

# Statistical Signal Processing

[Time: Three Hours]

[ Marks:80]

Please check whether you have got the right question paper.

- N.B: 1. Question No.1 is compulsory.  
2. Attempt any three questions from remaining five questions.  
3. Assume suitable data if necessary and state it clearly.  
4. Figures to right indicates full marks.

**Q.1. Solve any five questions**

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- What is linear transformation? Define kernel and 'range' as applied to linear transformation.
- Explain white noise process. Write expressions for autocorrelation and PSD of white noise process.
- What is correlation Matrices of stationary process?
- What is Unbiased Estimator?
- State the properties of probability density and distribution function?
- State the Kalman filtering problem also. state the important assumptions about the underlying state variable system

**Q.2. (a) Check whether following vectors are linearly independent**

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$$1) P_1 = [2, -3, 4]^T \quad 2) P_2 = [-1, 6, -2]^T \quad 3) P_3 = [1, 6, 2]^T$$

- What is ill-conditioned matrix? Define matrix condition number. A matrix has a large condition number, What does this indicate?

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- What is pseudo inverse and state its properties.

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**Q.3. (a) Let  $x(n)$  be a real -valued random process generated by the system**

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$$x(n) = ax(n-1) + w(n) \quad n \geq 10 \quad x(-1) = 0$$

Where  $w(n)$  is a stationary random process with mean  $\mu_w$  and  $r_w(l) = \sigma_w^2 \delta(l)$

The  $x(n)$  process is first order autoregressive and  $w(n)$  is white noise process.

Determine  $\mu_x$  of  $x(n)$  and comment on its stationary.

- Describe stationary process in frequency domain?

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- Determine the PSD of a zero mean WSS process  $x(n)$  with

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$$r_x(l) = a^{|l|}, -1 < a < 1.$$

**Q.4. (a) Derive the Random signal response for an LTI system.**

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- Let  $w(n)$  be zero mean, uncorrelated Gaussian random sequence with variance  $\sigma^2(n) = 1$

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i) Characterize the random sequence  $w(n)$

ii) Define  $x(n) = w(n) + w(n-1)$ ,  $-\infty < n < \infty$  Determine mean and

autocorrelation of  $x(n)$ . Also characterize  $x(n)$

- Consider the observation

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$$x[n] = A + w[n] \quad n = 0, 1, \dots, N-1$$

Where  $A$  ( $-\infty < A < \infty$ ) is parameter to be estimated and  $w(n)$  is WGN. The estimator for

average value of  $x[n]$  is  $\hat{A} = \frac{1}{N} \sum_{n=0}^{N-1} x[n]$

Find the mean of estimator. Is the estimator biased?

- State CRLB theorem

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- State the minimum variance criteria for the estimator

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- Q.6. (a) Describe Kalman filter I - Bayes approach.  
(b) State the uses of Gram-Schmidt orthogonalization procedure?  
(c) Explain application of Discrete Karhunen-Lo' eve Transform in signal coding using block diagram. Explain scheme for selection of reduced basis.

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Q. P. Code: 25232

Duration-3hrs

Marks -80

N.B.

i) Question no.1 is compulsory

ii) Solve any three from the remaining questions

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|----|---|----|
| 1A | Define NGN and mention the key features of NGN  | 5  |
| B  | Compare the role of IPV4 and IPV6 in NGN.   | 5  |
| C  | Explain QOE in NGN.   | 5  |
| D  | Explain the role of SIP in VOIP.  | 5  |
| 2A | How MPLS packet routing is different from traditional packet routing. Give the Concept of VPN . | 10 |
| B  | What are the major threats to Telecom Industry?   | 10 |
| 3A | Analyse the concept of SDR and Cognitive Radio.   | 10 |
| B  | Explain the concept of IOT with an example.   | 10 |
| 4A | Explain the naming, numbering & addressing schemes in NGN.                                      | 10 |
| B  | What are the IDs used in TISPAN, NGN? How are NGN IDs administered?                             | 10 |
| 5A | Explain the mobile IPTV service with challenges & applications.                                 | 10 |
| B  | Describe the NGN security mechanisms covering AAA.  | 10 |
| 6  | Write notes on[any two]   | 20 |
|    | a) FMC    b) migration of PSTN to NGN    c) Diameter protocol    d) IMS                         |    |

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