Sem - I - choice based

Time 3 Hours

Marks 80

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

Q. 1   Briefly explain **any four**   20

a)   Null Space of a linear transformation

b)   Cross product of vectors

c)   Orthogonal Vector

d)   Singular Value

e)   Gaussian Elimination

Q. 2   a)   What is linearly dependence of vectors?   10
Determine whether $x_1 = (2,3,1,4)^T, x_2 = (-1,1,2,3)^T x_3 = (4,0,-1,1)^T$ are linearly independent or linearly dependent.

b)   Compare LU decomposition & QR decomposition   10

Q.3   a)   What is the power method of obtaining the largest eigen value. Explain the concept.   10

b)   Explain the concept of constrained optimization. Find the maximum and minimum of $Q(x)$, where   10
$Q(x) = 10x_1^2 + 6x_2^2 + 2x_3^2$ subject to the constraints $x^T x = 1$

Q.4   a)   Explain the significance of Eigen value and Eigen vector in the trajectory of a discrete dynamic system. Use a suitable numerical example to illustrate it.   10

b)   Let $w = \frac{1}{\sqrt{3}}(1,-1,1)$. Compute householder matrix and verify that its rows are orthonormal.   10

Q.5   a)   Obtain the least square error solution of the system $Ax = b$ 10

b)   Apply GM orthogonalization to the column vectors of the matrix A   10
$$A = \begin{bmatrix} 2 & 1 \\ 1 & 1 \\ -2 & 0 \end{bmatrix}$$

Q.6   a)   What do you mean by positive definiteness of a matrix, Which of the following matrices are Positive Definite.   10

$$A = \begin{bmatrix} 3 & 4 \\ 4 & 5 \end{bmatrix} B = \begin{bmatrix} 8 & -3 \\ -3 & 2 \end{bmatrix} C = \begin{bmatrix} 2 & 1 \\ 1 & -3 \end{bmatrix} D = \begin{bmatrix} 3 & 5 \\ 5 & 9 \end{bmatrix}$$

b)   Briefly explain how the diagonalization of a matrix with repeated roots, can be performed.   10

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SEM I
(Voice Base)/ Instruf Control

Total Marks: 80

(3 Hours)

Note:
1. Question No.1 is compulsory
2. Solve any THREE questions out of remaining FIVE questions.
3. Figure to the right indicate full marks.
4. Assume suitable data if required.

Q 1	**Answer the following:**	(20)
a)	Explain the significance of material constant in case of thermistor. State linearising modes of thermistors.	
b)	Explain why dark current is associated with photodiode.	
c)	State and explain in brief different types of preamplifiers used in nuclear instrumentation.	
d)	Explain working of gas filled nuclear detector in various regions of operations.	
e)	What do you mean by thin film and thick film sensors? State deposition methods associated with it.	
Q 2 a)	Derive expression for charge sensitivity in case of piezoelectric transducers.	(10)
b)	Draw and explain the block diagram of single channel analyser.	(10)
Q 3 a)	Explain principle and working of semiconductor temperature sensors.	(10)
b)	Write a comphrensive note on scintillation detector.	10)
Q. 4 a)	Explain signal processing of inductive sensors.	(10)
b)	Draw and explain generic architecture of Smart transducers. State its features and advantages.	(10)
Q. 5 a)	Explain the need of guarding when transducers with high output impedances are used. Discuss various guarding techniques.	(10)
b)	Explain working principle of encoders. State types of encoders with their applications	(10)
Q. 6	Write short note on : (Any Two)	(20)
a)	Kelvin sensing system	
b)	Hall effect sensors with its biasing	
c)	Advantages and disadvantages of multichannel analyser over SCA.	

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59291

Duration: 3 Hours   **Max. Marks 80**

N.B.

1. **Q.1** is compulsory. Attempt **any three** from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1 Attempt **any four**   20

a. Write the various reaching laws for the sliding mode control design.

b. What are the sensitivity and complementary sensitivity functions for the classical control structure?

c. What are the advantages of QFT design?

d. Obtain the classical controller $c(s)$ for the plant transfer function $\tilde{p}(s)$ via block diagram reduction from IMC structure with controller $q(s)$.

e. Prove that - the phase $\arg[P(j\omega)]$ is continuous and strictly increasing with the frequency ω in Hurwitz polynomials $P(j\omega)$.

f. Solve the following-
   (i) $[1, 3] - [0.5, 1.5]$
   (ii) $[1, 2] \div [0.5, 1]$

Q.2 A. What is Hermite-Biehler theorem for Hurwitz polynomial? Give the proof.   10
   B. Write the Kharitonov's theorem for the stability of real interval polynomial.?   10

Q.3 A. Design the sliding mode control for the following system so that sliding motion is 10
characterised by eigen values $-1, -2$

$$\dot{x}_1 = x_2$$
$$\dot{x}_2 = x_3$$
$$\dot{x}_3 = x_1 + 3x_2 - 2x_3 + 5u + 2.4\sin 50t$$

   B. Prove that- $\dot{s} = -ks - Q\,\mathrm{sgn}(s)$ is finite time stable with $Q > 0$, $k > 0$.   10

Q.4 A. What is difference between matched and unmatched disturbance? Prove using an 10
equivalent control that a system $\dot{x} = ax + bu + bd$ is insensitive to the disturbance
d during sliding motion along a surface $s(x)$.

   B. Suppose that the system in regular form is given,   10

$$\dot{x}_1 = A_{11}x_1 + A_{12}x_2$$
$$\dot{x}_2 = A_{21}x_1 + A_{22}x_2 + B_2(u + d)$$

Derive the sliding mode control using Lyapunov function $V = 0.5s^2$. Where σ be
the sliding surface given by $\sigma = c_1x_1 + x_2 = 0$.

Turn Over

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Q.5 A. Unity feedback interval system has open loop transfer function,   **10**

$$G(s) = \frac{\beta_1 s + \beta_0}{s^2(\beta_4 s + \beta_3)}$$

where, $\beta_0 \in [1320, 1980], \beta_1 \in [340, 510], \beta_2 \in [32, 34], \beta_3 \in [28.8, 43.2]$ and $\beta_4 \in [0.8, 1.2]$. Determine closed loop stability of a family of systems.

B. Outline the design procedure of quantitative feedback control.   **10**

Q.6 A. Design the IMC based PID control for the system,   **10**

$$\tilde{G}(s) = \frac{\tilde{k}_p}{\tau s + 1}$$

B. Design the IMC control for the system with model   **10**

$$\tilde{G}(s) = \frac{(-3s + 1)e^{-s}}{s^2 + 15s + 56}$$

What will be output $Y(s)$ of a designed system to an unit step input if model is assumed to be perfect.

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

N.B.   1) Question No. 1 is compulsory.

         2) Attempt any 3 questions from remaining 5 questions.

1.   a. Write short notes on, Endoscopy.   (05)

     b. Justify that Instrumentation amplifiers are used as Bio-amplifiers.   (05)

     c. Explain in brief, the need of subcarriers in Bio-telemetry system.   (05)

     d. Explain in brief, about Gamma Camera.   (05)

2.   a. Explain the principle and working of Carrier type of Isolation amplifier.   (10)

     b. Explain with a neat diagram, working of Micro wave diathermy.   (10)

3.   a. Explain the various Image Reconstruction techniques used in MRI system.   (10)

     b. Explain working of Muscle stimulators with different types of waveforms.   (10)

4.   a. What is Cardioverter? Explain its working with a neat diagram.   (10)

     b. Explain the working of Multichannel Radio-telemetry system, with
       Time Division Multiplexing.   (10)

5.   a. Explain the different types of Lasers used in medicine and their working
      Concept.   (10)

     b. Explain with a neat diagram, the working of each block of 6-lead ECG
      Signal conditioning system.   (10)

6.   Write short notes on (any two):   (20)

     a. Lithotripsy

     b. Positron Emission Tomography (PET)

     c. Telemedicine

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Q.P. Code: 24387

(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.   A Canteen wants to design database with respect to the four dimensions, customer, Food items, category and bill.

   a) Design tables 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 schema   5

2. a) Define Big Data. Explain various characteristics and issues in Big Data.   10

   b) Define Functional area Information System. Explain Information system For Human Resource Management.   10

3. a) Define relational database. Explain its advantages and disadvantages in detail.   10

   b) Explain Computer based Information System with its types.   10

4. a) Explain various threats to information system.   10

   b) Explain Data Warehouses and Data Marts with its characteristics.   10

5. a) Explain Pervasive Computing and the technologies that provide infrastructure For Pervasive Computing.   10

   b) Define Business Intelligence. Explain Business Intelligence applications for Data Analysis.   10

6.   Write short notes on any two   20

   a) Transaction Processing System

   b) Enterprise Resource planning

   c) E-Commerce

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