

BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR
B.E. 7TH SEMESTER (CST) FINAL EXAMINATIONS, 2012
Computer Control of Industrial Processes (CS 702)

Full Marks: 70

Time: 3 hrs

Answer any four questions. All questions carry equal marks.
Two marks are reserved for neatness and clarity.

1. Describe the merits and demerits of using programmable logic controllers over microprocessor or computer based control in the industry. Design a PLC based temperature controller that puts a heater on and off upon monitoring of temperature of water that must stay within a pre-defined upper and lower threshold. Repeat the same design based on microprocessor. 5+6+6
2. Describe how a continuous dynamical system model is discretized with an example. Derive the state transition matrix in the discrete domain for a system that is described in continuous domain in terms of $\dot{x} = Ax + Bu$ and $y = Cx$. Hence obtain the z domain transfer function of the discretized system. 5+6+6
3. Show how the value at any sampled time instant inclusive of initial and final values can be computed from z-domain transfer function. Derive two approximations from z-domain to s-domain, namely, (a) bilinear transformation and (b) Pade approximation techniques. Discuss the role of the above approximations in stability analysis of discretized systems. 6+6+5
4. Explain the term observability of discrete dynamical systems. Derive the criteria for observability in case of linear time invariant systems. Describe the computational steps to be followed for observer design. What are the limitations of such design? 3+4+7+3
5. Obtain expressions for design of controller based on state feedback. Consider a discrete dynamical system having state equations:
$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$$
 Design a state feedback controller that places poles at the origin. 7+10
6. Write short notes on any two of the following: $2 \times 8\frac{1}{2}$
 - (a) Estimator and adaptive controller design.
 - (b) Choice of state variables for a dynamical system
 - (c) Computational design interface for industrial control