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FIRST SEMESTER **M.Tech. (C&I)**

SUPPLEM. EXAMINATION FEB 2019

EE-561 MODELLING, IDENTIFICATION AND CONTROL

Time: 3:00 Hours Max. Marks : 100

Note : Question no. 1 is compulsory. Answer any four questions from remaining. Assume suitable missing data if any.

1. Write true or false and justify your answer: (2X10)
   (a) Low value of proportional band is desirable in proportional controller.
   (b) The desired output behaviour is specified in form of a trajectory in model-based optimization approach of control system design.
   (c) Appropriate performance criterion is not required for selection of controller.
   (d) For flow control, proportional controller is the best choice.
   (e) Least squares estimate and recursive least squares estimate are related.
   (f) The classical feedback controller design approach is better than the direct synthesis approach for controller design.
   (g) The equations for system parameters are always such that all parameters can be identified.
   (h) Deadbeat controller provides better response than Dehlin's control algorithm.
   (i) Sampling period should always be in the range 0.7 to 0.9 of the dominant time constant or dead time, whichever is larger.
   (j) Tuning methodologies for digital controllers are two and they are different than continuous controllers.
2. (a) Explain the various control actions and their effects on process. What are various controllers ? (10)
   (b) For the overdetermined equations:

$$4x_1 - x_2 = -4$$
$$3x_1 + x_2 = 1$$
$$x_1 - 2x_2 = -5$$
$$2x_1 + 2x_2 = 1$$

Determine the Least Square Estimate of vector x.

3. (a) Derive/develop the algorithm for Recursive Least Squares Estimate and draw its block diagram also. (10)

(b)Consider the estimation of a two vectors x_1 and x_2 from the following measurements:

$$z_1 = 2 = 2x_1$$
$$z_2 = 5 = x_1 - x_2$$
$$z_3 = 4 = 3x_1 + x_2$$
$$z_4 = -4 = x_1 + 2x_2$$

Find the recursive least squares solution. (10)

4. (a) Explain the system identification with the help of some suitable example. (10)

(b) Design a controller for the following second –order system:

$$g(s) = \frac{1}{(2s+1)(3s+1)}$$

Using the direct synthesis approach, given that the desired closed loop behaviour is first order system with $\tau_r = 4$. Also compare the controller with that resulting from choosing $\tau_r = 1$.

5. (a) Prove that, for synthesis of Time Delay Systems, second order trajectory can not be selected. (10)

(b) Design a controller for the following inverse response system:

$$g(s) = \frac{(1-4s)}{(3s+1)(5s+1)}$$

Using the direct synthesis approach taking a suitable reference trajectory.

6. (a) Test time the following digital controller pulse transfer functions for physical realizability: (10)

(i) $D(z) = \frac{4z^{-1}+3+3z^{-2}}{1+4z^{-1}}$

(ii) $D(z) = \frac{3+2z+3z^{-2}}{1+4z^{-1}}$

(iii) $D(z) = \frac{3+z+2z^{-1}+3z^{-2}}{1+4z^{-1}}$

(b) Derive the discrete time model of a PID controller.

7. (a) Explain position form & velocity form of control algorithms. Which one is advantageous and why ? (10)

(b) Write short notes on any two of the following: (10)

(i) Stochastic process (2x5)

(ii) Random process & random variables

(iii) Correlation