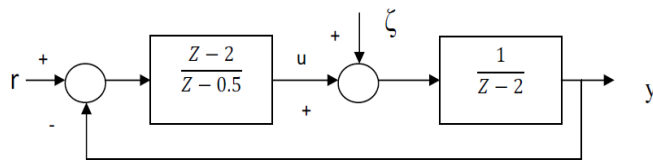


**GUJARAT TECHNOLOGICAL UNIVERSITY****M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013****Subject code: 1720301****Date: 24-12-2013****Subject Name: Digital Control****Time: 10.30 am – 01.00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** Verify whether the feedback system given below, in which a controller is designed with unstable pole-zero cancellation is internally stable, where  $\zeta$  denote the actuator noise. **03**



- (b)** Find the minimum variance controller for the system **07**

$$y(n) = \frac{1-a}{1-aZ^{-1}}u(n-1) + \frac{1}{1-cZ^{-1}}\zeta(n)$$

Where  $a=0.5$ ,  $c=0.9$  and  $\zeta(n)$  is white noise.

- (c)** Find ZOH equivalent transfer function of # **04**

$$\frac{K}{\tau s + 1}, \text{ where } K = 10, \tau = 5 \text{ sec and } T_s = 0.5 \text{ sec}$$

- Q.2 (a)** Derive GPC model for the system described by # **07**

$$(1 - 0.8Z^{-1})y(n) = (0.4 + 0.6Z^{-1})Z^{-1}u(n) + \frac{1}{\Delta}\zeta(n) \text{ for } N = 3 \text{ and } \rho = 0.8$$

- (b)** Why it is needed to redefine good and bad polynomials during the design of 2-DOF pole placement controller ?. Discuss it with suitable example. **07**

**OR**

- (b)** Justify with suitable example that “Internal stability ensures controller realizability”. **07**

- Q.3 (a)** Why noise splitting is done during estimation of prediction error model? Give detail analysis of prediction error modeling through noise splitting. **07**

- (b)** If  $G$  is the plant transfer function and that we want the closed loop transfer function as  $T$ . Determine the controller that is required for this purpose. Give your remark on controller realizability. **07**

$$\text{where, } G = \frac{Z^{-2}}{1-0.5Z^{-1}} \text{ and } T = \frac{Z^{-1}}{1-aZ^{-1}}$$

**OR**

- Q.3 (a)** If the system matrix # **07**

$$A = \begin{bmatrix} 1 & 2 \\ 0 & 3 \end{bmatrix}, b = [0 \ 1]^T, \text{ design state feedback controller to achieve desired characteristic polynomial equal to } Z^2 - 0.5Z + 0.5$$

- (b) Discuss GPC for ARIX model. 07
- Q.4** (a) Discuss the design of minimum variance controller for ARMAX system 07
- (b) What is the importance of estimator/observer in state feedback controller design. 07
- Discuss and derive the Ackermann's formula for designing estimator
- OR**
- Q.4** (a) Derive Ackermann's formula to design state feedback controller to get desired characteristics polynomial. 07
- (b) Discuss the formulation of optimal control problem in the design on Linear Quadratic Regulator 07
- Q.5** (a) Discretize PID controller with filtering and  $T_c = T_s$ . Determine the polynomial coefficients that correspond to the continuous time PID controller settings  $K=2, T_d=2.5$  sec,  $T_i=40$  sec and  $T_s=1$  sec. 07
- (b) Discuss the design steps for 2-DOF pole placement controller with performance specification 07
- OR**
- Q.5** (a) Discuss the modeling of mismatch between  $u$  and  $u_{sat}$  by an exogeneous variable  $\delta$  in 2-DOF controller design. ( $u$  and  $u_{sat}$  are control effort and limit on control effort) 07
- (b) What do you mean by receding horizon control ? what are the advantages of such control schemes ? How it is differ than the conventional PID controller ? 07

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