. | AP | 4 | 2 |
| 8. | Solve for the bits required for an ADC to obtain SNR $\geq$ 100 dB. | AP | 4 | 2 |
| 9. | Recall the noble identity for Up-sampler. | RE | 5 | 2 |
| 10. | List are the advantages of MAC units in DSP processors? | RE | 5 | 2 |

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

| *Q.No* | | | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|---|---|
| 11. | a | i | Solve for the 6-point DFT of the given signal x(n) = {1,2,2,1} and draw the amplitude and phase spectrum. | AP | 1 | 7 |
| | | ii | Choose concentric circle method to find the circular convolution of the given data sequences $x_1(n)$ = {1,3, 5} and $x_2(n)$={2,4,6, 8}. | AP | 1 | 6 |
| | | | Or | | | |
| | b | i | Apply the Radix-2 DIF FFT algorithm to find the DFT of the data sequence x(n) = {1,1,1,1}. | AP | 1 | 5 |
| | | ii | Choose overlap-save method to determine the output of a linear FIR filter with an impulse response h(n)={1, 2, 3} and an input signal x(n) ={1, 2, 3, 4, 5, 6, 7, 8, 9}. | AP | 1 | 8 |
| 12. | a | | Build a digital low-pass Butterworth filter using the bilinear transformation method with passband and stopband cutoff frequencies of 800 rad/sec and 1800 rad/sec, respectively. The passband attenuation is -3 dB, and the stopband attenuation is -10 dB. | AP | 2 | 13 |
| | | | Or | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | b | Develop the Direct Form II and cascade realizations of the system described by the difference equation, and compare the number of memory elements, multipliers, and adders used in each realization technique.<br><br>$y(n) + \frac{1}{16} y(n-1) + \frac{1}{6} y(n-2) - \frac{1}{24} y(n-3) - \frac{1}{16} y(n-4) = x(n) + \frac{5}{6} x(n-1) + x(n-2) + \frac{13}{16} x(n-3) + \frac{1}{6} y(n-4)$. | AP | 2 | 13 |
| 13. | a | Construct an Ideal BPF whose desired-frequency response is given by<br>$H_d(e^{j\omega}) = \begin{cases} 1, \frac{2\pi}{3} \geq \lvert\omega\rvert \geq \frac{\pi}{3} \\ 0, \quad Otherwise \end{cases}$<br>Using Hanning window, determine the impulse response for N=9. | AP | 3 | 13 |
| | | Or | | | |
| | b | Construct an HPF whose desired-frequency response is given by<br>$H_d(e^{j\omega}) = \begin{cases} e^{-j\left(\frac{N-1}{2}\right)\omega}, \ \pi \geq \lvert\omega\rvert \geq \frac{\pi}{2} \\ 0 \quad , \ \pi > \lvert\omega\rvert \geq 0 \end{cases}$<br>Using frequency sampling techniques, determine the impulse response for N=9. | AP | 3 | 13 |
| 14. | a i | Find the quantization error for a 16-bit ADC with an input voltage range of ± 12V. | RE | 4 | 5 |
| | ii | Two first-order low pass filters with system functions, $H_1(z) = \frac{1}{1-0.9z^{-1}}$ and $H_2(z) = \frac{1}{1-0.8z^{-1}}$ are connected in cascade. Find the overall noise power. | RE | 4 | 8 |
| | | Or | | | |
| | b i | Consider a second-order IIR filter with<br>$H(z) = \frac{1.0}{(1-0.5z^{-1})(1-0.45z^{-1})}$<br>Find the effect of quantization on the pole locations of the given system function in both direct form and cascade form. Assume b=3b = 3b=3 bits (including the sign bit) and that the quantization technique used is truncation. | RE | 4 | 6 |
| | ii | Determine the scaling factor S to avoid overflow in the given transfer function $H(z) = \frac{0.2+0.4z^{-1}}{1+0.6z^{-1}}$. | RE | 4 | 7 |
| 15. | a | Illustrate how adaptive filters are applied in equalization techniques. | UN | 5 | 13 |
| | | Or | | | |
| | b | Explain in detail about various DSP architectures. | UN | 5 | 13 |

*PART – C (Marks 1*15 = 15)*

| *Q.No* | | *Questions* | *BLT* | *CO* | *Marks* |
|---|---|---|---|---|---|
| 16. | a | Examine the process of sampling rate conversion by a rational factor, and derive the input-output relationship in both the time and frequency domains while distinguishing between the effects of upsampling and downsampling. | AN | 5 | 15 |
| | | Or | | | |
| | b | Analyze the various FIR filter realization structures and conclude with the number of basic elements required in each realization technique. | AN | 3 | 15 |