

GUJARAT TECHNOLOGICAL UNIVERSITY**M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013****Subject code: 1722601****Date: 24-12-2013****Subject Name: Advanced Digital Signal Processing and Applications****Time: 10.30 am – 01.00 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) Explain the forward linear prediction and find the conditions for minimum mean square prediction error. **07**

(b) What is Schure Algorithm? Explain the recursive procedures to describe Schure Algorithm. **07**

Q.2 (a) Explain the IIR Wiener filter. Find the system function for the optimum IIR Wiener filter. **07**

(b) Determine the lattice coefficients corresponding to the FIR Filter described by the system function **07**

$$H(z) = A_3(z) = 1 + \frac{13}{24}z^{-1} + \frac{5}{8}z^{-2} + \frac{1}{3}z^{-3}$$

OR

(b) Given a signal $x(n) = s(n) + w(n)$, where $s(n)$ is an AR(1) Process that satisfies the difference equation **07**

$$s(n) = 0.6s(n-1) + v(n),$$

Where $\{v(n)\}$ is a white noise sequence with variance $\sigma_v^2 = 0.64$, and $\{w(n)\}$ is a white noise sequence with variance $\sigma_w^2 = 1$. Design a Wiener filter of length $M=2$ to estimate $\{s(n)\}$

Q.3 (a) Define multirate digital signal processing. Explain how an increase in a sampling rate by an integer factor of I can be achieved. **07**

(b) Explain and compare AR and ARMA random processes with mathematical expressions for system functions as well as lattice structures. **07**

OR

Q.3 (a) Determine the impulse response of the FIR filter that is described by the lattice coefficients. **07**

$$K_1 = 0.6, K_2 = 0.3, K_3 = 0.5 \text{ and } K_4 = 0.9$$

(b) Explain the implementation of sampling rate conversion using polyphase filter structure. **07**

Q.4 (a) Explain the minimum phase property of the forward prediction error filter and Maximum phase property of the backward prediction error filter. **07**

(b) The polyphase matrix for a three channel perfect reconstruction FIR QMF bank is **07**

$$P(z^3) = \begin{bmatrix} 1 & 1 & 2 \\ 2 & 3 & 1 \\ 1 & 2 & 1 \end{bmatrix}$$

Determine the analysis and the synthesis filters in the QMF bank.

OR

- Q.4 (a)** Define the mean ergodic random process. Derive the condition for a random process to be mean ergodic. **07**
- (b)** How narrowband interference in wideband signal can be suppressed using adaptive filter? Explain with block diagram and mathematical relations. **07**
- Q.5 (a)** Explain the steps for recursive computation of filter coefficients using RLS adaptive filter algorithm. **07**
- (b)** Explain about subband coding of speech signal. **07**
- OR**
- Q.5 (a)** Explain the application of adaptive filter for Echo cancellation in data transmission over telephone lines using Symbol rate echo canceller. **07**
- (b)** Design a linear phase FIR filter that satisfies the following specifications : **07**

Sampling frequency 8000Hz

Passband: $0 \leq F \leq 75$

Transition band: $75 \leq F \leq 80$

Stopband : $80 \leq F \leq 4000$

Passband ripple: $\delta_1 = 10^{-2}$

Stopband ripple: $\delta_2 = 10^{-4}$

Show that under similar condition, a lowpass linear phase FIR filter may be more efficiently implemented in a multistage decimator interpolator configuration.
