

ME (ETRK) Sem I(R) DISPRA

16105109 11-2 BB-5664

Total Marks : 100

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(3 Hours) [Total Ma

N.B.: (1) Question No. 1 is compulsory.

- (2) Attempt any four questions out of remaining six questions.
- (3) Assume suitable data if necessary.
- (4) Figures to the right indicate full marks.
- 1. (a) Determine the energy of the signal $x(n) = \begin{cases} \left(\frac{1}{2}\right)^n & n \ge 0\\ (4)^n & n < 0 \end{cases}$
 - (b) If $H(z) = \frac{2(z-2)}{z-0.5}$, find passband of the filer.
 - (c) Derive a relation between auto correlation of input, impulse response of the system 5 and autocorrelation of output.
 - (d) Give the transfer function H(s) and show pole locations of third order low pass 5 normalised analog Butterwort filter.
- 2. (a) A linear times invarient system is described by the following difference equation: 10 y(n) = ay(n 1) + bx(n), 0 < a < 1
 - Determine the magnitude and phase of the frequency response H(w) of the system.
 - (ii) Choose the parameter b so that the maximum value of |H(w)| is unity, and sketch |H(w)| and $\not \leq H(w)$ for a = 0.9
 - (iii) Determine the output of the system to the input signal

$$x(n) = 5 + 12 \sin \frac{\pi}{2} n - 20 \cos \left(\pi n + \frac{\pi}{4} \right)$$

(b) Consider the analog signal

 $x_a(t) = 3 \cos 100\pi t$

(i) If the signal is sampled at the rate of $F_s = 75$ HZ, what is the discrete time signal obtained after sampling ?

(ii) What is the frequency $0 < F < \frac{F_s}{2}$ of a sinusoid that yields samples identical to those obtained in part (i).

(c) Determine the convolution of the following pairs of signals :

$$x_{1}(n) = \left(\frac{1}{2}\right)^{n} u(n)$$
$$x_{2}(n) = \cos\pi n u(n)$$

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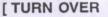
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3. (a) A system has impulse response $h(n) = (0.7)^n u(n) - (0.5)^n u(n)$ Show Direct form II and parallel realization of the system.

(b) A system is describe by the difference equation $y(n) = \frac{1}{2}y(n-1) + x(n)$. 10

Input given to the system is $x(n) = \left(\frac{1}{3}\right)^n u(n)$ and initial condition is y(-1) = 1

Determine : (i) Zero input response (ii) Zero State response (iii) Total response.



(c) A cumulative average of a signal x(n) in the interval $0 \le k \le n$ is defined as

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$$y(n) = \frac{1}{n+1} \sum_{k=0}^{n} x(k)$$
 $n = 0, 1, 2,$

Redize this system in a recursive manner.

- . (a) Using 4 point DFT and IDFT, determine the circular convolution of $x(n) = \{1, 2, 3, 1\}$ and $y(n) = \{4, 3, 2, 2\}$
 - (b) Draw FFT flow graph for N = 4 and hence find DFT for $x(n) = \{1, 2, 3, 4\}$. 5
 - (c) $x(n) = x_1(n) + x_2(n)$. If $x(k) = 2 \operatorname{Re}[x_1(k)]$, find the relation between $x_1(n)$ and $x_2(n)$, 5 when the sequences involved are real sequences.

Derive a relation between

(d) Let
$$y(n) = \begin{cases} x(\frac{n}{2}) & n \text{ even} \\ 0 & n \text{ odd} \end{cases}$$

Find 8 point y(k) in terms of x(k) without performing DFT/IDFT.

- (a) Derive two relations to find DFT of two real N point sequences using only a single 4 N point DFT.
 - (b) Using the relations derived in (a), find DFT of the sequence : $x_1(n) = \{1, 1, 1, 1\}$ $x_2(n) = \{2, 1, 2, 1\}$
 - (c) Find the number of real additions and real multiplications required to find DFT of 5 a 64 point signal if -
 - (i) Direct Computation of DFT is used
 - (ii) DITFFT is used.
 - (d) Derive the relation between analog frequency variable and digital frequency variable 6 under Bilinear transformation. Hence explain frequency warping.
- 6. (a) A digital LPF is required to meet the following specifications :
 - Passband ripple \leq 1 dB
 - Passband edge frequency z= 4 KHz
 - Stopband attenuation \geq 40 dB
 - Stopband edge frequency = 6 KHz

Sampling rate = 24 KHz wollowed to notatovnoo entrealmente

The filter is to be designed using Bilinear Transformation with Butterworth approximation. Determine two filter order.

- (b) Derive the expression for frequency sampling realization of FIR filter and sketch 10 the same.
- (a) Some of the zeros of a 5th order linear phase filter are located at

 $Z_1 = -1$, $Z_2 = 0.5 e^{+3}$

- (i) Complete two pole zero diagram
- (ii) Is the filter symmetric ? Draw its phase response to prove that it is a linear 4 phase filter.

Show Direct form II and parallel realization of

- (iii) Find the transfer function of the filter and realize it using minimum number 4 of components.
- (b) State and prove convolution property of z-transform.
- (c) Show pole-zero diagram for a system having transfer function $H(z) = 1 + z^{-4}$. 5