Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER –I-(New) EXAMINATION – SUMMER 2019

Subject Code: 3710501 **Date: 15/05/2019**

Subject Name: Advanced Digital Signal Processing

Time: 02:30 PM TO 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)** Consider a second-order transfer function $H(z)=\dfrac{1+2z^{-1}+z^{-2}}{\left(1-0.75z^{-1}+0.125z^{-2}\right)}$. **07**

Realize this system using direct form-I, direct form-II, and cascade form via first-order sections.

(b) Show that the bilinear transformation maps the $j\Omega$-axis in the *s*-plane onto the unit circle, $|z|=1$, and maps the left-half *s*-plane, $\mathrm{Re}(s)<0$ inside the unit circle, $|z|<1$. **07**

Q.2 **(a)** The impulse response of an FIR filter is **07**

$$h[n]=\left\{\underset{\uparrow}{0.2},0.7,0.8,0.15,0.6,0.32,0.5,0.4,0.9\right\}.$$

Perform two-component and three-component polyphase decomposition of $H(z)$.

(b) Explain two-channel quadrature mirror filter bank in detail. **07**

OR

(b) Explain sampling rate conversion with cascaded integrator comb filters. **07**

Q.3 **(a)** **07**

Consider a signal $x(n)=s(n)+w(n)$, where $s[n]$ is an AR(1) process that satisfies the difference equation $s(n)=0.8s(n-1)+v(n)$, where $\{v(n)\}$ is a white noise sequence with variance $\sigma_v^2=0.49$, and $\{w(n)\}$ is a white noise sequence with variance $\sigma_w^2=1$. The processes $\{v(n)\}$ and $\{w(n)\}$ are uncorrelated.

(1). Determine the auocorrelation sequences $\{\gamma_{ss}(m)\}$ and $\{\gamma_{xx}(m)\}$.

(2). Design a Wiener filter of length *M*=2 to estimate $\{s(n)\}$.

(3). Determine MMSE for *M*=2.

(b) Discuss Yule-Walker method for parameter estimation of stochastic models. **07**

OR

Q.3 **(a)** Determine the parameters and sketch the lattice-ladder filter structure for the system with system function **07**

$$H(z)=\frac{1-0.8z^{-1}+0.15z^{-2}}{1+0.1z^{-1}-0.72z^{-2}}$$

(b) Discuss forward linear prediction in detail. **07**

Q.4 **(a)** What is an adaptive filter? Using suitable block diagram, explain general adaptive filtering problem. **07**

	(b)	With the help of steepest descent algorithm, derive the LMS algorithm for noise cancellation.	**07**

OR

Q.4	**(a)**	Explain different performance measures used to evaluate the goodness of an adaptive algorithm.	**07**
	(b)	Explain the steepest descent algorithm and show that it becomes unstable when the step-size parameter is assigned a negative value.	**07**
Q.5	**(a)**	Explain system modeling using adaptive filters.	**07**
	(b)	Derive the Wiener-Hopf equation with reference to basic Wiener filter.	**07**

OR

Q.5	**(a)**	Explain the application of DSP in linear predictive coding of speech signals.	**07**
	(b)	Explain echo cancellation using adaptive filters.	**07**

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