| Enrolment No. |
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GUJARAT TECHNOLOGICAL UNIVERSITY M.E.- SEMESTER-I • EXAMINATION – WINTER 2013

| Subject Code: 2715203Date: 30-3Subject Name: Digital Signal Processing | | | |
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| Time: 10.30 To 13.00 Total Mark | | | Į |
| mst | 1. 2. | Attempt all questions. Make suitable assumptions wherever necessary. Figures to the right indicate full marks. | |
| Q.1 | (a) | $x(n) = 1 0 \le n \le 6$ | 07 |
| | | = 0 otherwise Also plot the magnitude and phase spectra obtained from the DTFT function $X(e^{j\omega})$ | |
| | (b) | | 07 |
| Q.2 | (a) | Mention and Prove the following properties of of Discrete Fourier Transform | 07 |
| | | (DFT) (i) Linearity (ii) Time Shifting | |
| | (b) | (iii) Frequency Shifting (iv) Time Scaling Draw the signal flow graph for an 8-point FFT. | 07 |
| | (~) | Compare the following arithmetic computational effort between 8-point FFT | ••• |
| | | and 8-point DFT (i) Complex Multiplication (ii) Real Multiplication | |
| | | (iii) Complex Additions (iv) Real Additions | |
| | (b) | (i) Find $H(z)$ and determine its poles and zeros if | 07 |
| | | $y(n) + \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$ | 07 |
| | | (ii) If $h_1(n) = \left(\frac{1}{2}\right)^n u(n)$ and $h_2(n) = \left(\frac{-1}{2}\right)^n u(n)$ are the impulse responses of two | |
| | | systems in cascade then determine the impulse response of the overall system with the following approaches • $h(n) = h_1(n) \otimes h_2(n)$ and $h(n) = Z^{-1}[H(z)]$ | |
| Q.3 | (9) | | 07 |
| Q 10 | (u) | is the length of the impulse response sequence. Obtain the expressions for magnitude and phase responses of the system with N as the order of the system. | 07 |
| | (b) | Find $f(n)$, a causal sequence, if $F(z)$ is given by the following | 07 |
| | | $(i)\frac{1+z^{-1}}{1-z^{-1}+z^{-2}} \qquad (ii)\frac{1+2z^{-1}}{1-\frac{1}{2}z^{-1}} (iii)\frac{1}{\left(1-\frac{1}{2}z^{-1}\right)^2}$ | |

OR

Q.3 (a) The frequency response of a linear-phase response FIR system is given by $H(e^{j\omega}) = e^{-j3\omega}(0.21145 + 0.386568.\cos\omega + 0.28856.\cos 2\omega + 0.21432.\cos 3\omega)$ Determine its impulse response and its step response

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- (b) Find the impulse response for the following systems using Z-transform 07 approach
 - (i) $y(n) \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n)$ (ii) y(n) - y(n-1) = x(n) + x(n-1)
- Q.4 (a) Design an analog Butterworth filter to obtain H(s) with the following filter 07 specifications
 - Passband frequency = 1,000Hz
 - Stopband frequency = 12,000Hz
 - Passband attenuation = 1dB
 - Stopband attenuation = 60dB
 - (b) Let x(t) be a composite signal made up of four sinusoidal signals of 07 frequencies 1kHz, 1.5kHz, 17kHz and 17.5kHz. Assuming the following sampling rates and plot the spectra of x(t = nTs) on ω (angle/sample) axis
 (i) Fs = 16kHz
 (ii) Fs = 24kHz
 (iii) Fs = 48kHz

- Q.4 (a) Design an analog Chebyshev filter to obtain H(s) with the following filter 07 specifications
 - Passband frequency = 500Hz
 - Stopband frequency = 10,000Hz
 - Passband attenuation = 1dB
 - Stopband attenuation = 80dB
 - (b) Let $X(e^{j\omega})$ be the Fourier Transform of x(n). Show that **07** $X(e^{j\omega}) = X_e(e^{j\omega}) + X_o(e^{j\omega})$ where $X_e(e^{j\omega})$ and $X_o(e^{j\omega})$ are the even and odd parts of $X(e^{j\omega})$

Q.5 (a) Obtain the cut-off frequencies of the following systems

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

(ii) $H(s) = \frac{1}{s^2 + \sqrt{2}s + 1}$

Using impulse invariant transformation method, obtain H(z) and determine the d.c. gains of the above systems. Assume the sampling rate to be 1000Hz.

(b) Let $H(s) = \frac{10}{s+10}$ be the system function of an analog low pass system. Obtain

H(z) out of H(s) using frequency transformation methods, if H(z) represents a digital highpass filter.

OR

Q.5 (a) Let $H(s) = \frac{s+2}{s^2+4s+3}$ be the system function of an analog system. Using Bilinear Transformation method and assuming a sampling rate of fs = 1000Hz,

obtain H(z) and determine its frequency response at $\omega = \pi/2$.

- (b) Obtain the relations for the following analog system transformation methods07(a) Low Pass to High Pass
 - (b) Low Pass to Band Pass
 - (c) Low Pass to Band Stop

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