BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

EEE G613 ADVANCED DIGITAL SIGNAL PROCESSING,

I SEMESTER 2017-18 (ME-CS)

END-SEMESTER TEST (Closed Book)

Marks: 35 **Time: 180 minutes** **Dec 11th 2017 (2.00-5.00 PM)**

Answer All Questions

1. **(A)** Derive an expression for the stability of NLMS adaptive algorithm. **(2)**

(B) Draw a block diagram that explains the application of NLMS for communication channel equalization. Also, find an expression for MSE, weight update and step-size for this scenario. **(2+1+1+1=5)**

2. What do you mean by structure adaptation in adaptive filters? Explain the fractional tap-length adaptation for different error adaptive algorithm in monophonic acoustic echo cancellation application.

(A) Draw the block diagram (C) Briefly explain, & (C) Derive the algorithm mathematically. **(1+6=7)**

3. **(A)** Derive an expression for Kalman gain factor from RLS adaptive algorithm using Matrix Inverse Lemma. **(4)**

(B) From the performance evaluation of RLS algorithm prove that $\lim_{n\to\infty} E[w(n)] \to w_{optimum}$. Where $w(n)$ is the time-varying filter weight. **(3)**

4. A long distance telephone system is suffering from hybrid echo at near-end and wideband active noise at far end. The near end system is a landline telephone whereas the person in the far-end is using a cell phone. Design a solution to these two issues at two different ends of communication using adaptive algorithms as per the below mentioned specifications:

(A) Use RLS algorithm for cancelling hybrid echo. Derive the weight update. **(3)**

(B) Use LMS algorithm for wideband active noise cancellation. Derive the weight update equation. **(3)**

(C) Draw the complete block diagram for the above-mentioned system. **(3)**

NOTE:

You can declare the variables as per your own convenience to derive the weight update equations. While defining the variables, vectors and scalars should be explicitly defined.

5. With the help of suitable equations, explain the application of Kalman filter for measuring the internal temperature at the exhaust of a spacecraft. Design the state observer for the Kalman filter in this application. **(3+2=5)**

***************Good Luck***************