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NPTEL

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Courses » Mathematical Methods and Techniques in Signal Processing

Announcements **Course** Ask a Question Progress FAQ

Week 6 - Multirate Systems - II

Register for Certification exam

Course outline

How to access the portal

Week 0 - Background and Prerequisites

Week 1 - Introduction to Signal Processing, State Space Representation and Vector Spaces - I

Week 2 - Vector Spaces - II

Week 3 - Vector Spaces - III and Signal Geometry

Week 4 - Probability and Random Processes

Week 5 - Sampling Theorem and Multirate Systems - I

Assignment 06

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment. **Due on 2019-03-13, 23:59 IST.**

Instructions:

1. **Attempt all questions.**
2. **Submission deadline**: 13th March 2019 23:55 IST
3. **Solutions to be posted**: 14th March 2019
4. Older browsers might show **unnecessary vertical bars** at the end of math equations

1) (True/False) For linear phase FIR decimation filters of even length, for $M = 2$, only the Type I polyphase components $E_0(z)$ and $E_1(z)$ are symmetric, while the Type II polyphase components $R_0(z)$ and $R_1(z)$ are not always symmetric. ***1 point***

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

2) (True/False) The following is an efficient way for sampling rate conversion from 36 Ksamples/s to 54 Ksamples/s. ***1 point***

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

3) We intend to design an equiripple filter (with $\delta_1 = \delta_2 = 0.02$). The filter should have a

Score: 0

Accepted Answers:
(Type: Numeric) 8

1.5 points

4) Let $H(z)$ represent an FIR filter of length 10 with impulse response coefficients $h(n) = 0.5^n$ for $0 \leq n \leq 9$ and zero otherwise. Let $E_0(z)$ and $E_1(z)$ be the Type I polyphase components for $M = 2$. What is $E_0(z) + E_1(z)$? ***1.5 points***

- $\sum_{n=0}^{4} 0.5^n z^{-2n} + \sum_{n=0}^{4} 0.5^{n+1} z^{-2n}$
- $\sum_{n=0}^{9} \frac{1}{2^n} z^{-n}$
- $\sum_{n=0}^{4} \frac{3}{2^{2n+1}} z^{-n}$
- $\sum_{n=0}^{4} 0.5^{2n} z^{-n}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sum_{n=0}^{4} \frac{3}{2^{2n+1}} z^{-n}$

5) (True/False) Consider a filter with impulse response $H(z) = \frac{p+z^{-1}}{1+pz^{-1}}$. A digital filter is an all pass filter if it has impulse response of the form $\frac{z^{-1}-\bar{a}}{1-az^{-1}}$. Filter $H(z)$ is an all pass filter for real p. The Type II polyphase component filters of $H(z)$ are all pass filters? ***2 points***

- True
- False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

6) The efficient architecture for a decimation filter $(M = 2)$ is given as follows:

The length of the filter is 4. Let the Type I polyphase components be $E_0(z) = a + bz^{-1}$ and $E_1(z) = c + dz^{-1}$. What is $a + 2b + 3c + 4d$?

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: Numeric) 15

2 points

7) Consider the following system with input $x(n)$ and output $y(n)$ ***2.5 points***

Which of the following system is equivalent to the above system?

No, the answer is incorrect.
Score: 0

Accepted Answers:

8) What is the output $y[n]$ of the multirate system given below in terms of the input $x[n]$? ***2.5 points***

0

$x[n - \frac{5}{11}]$

$\frac{1}{10}\sum_{i=0}^{9} x[n]\omega^{-i(n-\frac{5}{11})}$ where $\omega = e^{\frac{2\pi}{10}}$

$x[n]$

No, the answer is incorrect.
Score: 0

Accepted Answers:
0

9) Which of the following gives an output $y[n] = 0$? ***3 points***

No, the answer is incorrect.
Score: 0

Accepted Answers:

10) Consider the DFT synthesis bank in Lecture 43. Let $F_0(\mathrm{f})$, $F_1(\mathrm{f})$ and $F_2(\mathrm{f})$ denote the frequency responses of the synthesis bank filters. Which of the following relations does magnitudes of $F_0(\mathrm{f})$, $F_1(\mathrm{f})$ and $F_2(\mathrm{f})$ satisfy? ***3 points***

$|F_0(\mathrm{f})| = |F_1(\mathrm{f})| = |F_2(\mathrm{f})|$

$|F_0(\mathrm{f})| = |F_1(\mathrm{f} + \frac{1}{3})| = |F_2(\mathrm{f} + \frac{2}{3})|$

$|F_0(\mathrm{f})| = |F_1(\mathrm{f} + \frac{1}{3})| = |F_2(\mathrm{f} - \frac{1}{3})|$

$|F_0(\mathrm{f})| = 7, |F_1(\mathrm{f})| = 7, |F_2(\mathrm{f})| = 7$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$|F_0(\mathrm{f})| = |F_1(\mathrm{f} + \frac{1}{3})| = |F_2(\mathrm{f} + \frac{2}{3})|$

$|F_0(f)| = |F_1(f + \frac{1}{3})| = |F_2(f - \frac{1}{3})|$

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