Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2720301 **Date: 25/05/2016**

Subject Name: Digital Control

Time:10:30 am to 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 Derive the Generalized Predictive control law for system describe as follows **14**

$$(1-0.8Z^{-1})y(n) = (0.4+0.6Z^{-1})Z^{-1}u(n) + \frac{1}{\Delta}\gamma(n)$$

For predictive horizon N=2 and control horizon Nu=2 and weight ρ=0.8.
Also for the same system shows the changes in control law if Nu=1.

Q.2 (a) Discuss about optimal estimator as a KALMAN filter with necessary derivations. **07**

(b) Give explanation on Internal Model Principle for Robustness in detail. **07**

OR

(b) Discuss about PID Tuning Through Pole Placement Control in detail. **07**

Q.3 Discuss about Minimum Variance Controller for ARMAX Systems with all necessary derivations in detail. **14**

OR

Q.3 Design the minimum variance control law for the control problem presented by **14**

$$y(n) = \frac{0.51+1.21Z^{-1}}{1-0.44Z^{-1}}u(n-1) + \frac{1}{1-Z^{-1}}\zeta(n).$$

Q.4 The system is described by the following state space equations. **14**

$$\frac{d}{dt}\begin{bmatrix} x1 \\ x2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix}u$$

$$y = \begin{bmatrix} 0 & 1 \end{bmatrix}\begin{bmatrix} x1 \\ x2 \end{bmatrix}$$

Design a 2-DOF pole placement controller that has a rise time of 3 seconds and overshoot of not more than 0.05 for a step change in the command signal. The sampling time Ts is 0.25 sec.

OR

Q.4 Consider the unstable system given by $G(Z) = z^{-k}\frac{B(Z^{-1})}{A(Z^{-1})}$, where **14**

$A(z^{-1}) = 1 - 1.95z^{-1} + 0.935z^{-2}, B = -0.015, k = 1.$

Assume the sampling time to be Ts = 1 sec. Design a PID controller with its parameters tuned by the GMVC(Generalized Minimum Variance Controller), such that the rise time to a step input is 15 sec and overshoot is ε = 0.1

Q.5 (a) Discuss about Bumpless digital PID Controller with Tc = Sc with all necessary derivation. **07**

(b) Discuss about 2-DOF PID control structure without proportional and derivative actions on a reference signal in detail. **07**

OR

Q.5 (a) Discuss about digital PID Controller with Filtering and Tc = Sc with all necessary derivation. **07**

(b) Discuss about Anti Windup Control strategy with 2-DOF controller structure in detail. **07**

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