Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, MAY/JUNE 2017
FIRST SEMESTER

COMMUNICATION SYSTEMS
CU16103 -ADVANCED DIGITAL SIGNAL PROCESSING
(Regulation 2016)

Q. Code: 949867

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 marks)

1. Consider the random process $X(t)=\alpha\cos 2\pi f_c t$, with f_c constant and α is uniformly distributed in [0,1/2]. What is the autocorrelation function corresponding to time instants t_1,t_2?
2. State Weiner Khintchine relation.
3. Obtain the Periodogram, if the autocorrelation sequence is given by $r_x(k)=\{0.1,0.3,\underset{\uparrow}{0.8},0.3,0.1\}$.
4. When an estimator is said to be unbiased and consistent?
5. Write the Wiener Hoff equation and give its significance.
6. Differentiate forward and backward prediction.
7. Discuss the reasons for the popularity of FIR adaptive filters over IIR?
8. What is the difference between LMS and RLS adaptive filters?
9. Anti-imaging filter is used after upsampler -Justify.
10. What are the advantage of subband coding?

PART B - (5 X16 = 80 marks)

11. (a) (i) Determine the power spectrum of the random process x(n), which is generated by filtering white noise w(n) with a first order linear shift invariant filter having a system function $H(z)=\frac{1}{1-0.5z^{-1}}$. The variance of the white noise is unity. **(8)**

(ii) A random process x(n) having a power spectrum of the form $P_x(e^{jw})=\frac{5+4\cos 2w}{10+6\cos w}$ is generated by filtering unit variance white noise with a linear shift invariant filter. Determine the impulse response of the filter. **(8)**

(OR)

(b) Describe the Prony's method for signal modeling. What is the limitation in Pade approximation? How it is eliminated in Prony's method. **(16)**

12. (a) (i) Discuss the Bartlett method of spectrum estimation. **(8)**

(ii) Compare the performance of different non parametric methods of power spectrum estimation. **(8)**

(OR)

(b) The autocorrelation of the sequence x(n) is given by $r_x(0)=26$, $r_x(1)=7$, $r_x(2)=7/2$. Use Yule Walker equation to design an ARMA (1, 1) process and determine the power spectrum of x(n) and also, design a 2nd order all pole model for the above specification. **(16)**

13. (a) (i) Use Levinson recursion algorithm to solve for the following Toeplitz equation $\begin{bmatrix} 4 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 4 \end{bmatrix}\begin{bmatrix} x(0) \\ x(1) \\ x(2) \end{bmatrix}=\begin{bmatrix} 9 \\ 6 \\ 12 \end{bmatrix}$. **(8)**

(ii) Find the optimum linear predictor for an AR(1) process x(n) having an autocorrelation given by $r_x(k)=0.5^{|k|}$. **(8)**

(OR)

(b) Show how discrete Kalman filter can be effectively used for the estimation problem of nonstationary process. Derive the Kalman filtering equation for recursively estimating the state vector. **(16)**

14. (a) Derive the weight update equation for the steepest descent algorithm. In what way, the LMS algorithm differs from steepest descent algorithm. Discuss. **(16)**

(OR)

(b) Discuss how the adaptive filters are used as a channel equalizer and echo canceller. **(16)**

15. (a) Design a single stage and two stage interpolator to meet the following specifications: **(16)**

passband	: $0 \le f \le 90$
transition band	: $90 \le f \le 100$
input sampling rate	:10,000Hz
passband ripple	:10^{-2}
stopband ripple	:10^{-3}
Interpolation factor	:20

(OR)

(b) Discuss the two channel quadrature mirror filter bank and derive the expressions required for perfect reconstruction of signals? **(16)**