M.E- SEM I (Choice Base) INSP & CONT.

May 2019

Q.P. Code: 27382

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.

Time **3 Hours** **Total Marks** **80**

Q. 1 Answer any four questions. 20

a) Eigen vector of a matrix

b) Null space

c) Minimal polynomial

d) Span of vectors

e) Inner Product

Q. 2 a) Show that the following system has a solution for any values of a, b & c. 10

$x + y + z = a$

$x + 2y - z = b$

$2x - 2y + z = c$

b) What is linear combination? Can vector $u_1 = \begin{bmatrix} 1 \\ -6 \end{bmatrix}$ can be represented a linear combination of $v_1 = \begin{bmatrix} 1 \\ -4 \end{bmatrix}$, $v_2 = \begin{bmatrix} 2 \\ 0 \end{bmatrix}$, and $v_3 = \begin{bmatrix} 3 \\ -1 \end{bmatrix}$ 10

Q.3 a) What do you mean by basis vector? Show that $B = \left\{ \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix} \right\}$ is a basis for R^3 10

b) Identify whether the following statements are true or false, justify your answer 10

i) If zero is an eigen value of matrix x, then A cannot be invertible

ii) If $A = \begin{bmatrix} -1 & 0 \\ 0 & 2 \end{bmatrix}$, then $\lambda = 1$ is an eigen value of A^{10}

iii) If an nxn matrix is diagonalizable, then it must have 'n' different eigen values.

Q.4 a) Let B be a basis for R^3 given by $B = (v_1, v_2, v_3)$ where $v_1 = (1,1,1)$, $v_2 = (-1,1,0)$, $v_3 = (-1,0,1)$. Apply the Gram Schmidt process to B to find an orthonormal basis for R^3 10

b) Obtain solution of the system 10

$x_1^0 = x_1 + x_2$

$x_2^0 = 4x_1 - 2x_2$

Assume initial condition $x_1(0) = 1, x_2(0)=6$

Q.5 a) What do you mean by Singular Value Decomposition? 10

Find a singular value decomposition of

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

b) Consider the following two basis in R^2. Find the change of basis matrix P from U to the new basis S. 10

$U = \{u_1, u_2\}, S = \{v_1, v_2\}$

$u_1 = (1,2), u_2 = (3,5), v_1 = (1,-1), v_2 = (1,-2)$

Q.6 Write short notes on 20

i) Quadratic form and its significance in engineering

ii) QR decomposition

****

M.E. SEM I (Choice Base) May 2019,

Paper / Subject Code: 60202 / Advanced Signal Processing for Sensors.

Inst + 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 working of gas filled nuclear detector in various regions of operations.

b) Why shaping amplifiers are required for nuclear signal processing system?

c) Explain sources of noise in any measurement system with remedies.

d) Explain photovoltaic mode of photodiode with its applications.

e) Explain use of bridge circuits.

Q 2 a) Derive charge sensitivity in case of piezoelectric transducers. (10)

b) Explain the working of kelvin sensing system and its use. (10)

Q 3 a) Discuss resolution and accuracy of incremental and absolute type of encoders. (10)

b) Discuss any one linearization technique for bridge circuit for resistance measurement. (10)

Q. 4 a) Draw and explain the block diagram of multi channel analyser. (10)

b) What is micromachining? State and compare the types of micromachining (10)

Q. 5 a) Explain circuit used for processing signals from capacitive transducers. (10)

b) Why guarding is necessary for processing output of high output impedances transducers? (10)

Q. 6 Write short note on : (20)

a) Semiconductor temperature transducers

b) Transducer Electronics Data Sheets

****

59290

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. Explain chattering avoidance via auxiliary sliding surface defined in terms of the switching surface and it's rate.

b. Obtain the sensitivity and complementary sensitivity functions for the classical control structure with output disturbance.

c. Write the conditions for existence of the sliding motion.

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

e. What are the advantages of QFT design?

f. Prove that $\dot{z}(t) = -Q\text{sgn}(z)$ with $Q > 0$ is a finite time stable.

Q.2 A. Obtain the equivalent for a system with discontinuous right hand side. **10**

B. Design the sliding mode control for the following system so that sliding motion is governed by eigenvalues $-1, -3$ **10**

$$\begin{aligned} \dot{z}_1 &= z_2 \\ \dot{z}_2 &= z_3 \\ \dot{z}_3 &= 6z_1 + 2z_2 + z_3 + u + 0.5\sin 20t \end{aligned}$$

Q.3 A. Write interlacing properties of a polynomial. How to determine the stability of real polynomial using interlacing properties. **10**

B. Suppose that a nominal polynomial is, **10**

$$P(s) = s^3 + \delta_2 s^2 + \delta_1 s + \delta_0, \text{ with } (\delta_0, \delta_1, \delta_2) = (6, 11, 6).$$

Design robust state feedback control if uncertainty ranges are given by $\Delta\delta_0 = 0.5$, $\Delta\delta_1 = 0.5$ and $\Delta\delta_2 = 0.5$.

4D8D3D396A1996D9CD52F4C3FBBFB036

Q.4 A. Design the IMC control for the system with model **10**

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

with all-pass factorization. Compute the unit step response of the system in absence of disturbance if model is perfect.

B. Design the IMC based PID control for the system, **10**

$$\tilde{G}(s) = \frac{5}{s^2+3s+2}$$

Q.5 A. Write various reaching laws for sliding mode control design. **10**

B. Write objectives of QFT design. **10**

Q.6 A. Write the Kharitonov's theorem for the stability of real interval polynomial. **10**

B. Write the steps in IMC design for improved disturbance rejection. **10**

4D8D3D396A1996D9CD52F4C3FBBFB036

EMI Paper / Subject Code: 60204 / Elective I : Advanced Biomedical Instrumentation. /MAY2019
Choice Base/ INST&CONT

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. Justify that bio-amplifiers are instrumentation amplifiers. **(05)**
   b. Explain in brief, about specification requirements of Biotelemetry system. **(05)**
   c. Explain the basic setup and requirements for generating lasers. **(05)**
   d. Explain in brief, about Cardioverter. **(05)**

2. a. Explain the principle and working of Optical type of Isolation amplifier. **(10)**
   b. Explain with neat diagram, working of Telemedicine system. **(10)**

3. a. Explain, the various Image Reconstruction techniques used in CT systems. **(10)**
   b. Explain the principle and working of Endoscope systems, with neat diagram. **(10)**

4. a. Explain working of Muscle stimulator, with different types of waveforms. **(10)**
   b. Explain with a neat diagram, each block of EEG signal conditioning System. **(10)**

5. a. Explain with a neat diagram, the working of Short wave Diathermy. **(10)**
   b. Explain the working of Multichannel Radio-telemetry system, with Pulse-width Division Multiplexing. **(10)**

6. Write short notes on **(any two):** **(20)**
   a. Asynchronous pacemaker with design
   b. Lithotripsy
   c. SPECT
