ME EXTC (CBGS) Sem I NOV DEC-2016
Sub: SSP
7/12/16

QP Code : 841901

(3 Hours) **[Total Marks : 80**

N.B. : (1) Question No. 1 is compulsory.
(2) Attempt any three questions from the remaining five questions.
(3) Assume **suitable data** if needed and state it clearly.
(4) Figures to right indicate full marks.

1. Solve **any five :**
   (a) Define and explain the terms "Basis of vector space" and "subspace of a vector space". **4**
   (b) Two statistically independent random variables X and Y have mean values 2 and 4 respectively. If W = 3X- Y, Find the mean and variance of random variable W. **4**
   (c) State the important properties of General correlation matrices. **4**
   (d) Describe application of DKLT (Discrete Karhunen-Loeve Transform) in data compression. **4**
   (e) State the CRLB theorem. **4**
   (f) Give assumptions about the state variable system used in Kalman filtering. **4**

2. (a) Check whether the following vectors are independent $[1\ 3\ 2]^T$, $[2\ 1\ 3]^T$ $[3\ 2\ 1]^T$. **6**
   (b) Explain the four fundamental subspaces of linear operator. **6**
   (c) Explain Gram-Schmidt orthogonalization procedure. **8**

3. (a) Let $x(n) = A + w(n)$ $n=0,1....N-1$ where $w(n)$ is WGN with zero mean and variance σ^2. Determine the CRLB for A. **10**
   (b) Consider a linear transformation $\mathbf{y} = \mathbf{A}^T\mathbf{x}$. The mean vector $\mu_x = [2\ 1]^T$, Find the mean vector of **y** if **A** is 2x2 identity matrix. **4**
   (c) State and explain central limit theorem (CLT). **6**

4. (a) Explain the concept of Innovations representation. What is whitening process. **6**
   (b) Define and explain following **4**
      (i) Bias of Estimator
      (ii) Efficient estimator

[TURN OVER]

(c) Compare and contrast orthogonal and triangular decompositions for zero mean random vectors. 10

5. (a) What is Kalman filtering? Discuss in detail. 10
(b) A random process is defined as $X(n) = A\cos(2\pi n)$, where A is a Gaussian random variable with zero mean and variance σ^2. 10
(i) Determine the density function of X(0) and X(1).
(ii) Is X(n) a stationary process in any sense?

6. (a) A causal LTI system is described by the difference equation 10

$y(n) = \frac{1}{2} y(n-1) + x(n) + x(n-1)$ is driven by zero mean WSS process with autocorrelation $R_x(\ell) = 2\,\delta(n)$.
(a) Determine the cross power spectral density between input and output
(b) Power spectral density at the output

(b) It is desired to estimate the value of a DC level A in WGN or 10
$x(n) = A + w(n)$, $n=0,1,\ldots, N-1$.
where w(n) is zero mean and uncorrelated and each sample has variance $\sigma^2=1$. Consider following estimator

$$\hat{A} = \frac{X(0) + X(N-1)}{2}$$

Find the mean of the estimator. Is the estimator biased? Compute the variance of the estimator.