

(03 Hours)

Total Marks 80

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.

1. Solve any five 20

- (a) State and explain the four fundamental subspaces for an  $m \times n$  matrix of rank  $r$ .
- (b) The distribution function for a random variable  $X$  is

$$F(x) = \begin{cases} 1 - e^{-2x}, & x \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Find i) the density function ii) the probability that  $X > 2$

- (c) Define and explain following terms as related to estimators  
i) Bias ii) Variance iii) Efficiency iv) Consistency
- (d) State and explain the properties of autocorrelation sequence (function) of stationary process.
- (e) Let  $\mathbf{x}$  be a random vector with mean  $\mu_x$  and autocorrelation  $\mathbf{R}_x$ . Show that  $\mathbf{y} = \mathbf{Q}^T \mathbf{x}$  transforms  $\mathbf{x}$  to an uncorrelated component vector  $\mathbf{y}$  if  $\mathbf{Q}$  is the eigenmatrix of  $\mathbf{R}_x$ .
- (f) State and explain Kalman filtering problem using underlying state variable system.

2. (a) Find column space and nullspace of matrix 10

$$A = \begin{bmatrix} 2 & 0 & 1 & 0 \\ -1 & 2 & 0 & 1 \\ 3 & 0 & 1 & 4 \end{bmatrix}$$

- (b) Explain Gram-Schmidt orthogonalization procedure and state its applications. 6
- (c) "If  $A$  and  $B$  are  $n \times n$  matrices and  $AB=0$ , then either  $A=0$  or  $B=0$ ". Is this a true statement? Explain with example. 4
3. (a) State the important properties of PSD. Determine the PSD of a zero mean WSS process  $x[n]$  with  $r_x(l) = a^{|l|}$ ,  $-1 < a < 1$ . 10  
(P.T.O.)

- (b) Explain the Kalman filtering algorithm using suitable equations  
10
4. (a) Let  $x[n] = A + w[n]$ ,  $n = 0, 1, \dots, N - 1$ . It is desired to estimate the value of a DC level  $A$  in WGN  $w[n]$  where  $w[n]$  is zero mean and uncorrelated and each sample has variance  $\sigma^2 = 7$ . Consider the two estimators
- $\hat{A} = \frac{1}{N} \sum_{n=0}^{N-1} x[n]$
  - $\tilde{A} = \frac{x[0] + x[N-1]}{2}$
- Find the mean and variance of each estimator. State whether these estimators are unbiased. Which one is better according to variance?  
10
- (b) Consider the multiple observations  
 $x[n] = A + w[n]$ ,  $n = 0, 1, \dots, N - 1$  where  $w[n] \sim \mathcal{N}(0, \sigma^2)$ . Determine the CRLB for  $A$ .  
10
5. (a) Consider following random processes
- $X(t) = A$  where  $A$  is a random variable uniformly distributed between 0 and 1
  - $X[n] = A \cos(\omega n)$  where  $A$  is a Gaussian random variable with mean 0 and variance 1
- Determine whether these random processes are WSS or not. 10
- (b) The exponential density function is given by  $f_x(x) = e^{-x}u(x)$  where  $u(x)$  is a unit step function. Let  $x_1$  and  $x_2$  be two IID random variables with exponential pdf. Let  $y = x_1 + x_2$ . Determine and plot pdf of  $y$   
10
6. (a) Consider a linear transformation  $\mathbf{y} = \mathbf{A}\mathbf{x}$  where

$$\mu_x = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \quad \mathbf{R}_x = \begin{bmatrix} 4 & 0.8 \\ 0.8 & 1 \end{bmatrix}$$

$$\mathbf{A} = \begin{bmatrix} 1 & 3 \\ -1 & 2 \\ 2 & 3 \end{bmatrix}$$

Find i) Mean vector  $\mu_y$  ii) Autocorrelation matrix  $\mathbf{R}_y$  10

- (b) Explain application of DKLT (Discrete Karhunen-Loève Transform) in signal coding using block diagram. Explain scheme for selection of optimal reduced basis. 6
- (c) Write a short note on SVD. 4



[Time: Three Hours]

[Marks:80]

- N.B.: (1) Question No. **1** is compulsory.  
(2) Solve any **three** questions from the **remaining five**  
(3) Figures to the right indicate full marks  
(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt **any 4** questions.

[20]

- Define attenuation mechanism with respect to optical communication. What are its different types?
- Compare spontaneous and stimulated emission.
- Derive an expression for the responsivity of an intrinsic photo detector.
- Explain working principle of optical multiplexer.
- Define line, path and section wrt SONET.

Q.2 a) Explain principle of operation of Resonant cavity Enhanced (RCE) photo detector in detail. [10]

b) Explain any one fiber fabrication process with neat diagram. [10]

Q.3 a) Lists properties of solitons and explain Loss managed solitons in detail. [10]

b) What is optical amplifier? Compare Semiconductor optical amplifier with erbium doped fiber amplifier and Raman amplifier. [10]

Q.4 a) Explain working principle of optical isolator with neat sketch and also compare with circulator. [10]

b) What is optical transport network (OTN)? Explain OTN frame structure in detail. [10]

Q.5 a) Explain first passage model and blocking model for statistical wavelength routing network. [10]

b) Write short notes on detailed Ring Network. [10]

Q.6 Short notes on: (**Attempt any two**) [20]

- Metro network
- Four wave mixing and its mitigation
- Unidirectional and bi directional WDM system.
- Optical Fiber Network Topologies

\*\*\*\*\*



(Time: 3 hrs.)

(Max. Marks: 80)

N. B. Q.1 is compulsory.

1. Answer any **three** out of the remaining five questions.
2. Figures to the right indicate full marks.
3. Answer to the questions should be grouped and written together.

Q1 Solve **any four**

- |    |  |    |
|----|--|----|
| a  | Differentiate between wave and wavelet? Define Wavelet Transform and write the criteria to be satisfied by the function to be a mother wavelet.  | 05 |
| b  | Explain concept of multi-resolution analysis using wavelet transform.  | 05 |
| c  | Describe with diagram the multiple echo filter   | 05 |
| d  | Mean of the Periodogram estimate can be interpreted as convolution of two functions. What are those two functions?   | 05 |
| e  | Differentiate between LMS and RLS algorithms   | 05 |
| 2a | Explain spectrum estimation using Bartlett Method. Compare the performance of Bartlett with Welch methods on the basis of Quality factor, Variability, Frequency resolution, Figure of merit.  | 10 |
| 2b | Derive the LMS Algorithm and explain its limitations   | 10 |
| 3a | Explain with suitable block diagram an application of LMS algorithm for adaptive echo cancellation.  | 10 |
| 3b | Describe signal processing for the generation of:<br>i) Chorus and ii) Reverberation Effect.   | 10 |
| 4a | Discuss the concept of Short Time Fourier Transform and Wavelet Transform with suitable Time-Frequency tiling diagrams.  | 10 |
| 4b | Discuss various sources of artefacts in EEG signals. Describe suitable block diagram and adaptive algorithm for removal of ocular artifacts from human EEG.  | 10 |
| 5a | With a suitable block diagram explain process for noise removal from a signal using wavelets.  | 10 |
| 5b | Draw multiple input adaptive linear combiner with desired response and error signal between desired response and actual output signal. Also, derive the equation for minimum mean-square error for an adaptive linear combiner in terms of input correlation matrix, cross correlation between desired response and the input component, and expected value of the desired response. | 10 |
| 6a | Discuss ECG and QRS complex in ECG with its time and frequency parameters. With a suitable diagram and signal processing explain any method for detection of QRS complex.  | 10 |
| 6b | What are the advantages Short Time Fourier Transform as compared to Fourier transform. Explain using suitable time and frequency domain waveforms for a signal.  | 10 |

\*\*\*\*\*



Sem - I  
ETC  
choice based.

Duration: 3 hours

Max marks: 80

Note the following instructions.

- (a) Question No.1 is compulsory
- (b) Total 4 questions need to be solved
- (c) Attempt any three questions from remaining five questions.
- (d) Assume suitable data wherever necessary, justify the same

- 1.a Explain QOE in NGN. [5]
- 1.b Explain the concept of SDR and Cognitive Radio. [5]
- 1.c Discuss the importance of IPV6 for NGN. [5]
- 1.d Define NGN and mention the key features of NGN. [5]
  
- 2.a Explain the naming, numbering & addressing schemes in NGN. [10]
- 2.b Classify the Wireline NG Technologies and Explain any one in detail. [10]
  
- 3.a Explain the MPLS Services and Components [10]
- 3.b Explain the concept of IOT with an example. [10]
  
- 4.a Discuss the important aspects of NGN architecture with a suitable diagram. [10]
- 4.b Describe the NGN security mechanisms covering AAA. [10]
  
- 5.a Explain the concept of VPN and its implementation in Layer2 and layer3. [10]
- 5.b How is service convergence implemented in NGN? [10]
  
- 6 Write Notes on: [any two] [20]
  - a)FTTP
  - b)IPTV
  - c)VOIP
  - d)FMC



E-EXTC  
em-I  
choice based

Time: 3 Hours

Total Marks: 80

N.B. : (1) Question No.1 is Compulsory.

- (2) Attempt any 3 questions out of rest.
- (3) Figure to the right indicate full marks.
- (4) All questions carry equal marks.

1. College wants to design database for examinations system.
  - a) Design tables (Student, branch, Semester, Subjects, marks) with assuming suitable attributes and normalize the database. 5
  - b) Define primary key, foreign key with its importance in database design. List Primary and foreign key in each table of above tables. 5
  - c) Draw Star schema and Snowflake schema for above design. 5
  - d) Explain difference between star schema and snowflake. 5
2.
  - a) Define Customer relationship Management. Explain in detail Operational And Analytical CRM. 10
  - b) Explain Cloud Computing with various types of Clouds 10
3.
  - a) Explain various Business intelligence Applications for presenting Results. 10
  - b) Explain Computer based Information System with its types. 10
4.
  - a) Explain Big data with its characteristics and issues 10
  - b) What is strategic information system? What strategies can company use to gain competitive advantage? 10
5.
  - a) Define Social Computing. Explain Social Shopping and Marketing. 10
  - b) Explain Pervasive Computing and the technologies that provide infrastructure For Pervasive Computing. 10
6. Write short notes on any two. 20
  - a) Transaction Processing System
  - b) E-Commerce
  - c) Customer Relationship Management