Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – IInd - Examination – June/July- 2011

Subject code: 1720301

Subject Name: Digital Control

Date:22/06/2011 **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)** Derive equations for 1-DOF and 2-DOF feedback controller. Which one is better? Why? **08**

(b) Design a Bump less PID controller having K=2, τ_d= 2.5 s, τ_i= 40s and T_s=1s. **06**

Q.2 **(a)** What is a pole placement controller? Write a short note on Anti Windup controller. **07**

(b) Design an IMC (G_c) for the given system, **07**

$$G(z) = \frac{0.6321\, z^{-1}}{1-0.3679z^{-1}}$$

And express it in the conventional form. Represent it in the block diagram also.

OR

(b) Derive an expression for ARIMAX prediction error model. **07**

Q.3 **(a)** State and explain Internal Model Principle. **06**

(b) Design a 2-DOF PID controller, which eliminates the effect of proportional kick and Derivative kick. **08**

OR

Q.3 **(a)** Design a 2-DOF pole placement controller having a transfer function, **10**

$$G(Z) = \frac{0.47z^{-1}}{1-0.43z^{-1}}$$

such that the following transient specifications in tracking a step input are met:

Rise time ≤ 10 and

peak overshoot ≤ 0.01.

(b) Divide the noise term having, **04**

$C(z) = 1+0.5z^{-1}$

$A(z) = (1+0.2z^{-1})(1-0.8z^{-1})$ for j = 2, using long division.

Q.4 **(a)** What is the procedure to obtain a realizable G_Q(inverse of the plant) for IMC design, having stable plant conditions. **06**

Design an IMC for the open loop transfer function,

$$G= z^{-1} \frac{0.51+1.21z^{-1}}{1-0.44z^{-1}}$$

(b) Derive equations for Generalized Predictive control for ARIX model. **08**

OR

Q.4	**(a)**	Derive the equation of Minimum Variance Control law for ARMAX system.	**07**
	(b)	Write a short note on Smith Predictor.	**07**
Q.5	**(a)**	What is linear quadratic regulator? Derive infinite horizon solution to LQR design (equations of K_{∞} & J_{∞}).	**06**
	(b)	Design the minimum variance control for the system, $(1-0.9z^{-1})\, y(n) = 0.5u(n-1) + (1-0.5z^{-1})\xi(n)$	**08**

OR

Q.5	**(a)**	Explain various discretization techniques. Find ZOH of $1/s^2$.	**06**
	(b)	Define state estimator. Describe in detail, prediction state estimators.	**08**

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