ME/SEM-I (CBSGS) / INST & Control / Applied Linear Algebra

Q.P. Code : **30541**

(3 Hours) [Total Marks : 80

N.B. : (1) Questions **No.1** is **compulsory**.
(2) **Assume** suitable data wherever **necessary**.
(3) **Answer** any **three** from the remaining **five** questions.

1. Briefly explain any **four** : 20
   (a) Basis vector
   (b) Linear vector space
   (c) Moore Penrose inverse
   (d) Quadratic form
   (e) Condition number of a matrix

2. (a) Consider a system of equations Ax = b. Assume that 'b' is not in the column space of the matrix A. Suggest a method to find out the least square error solution for the system. 10
   (b) Find a least square error solution for the system Ax = b 10

   Where $A = \begin{bmatrix} 4 & 0 \\ 0 & 2 \\ 1 & 1 \end{bmatrix}$, $b = \begin{bmatrix} 2 \\ 0 \\ 11 \end{bmatrix}$

3. (a) Differentiate between column space and null space of a matrix 10

   Let $A = \begin{bmatrix} 1 & -3 & -4 \\ -4 & 6 & -2 \\ -3 & 7 & 6 \end{bmatrix}$ $b = \begin{bmatrix} 3 \\ 3 \\ -4 \end{bmatrix}$

   Check whether 'b' is in the column space of A.
   (b) What do you mean by linear independence of vectors? 10

   Determine whether $S = \left\{ \begin{bmatrix} 1 \\ 0 \\ 3 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 4 \end{bmatrix} \begin{bmatrix} 1 \\ 4 \\ 5 \end{bmatrix} \right\}$ is linearly independent.

TURN OVER

4. Let a matrix A can be factored as

$$A = \begin{bmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & 0 & \frac{-1}{\sqrt{2}} \\ 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 6 & 0 & 0 \\ 0 & 2\sqrt{6} & 0 \\ 0 & 0 & \frac{\sqrt{6}}{100} \end{bmatrix} \begin{bmatrix} \frac{1}{\sqrt{2}} & 0 & \frac{-1}{\sqrt{2}} \\ \frac{1}{\sqrt{6}} & \frac{-2}{\sqrt{6}} & \frac{1}{\sqrt{6}} \\ \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{3}} & \frac{1}{\sqrt{3}} \end{bmatrix}$$

(a) Identify the type of factorization and explain. 5

(b) Obtain the factorization of inverse of the matrix (A). 5

(c) Express A as the sum of three square matrices of the order 3. 5

(d) Define rank and condition no. of a matrix. Find the rank and condition number of the matrix A. 5

5. (a) What is LU factorization? Find LU factorization of 10

$$A = \begin{bmatrix} 1 & -3 & 5 \\ 2 & -4 & 7 \\ -1 & -2 & 1 \end{bmatrix}$$

(b) What is QR decomposition? Explain briefly. 10

6. (a) What are the applications of diagonalization? Find a transformation matrix that diagonalizes A, 10

Where, $A = \begin{bmatrix} 1 & 0 \\ 6 & -1 \end{bmatrix}$

(b) Check the definiteness of the following matrix using pivots, determinant and eigenvalues. 10

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

ME (Instr) Second CBGS

Advanced Sensors and Signal Processing

Q.P. Code : 30544

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

N.B: (1) Q.1 is compulsory.
(2) Attempt any three questions from the remaining questions.
(3) Assume suitable data wherever necessary.

1. Attempt the following : 20
   (a) State and explain by which inductance of a coil varies.
   (b) Explain the architecture of smart sensors.
   (c) Compare photovoltaic and photoconductive modes used for operation of photodiode
   (d) Explain in brief signal processing of capacitive transdcers.

2. (a) Explain with block diagram basic and auxillary functional elements of the system. 10
   (b) Explain construction, characteristics and applications of microsensors. 10

3. (a) Describe signal processing of high output impedance sensors. 10
   (b) State the types of potentiometers and also explain the following : 10
      (i) Major resolution
      (ii) Minor resolution
      (iii) Apperant resolution

4. (a) Explain DC to DC converter for noise reduction. 10
   (b) State and explain the problems encountered in driving and processing signals from remotely located bridge circuits. Discuss remidies. 10

5. (a) Explain the encoders with the following : 10
      (i) Working principle
      (ii) Types
      (iii) Resolution
      (iv) Measurement of direction and velocity
   (b) Explain communication and computational capabilities of SMART transducers. 10

6. Write a short note on : 20
   (i) Gaurding techniques
   (ii) Accelerometer

ME/ ACT / DEC 2015 / I

QP Code : 30546

(3 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.
(4) Figures to the right indicate full marks.

1. Answer the following: 20

(a) Explain what is system identification and methods of system identification.
(b) Explain importance of integral controller with example.
(c) Compare ZOH and FOH.
(d)Differentiate MRAC and MIAC.

2. (a) Explain dead beat controller with example. 10

(b) Define MIT rule and obtain MIT rule for feedforward gain. 10

3. (a) Explain any two methods of DC value estimation. 10

(b) Explain how RLS method of parameter estimation is used for a stochastic signal model? 10

4. (a) What are the methods of building deterministic state controller? Draw and explain the general adaptive state controller scheme. 10

(b) Explain RCS method of parameter estimation for time varying processes. 10

5. (a) Consider the process $G(s) = \frac{1}{s(s+a)}$, where a is unknown parameter. Design a Controller such that the closed loop transfer function becomes $G_m(s) = \frac{w_n^2}{s^2+2w_n s+w_n^2}$. 10

(b) Derive the adaptive minimum variance control for RLS-MV4. 10

6. Write short notes on: 20

(a) Minimum variance control.
(b) Square root filtering
(c) Non-dual adaptive controllers.
(d) Tuning of controllers.

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BB-Con. 9721-15.

ME-Sem-I-(CBSGS)-Instr & Cont. - Bio-Instrumentation & Imaging

QP Code : 30549 Nov-15

Duration: 03 hrs **Marks:** 80 marks

(Question No. 1 is compulsory. Answer any 3 from the remaining 5 questions)

1. a) Explain need and working of Advanced Instrumentation Amplifier and its advantages over classical Instrumentation amplifier. (05)

   b) Explain the principle and working of TENS. (05)

   c) Explain the need for sub-carriers in Bio-telemetry system. (05)

   d) Give the block diagram of Central Nurse station and explain, in brief. (05)

2. a) Explain in detail with a diagram, 6-lead ECG signal conditioning system. (10)

   b) Explain with a neat diagram the working of Gamma Camera Imaging system. (10)

3. a) What is Cardioversion? With a neat schematic explain cardioverter system. (10)

   b) What are Isolation Amplifiers? Explain with a neat diagram the working of Carrier-type Isolation amplifiers. (10)

4. a) What is a Bionic ear? Explain its working by comparing with natural ear. (10)

   b) Explain various image reconstruction techniques used in MRI systems. (10)

5. a) Explain the working of Telemedicine system with neat diagram. (10)

   b) Explain the various Grounding techniques used in Biomedical systems for optimal performance. (10)

6. Write short notes on: (05 each)

   a) Arrythmias in ECG

   b) Multichannel DAS

   c) Retinal Implant

   d) PET

BB-Con. 9817-15.