Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER–III • EXAMINATION – SUMMER • 2014

Subject Code: 735206 **Date: 05-06-2014**

Subject Name: Digital Signal Processing

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Check whether the following systems are linear and time invariant or not **07**

$(i)\ y(n) = e^{x(n)}$

$(ii)\ y(n) = a.x(n) + b$

$(iii)\ y(n) = a.n.x(n) + b$

(b) Find the impulse response of the following systems, assuming $y(n) = 0$ for $n < 0$ **07**

$(i)\ \ y(n) - ay(n-1) = x(n-1)$

$(ii)\ \ y(n) - y(n-1) - y(n-2) = x(n)$

Q.2 **(a)** Discuss the following properties of Z Transform **07**

(i) Linearity

(ii) Time Shift

(iii) Convolution in time

(iv) Multiplication by exponential

(b) Use convolution in time property of z-transform to find x(n) if X(z) is given by **07**

$$X(z) = \frac{1}{\left(1 - \frac{1}{2}z^{-1}\right)\left(1 + \frac{1}{4}z^{-1}\right)}$$

OR

(b) Using partial fraction expansion method find the inverse z-transform of X(z) given by $X(z) = \dfrac{4 - 8z^{-1} + 6z^{-2}}{(1 - 2z^{-1})(1 + z^{-1})}$ **07**

Q.3 **(a)** Suppose that $H(z)$ has zeros at $\frac{3}{4}e^{-j\pi/2}$ and $2e^{-j\pi/4}$. Determine the lowest degree $H(z)$ that has a linear phase. **07**

(b) State and describe Sampling Theorem for bandlimited signals. Explain aliasing. **07**

OR

Q.3 **(a)** Explain Bilinear Transformation and Impulse Invariant Transformation methods for transforming $X(s)$ to $X(z)$ **07**

(b) Let the system function of an analog system is given by $H(s) = \dfrac{\alpha}{\alpha + s}$, find the corresponding system function for a discrete time system $H(z)$ using Bilinear and Impulse Invariant Transformation methods. **07**

Q.4 **(a)** Design an analog low pass Butterworth filter and obtain $H(s)$ with the following specifications: **07**

(i) Passband Frequency: 500Hz
(ii) Stopband Frequency: 6000Hz
(iii) Passband attenuation(in dB): 1
(iv) Stopband attenuation (in dB): 60

(b) Design an analog low pass Chebyshev filter with the order of the system given by 4, and passband frequency given by 10Hz and passband ripple given by 1dB. **07**

OR

Q.4 **(a)** Explain sine-cosine generator and comb filter. **07**

(b) Explain what is phase distortion and show that the phase distortion in the output signal of a system is zero for a linear phase response system. Also show that an FIR system with its impulse response symmetrical is a linear phase system. **07**

Q.5 **(a)** If the system function of a low pass system is given by $H(z) = \frac{\alpha}{1 - az^{-1}}$, using frequency transformation method obtain the system function of the equivalent Bandpass System. **07**

(b) Discuss the advantages and disadvantages of FIR system over IIR System. **07**

OR

Q.5 **(a)** Explain the Windowing method and Frequency Sampling methods for designing FIR Systems. **07**

(b) Sketch the following window functions based on their definitions: **07**

(i) Hamming Window
(ii) Hanning Window
(iii) Barlett Window

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