(3 Hours) [Total Marks : 80

N.B. : (1) Question **No. 1** is Compulsory.
(2) Answer **any three** out of remaining questions.
(3) Assume suitable data wherever required.
(4) Figures to the **right** indicate **full** marks.

1. Briefly explain the following   20
   (a) Orthogonal Projection
   (b) Least Square Solution
   (c) Minimal polynomial and Characteristics polynomial
   (d) Change of Basis.

2. (a) Define eigen value and eigen vector. Calculate all the eigen values and   10
   eigen vectors of the following matrix, $A = \begin{bmatrix} 5 & 1 \\ 1 & 2 \end{bmatrix}$ and check whether it
   is diagonalizable or not.

   (b) Explain how the given vectors can be converted to orthonormal base vectors   10
   using Gram Schmidt process.

3. (a) State Cayley Hamilton theorem. Explain how this can be applied to find   10
   the power of a matrix.

   (b) Find the reduced row echelon form of the matrix A. Identify the linearly   10
   independent columns in A.

   $$A = \begin{bmatrix} 1 & 2 & 0 & 1 \\ 2 & 4 & 1 & 4 \\ 3 & 6 & 3 & 9 \end{bmatrix}$$

4. (a) Explain Singular Value Decomposition with application.   10

   (b) Explain Kernel, Range, Nullity, and Rank of a linear transformation.   10

5. (a) For which values of k does the system below have a solution?   10
   x - 3y = 6;   x + 3z = - 32;   x + ky + (3-k)z = 1

[TURN OVER]

(b) Explain the concept of span of a vector space and check whether the given vectors span R^3 space. (2 1 2), (-1 0 1), (0 8 0). Justify the answer.   10

6 (a) Explain Inner product and Cross product of vectors.Choose suitable numerical examples.   10

(b) Find A= LU factorization of the matrix   10

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 4 & 4 \\ 3 & 7 & 10 \end{bmatrix}.$$

Using this factorization solve the system Ax= (3, 10, 20)^T.

M.E./INST/ Sem I (CBSGS)   NOV/DEC '16

ADVANCED SENSORS & SIGNAL   Q. P. Code : 687701
PROCESSING SYSTEM

(3 Hours)   (Total Marks : 80)

N.B. (1) Question no 1 is compulsory.
(2) Attempt any three questions from the remaining questions
(3) Assume suitable data wherever necessary.

1. Attempt the following:-   20
   (a) Explain linearising technique of capacitive sensor's output.
   (b) Compare photovoltaic and photoconductive modes used in operation of a
       photodiode.
   (c) Explain with block diagram basic and auxiliary functional elements of the
       measurement systems.
   (d) Discuss communication and computation capabilities of smart transducer.

2. (a) Explain signal processing of capacitive type transducer.   10
   (b) Explain with suitable diagram sensitivity and linearity with respect to   10
       potentiometric transducer.

3. (a) State and explain with suitable diagram by which capacitance changes. Also   10
       explain its equivalent circuit.
   (b) Describe working and use of Kelvin Bridge sensing system.   10

4. (a) Discuss analog techniques for linearization of RTD.   10
   (b) What is ratiometric measurement techniques? Explain its need with   10
       suitable examples.

5. (a) Explain with suitable diagram fabrication of Microsensors.   10
   (b) Discuss effects of power supply variations and grounding connections on   10
       signal processing systems.

6. (a) Explain different guarding techniques.   10
   (b) What is encoder? Explain its types in brief.   10

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ADAPTIVE CONTROL THEORY

Q. P. Code : 685600

(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 any four of the following: (20)

   a) What do you mean by the term Adaptive Control? Also mention an example.
   b) What is system identification? Explain in brief.
   c) Explain cancellation controller in brief.
   d) Compare different parameter estimation methods.
   e) What is the difference between ARMAX and LS models?
   f) Explain feedforward adaptive controllers.

2. a) Explain MRAS in detail. Also derive the MIT rule. (10)

   b) Derive an equation for parametric estimator using non-recursive LS method. (10)

3. a) Design an MRAS for 2nd order system having 2 adjustable parameters. Assume the (10)
   control law to be: $u=\Theta_1(u_c-y)-\Theta_2 v$ .The model for the system is a general 2nd order system.

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

4. a) Derive the identifiability condition via convolution function for non parametric (10)
   identification.

   b) Explain dead beat controller in detail with example. (10)

5. a) Derive the impulse response of a linear system if stationary stochastic signal is (10)
   applied via estimation of ACF of i/p and CCF of i/p and o/p signal.

   b) Differentiate between MIAC and MRAC systems. (10)

6. Write short notes on: (20)

   a) Square root filtering.
   b) Method of tuning controllers
   c) Generalized predictive controller
   d) RLS MV4.

Q.P. Code : 687900

(3 Hours)   [Total Marks : 80

N.B. : (1)   Question **No.1** is **Compulsory**.
      (2)   Attempt any **Three** questions from remaining **Five** questions.
      (3)   **Figures** to the **right** indicate full **marks.**

1.   (a)   Explain the need of subcarriers in Bio-telemetry system.   5
     (b)   Explain in brief, the driven right leg configuration.   5
     (c)   Write short notes on X-ray Image Intensifier system.   5
     (d)   Explain in brief, about Multichannel DAS.   5

2.   (a)   Explain the principle and working of any one type of Isolation amplifier.   10
     (b)   Explain with a neat diagram, each block of 6-lead ECG signal Conditioning system.   10

3.   (a)   Explain the various Image Reconstruction techniques used in CT system with neat pulse diagram.   10
     (b)   Explain the various Grounding techniques used in Biomedical systems for improved performance.   10

4.   (a)   Explain working of Muscle stimulators with different types of waveforms.   10
     (b)   Explain the working of Multichannel Radio-telemetry system, with Frequency Division Multiplexing.   10

5.   (a)   What is a Bionic ear ? Explain its working with a neat diagram.   10
     (b)   Explain with a neat diagram, working of Gamma Camera Imaging system.   10

6.   Write short notes on (**Any Two**):
     (a)   PET   20
     (b)   Telemedicine
     (c)   Retinal Implant

Q.P. Code : 688500

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

Note :1. Question No. **1** is **compulsory**.
     2. Attempt any **three** questions from remaining five questions.
     3. Assume suitable data if necessary.

1. a) Explain working of a constant current source with circuit diagram.   5
   b) Explain working of instrumentation amplifier.   5
   c) Explain working of flash ADC and its uses .   5
   d) Explain why guarding techniques are required.   5

2. a) Explain working of a successive approximation type ADC.   10
   b) Explain use of log. Amplifier for multiplication and division of analog signals   10

3. a) Explain working of analog multiplexer and its applications.   10
   b) Explain need of hysteresis in comparator circuit with circuit diagram.   10

4. a) Explain working of DC to DC convertor and mention its uses in signal processing.   10
   b) Explain important performance parameters of Digital to Analog Convertor.   10

5. a) Explain need and methods used in electronic circuits for RF shielding.   10
   b) Discuss important issues involved in power management of electronic circuits.   10

6. Write short notes on **any two** of the following-   20
   a) Limitations in using AC coupling circuits at input of instrumentation amplifier.
   b) Switched capacitor filters.
   c) Dual slope integration technique for Analog to Digital Conversion.