Total No. of Questions : 10]

SEAT No. :

P2404

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[4758]-565

T.E. (Electronics)

DISCRETE TIME SIGNAL PROCESSING

(2012 Course) (End-Sem.) (Semester - II) (304210)

Time : 2½ Hours] *[Max. Marks :70*

Instructions to the candidates:

1) *Neat diagrams must be drawn wherever necessary.*
2) *Figures to the right indicate full marks.*
3) *Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*
4) *Assume suitable data, if necessary.*

Q1) a) An analog signal is represented as $x(t) = 5\cos(2\pi 2000t) + \cos(2\pi 5000\pi t)$ **[6]**

i) What is the Nyquist rate for the signal?

ii) Suppose, we sample this signal with a sampling frequency F_s = 8kHz, what is the folding frequency?

iii) Write the equation of sampled signal.

b) If the DFT of the sequence $x(n)$ = {1 2 3 4} is given by X(k) = {10 –2 +j2 –2 –2 –j2}. What will be the DFT of time reversed sequence?**[4]**

OR

Q2) a) The analog signal is represented as

$x(t) = \sin(10\pi t) + 2\sin(20\pi t) - 2\cos(30\pi t)$ **[6]**

i) What is the Nyquist rate for this signal?

ii) If the signal is sampled with a sampling frequency of 20Hz, what is the discrete time signal obtained after sampling?

iii) What is the recovered signal?

b) Complete 4 - point DFT of the sequence $x(n) = \cos\frac{n\pi}{2}$ using DIF FFT algorithm. **[4]**

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Q3) a) Compute the 4 - point DFT of the sequence $x(n) = \{4\ 3\ 2\ 1\}$ by linear transformation. **[4]**

b) A causal discrete time system is described by

$$y(n)-\frac{3}{4}y(n-1)+\frac{1}{8}y(n-2)=x(n).$$ **[6]**

i) Determine the system function H(z).

ii) Compute the impulse response of the system.

OR

Q4) a) Find the z-transform of $x(n) = n^2u(n)$. **[4]**

b) Compute $x_1(n) \circledN x_2(n)$ if

$x_1(n) = \delta(n) + \delta(n-1) - \delta(n-2) - \delta(n-3)$

$x_2(n) = \delta(n) - \delta(n-2) + \delta(n-4)$ **[6]**

Q5) a) Design a bandpass linear phase FIR filter having cut-off frequencies of ω_{c_1} = 1 rad/sample and ω_{c_2} = 2 rad/sample. Use rectangular window function. **[6]**

b) Write a note on window functions. **[4]**

c) Show that symmetric FIR filter has linear phase response. **[7]**

OR

Q6) a) Using frequency sampling technique, determine the filter coefficients, length of filter is 17.

<u>Specifications</u>:

$$H_d(e^{j\omega})=\begin{cases} e^{-j8\omega} & 0\le\omega\le\pi/2 \\ 1 & \pi/2\le\omega\le\pi \end{cases}$$ **[8]**

b) Obtain direct form I & cascade form realisation for the transfer function given by

$$H(z) = \left(1 - \frac{1}{4}z^{-1} + \frac{3}{8}z^{-2}\right)\left(1 - \frac{1}{8}z^{-1} - \frac{1}{2}z^{-2}\right)$$ **[9]**

Q7) a) An analog filter has the transfer function **[4]**

$$H(s) = \frac{1}{s+1}$$

Using bilinear transformation, determine the transfer function of digital filter H(z) and also write the difference equation of digital filter. Assume T= 1 sec.

b) Using bilinear transformation, design a butterworth filter which satisfies the following conditions. **[8]**

$$0.8 \le \left|H(e^{j\omega})\right| \le 1 \qquad 0 \le \omega \le 0.2\pi$$

$$\left|H(e^{j\omega})\right| \le 0.2 \qquad 0.6 \le \omega < \pi \quad \text{Assume}T = 1\text{sec}.$$

c) Realize the following second order system in direct form I & direct form II. **[5]**

$$y(n) = 2r\cos(\omega_0)\, y(n-1) - r^2 y(n-2) + x(n) - r\cos(\omega_0)\, x(n-1)$$

OR

Q8) a) For the analog system transfer function

$$H(s) = \frac{1}{(s+1)(s+2)}, \quad \text{Assume T = 1 second}$$

determine H(z) using impulse invariant technique. **[5]**

b) What are the effects of finite word length in digital filter IIR filters. **[5]**

c) Determine parallel realisation of the IIR digital filter transfer function **[7]**

$$H(z) = \frac{3(2z^2 + 5z + 4)}{(2z+1)(z+2)}.$$