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NPTEL

reviewer4@nptel.iitm.ac.in ▾

Courses » Mathematical Methods and Techniques in Signal Processing

Announcements **Course** Ask a Question Progress FAQ

Week 7 - Multirate Systems - III

Assignment 07

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-03-20, 23:59 IST.

__Instructions__:

1. **Attempt all questions.**
2. **Submission deadline**: 20th March 2019 23:59 IST
3. **Solutions to be posted**: 21st March 2019
4. Older browsers might show **unnecessary vertical bars** at the end of math equations

1) Consider a $\frac{L}{M}$ fractional rate conversion filter with $\gcd(L, M) = 1,\ L \neq 1$ and $M \neq 1$. Which of the following statements are true about the fully efficient architecture realized using polyphase representation of the filter? ***2 points***

- The efficient architecture will have LM filters.
- The efficient architecture will upsample the signal before filtering.
- If L>M, the efficient architecture will have L filters.
- The architecture is efficient because we can use filters with larger transition bandwidth.

No, the answer is incorrect.
Score: 0

Accepted Answers:
The efficient architecture will have LM filters.

2) onsider the following decimation filter and a 2-stage architecture of the same. We want to design filters such that the passband and stopband ripples are 0.01 and 0.001 respectively. The input signal has 100 Hz bandwidth and 24 kHz sampling rate. The filter order with passband frequency f_p, stopband frequency f_s, passband ripple δ_p, stopband ripple δ_s and the sampling rate F is given by $N = \frac{D_\infty(\delta_p,\delta_s)}{(f_s - f_p)/F}$. ***2 points***
Use the approximations $D_\infty\left(0.01, 0.001\right) \approx 2$ and $D_\infty\left(0.005, 0.001\right) \approx 2.5$ for your computations.

- 1200
- 1500

No, the answer is incorrect.
Score: 0

Accepted Answers:
1200

3) With reference to question 2, what is the largest possible transition bandwidth $f_s - f_p$ in Hz of the 1^{st} stage filter in the 2 stage architecture? ***1.5 points***

- 3800
- 3900
- 5900
- 5800

No, the answer is incorrect.
Score: 0

Accepted Answers:
5800

4) With reference to question 2, what is the smallest filter order to avoid aliasing in the 2^{nd} stage of 2 stage architecture? ***2 points***

- 600
- 750
- 300
- 375

No, the answer is incorrect.
Score: 0

Accepted Answers:
375

5) With reference to question 2, if M_1 is the total number of multiplications per second in single stage architecture and M_2 is the total number of multiplications per second in the two stage architecture, what is the ratio $\frac{M_1}{M_2}$? (Round the filter order values to the next integer.) ***2.5 points***

- 1.46
- 1.85
- 2.24
- 2.84

No, the answer is incorrect.
Score: 0

Accepted Answers:
1.85

6) With reference to question 2, if we use polyphase representation based efficient architectures to implement each decimation filter in the two stage architecture, what is the total number of filters that must implemented? ***1 point***

- 100
- 104
- 25
- 29

No, the answer is incorrect.
Score: 0

Accepted Answers:
29

7) (True/False) Consider the two channel filter bank with $H_0(z) = 1 + z^{-1}$ and $H_1(z) = 1 - z^{-1}$. Then the synthesis bank $F_0(z) = 1 - z^{-1}$, $F_1(z) = -1 - z^{-1}$ results in perfect reconstruction of the input signal. ***1 point***

True

False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

8) Consider a 2-channel QMF filter with $H_0(z) = G(z^2)$. Which of the following choices are true? ***2.5 points***

$\frac{F_0(z)}{F_1(z)} = -\frac{G(z^2)}{1+G(z^2)}$

$\frac{F_0(z)}{F_1(z)} = 1$

$\frac{F_0(z)}{F_1(z)} = -1$

$\frac{F_0(z)}{F_1(z)} = G(z^2)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{F_0(z)}{F_1(z)} = -1$

9) (True/False) Consider a two channel filter bank, free of aliasing. Then the only possible choice of synthesis bank filters is $F_0(z) = H_1(-z)$ and $F_1(z) = -H_0(-z)$. ***1 point***

True

False

No, the answer is incorrect.
Score: 0

Accepted Answers:
False

10)Consider a two channel filter bank with $H_0(z) = 5 + 8z^{-1} - 4z^{-2}$ and $H_1(z) = 5 + 23z^{-1} - 10z^{-2}$. We want to design synthesis bank such that the filters $F_0(z)$ and $F_1(z)$ are stable filters to achieve alias-free output signal. Which of the following conditions can achieve the same? ***1.5 points***

$F_0(z) = 1 - 5z^{-1}$

$F_0(z) = 1 - 2z^{-1}$

$F_0(z) = \frac{1-5z^{-1}}{1-2z^{-1}}$

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
$F_0(z) = 1 - 5z^{-1}$

11) Consider a fractional sampling rate alteration filter with upsample rate L = 3 and downsample rate M = 2. Consider the following two efficient architectures. Architecture 1 is obtained by starting with efficient architecture of decimation, followed by efficient architecture of interpolation in individual branches. Architecture 2 is obtained using the same procedure as followed in the lecture i.e., by starting with efficient architecture of interpolation, followed by efficient architecture of decimation in individual branches. ***3 points***

Which of the following are true?

$R_{00}(z) = E_{00}(z)$

$R_{ij}(z) = E_{ji}(z),\ i \in \{0,1,2\}$ and $j \in \{0,1\}$

$R_{20}(z) = E_{02}(z)$

$R_{ij}(z) = E_{kl}(z)$ if $k + 2(2-l) = 2 - i + 3j,\ i,l \in \{0,1,2\}$ and $j,k \in \{0,1\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$R_{20}(z) = E_{02}(z)$
$R_{ij}(z) = E_{kl}(z)$ if $k + 2(2-l) = 2 - i + 3j,\ i,l \in \{0,1,2\}$ and $j,k \in \{0,1\}$

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