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Question Paper Code : X20450

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020 AND APRIL/MAY 2021
Fifth/Sixth Semester
Electronics and Communication Engineering
EC 6502 – PRINCIPLES OF DIGITAL SIGNAL PROCESSING
(Common to Biomedical Engineering, Medical Electronics)
(Regulations 2013)
(Common to PTEC 6502 – Principles of Digital Signal Processing for
B.E. Part-Time – Fourth Semester – Electronics and Communication Engineering
– Regulations 2014)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What is the relation between DTFT and DFT ?

2. Compute the DFT of the sequence x(n) = {1, –1, 1, –1}.

3. What is known as prewarping ?

4. What are the properties of bilinear transformation ?

5. What is the necessary and sufficient condition for linear phase characteristic in FIR filter ?

6. What are the advantages of Kaiser Window ?

7. What does the truncation of data result in ?

8. List the representations for which truncation error is analyzed.

9. What is the need for antialiasing filter ?

10. If the spectrum of a sequence x(n) is $X(e^{j\omega})$, then what is the spectrum of the signal down sampled by 2 ?

PART – B **(5×13=65 Marks)**

11. a) Derive radix 2 – DIT FFT algorithm and obtain DFT of the sequence x(n) = {1, 2, 3, 4, 4, 3, 2, 1} using DIT algorithm.

(OR)

b) i) Compute IDFT of the sequence X(K) = {7, –0.707, –j0.707, –j, 0.707 – j0.707, 1, 0.707 + j0.707 j, –0.707 + j 0.707} using DIF algorithm. **(8)**

ii) Perform the linear convolution of finite duration sequences h(n) = {1, 2} and x(n) = {1, 2, –1, 2, 3, –2, –3, –1, 1, 2, –1} by overlap save method. **(5)**

12. a) Design a minimum length linear phase FIR filter to meet the following constraints :

Pass band edge frequency = 2000 Hz

Stop band edge frequency = 5000 Hz

Stop band attenuation > 50 dB and sampling frequency = 20000 Hz.

(OR)

b) $H(s) = \frac{1}{(s+1)^2 + 4}$, T_s = 1 Sec. Convert this analog filter into digital filter by impulse invariance method.

13. a) Design a HPF with the following frequency response.

$H_d(e^{j\omega}) = 1$ for $\pi/4 \le |\omega| \le \pi$

$= 0$ for $|\omega| \le \pi/4$

of length N = 11 using Hanning window.

(OR)

b) Determine the coefficients of a linear phase FIR filter of length N = 15 which has a symmetric unit sample response and a frequency response that satisfies the conditions.

$H(2\pi k/15) = 1$; for k = 0, 1, 2, 3

$= 0$; for k = 4, 5, 6, 7

14. a) i) The output of an ADC is applied to a digital filter with system function $H(z) = \frac{0.5z}{z - 0.5}$. Find the output noise power from digital filter when input signal is quantized to have 8 bits. **(7)**

ii) Prove that $\sum_{n=0}^{\infty} x^2(n) = \frac{1}{2\pi j} \oint_c x(z)x(z^{-1})z^{-1}dz$. **(6)**

(OR)

b) A digital system is characterized by the difference equation

$y(n) = 0.9\, y(n-1) + x(n)$ with $x(0) = 0$ and initial condition $y(-1) = 12$. Find the dead band of the system. Verify with formula for largest integer.

15. a) For the signal $x(n)$, obtain the spectrum of down sampled signal $x(Mn)$ and upsampled signal $x\left(\frac{n}{L}\right)$.

(OR)

b) Discuss in detail about any two applications of adaptive filtering with a suitable diagram.

PART – C **(1×15=15 Marks)**

16. a) Using bilinear transformation, design a digital IIR filter with Butterworth characteristics to meet the following specifications.

$$\frac{1}{\sqrt{2}} \le |H(\omega)| \le 1,\ 0 \le \omega \le \pi/2$$

$$0 < |H(\omega)| \le 0.2,\ \frac{3\pi}{4} \le \omega \le \pi.$$

(OR)

b) Consider the low pass filter $y(n) = ay(n-1) + bx(n)$, $0 < a < 1$. **(4)**

i) Determine b, so that $|H(0)| = 1$. **(4)**

ii) Determine the 3-dB bandwidth ω_3 for the normalized filter in part(i).

iii) How does the choice of the parameter 'a' affect ω_3? **(3)**

iv) Repeat parts (i) through (iii) for the high pass filter obtained by choosing $-1 < a < 0$. **(4)**