

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-II Examination July 2010****Subject code:720301****Subject Name: Digital Control****Date: 05 /07 /2010****Time: 11.00am – 1.30pm****Instructions:****Total Marks: 60**

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

- Q.1** (a) Discuss Internal Model Principle for Robustness in detail **06**
 (b) Find the ZOH equivalent of (i) $\frac{1}{s^2}$ (ii) $\frac{1}{s}$ (iii) $\frac{K}{\tau s+1}$ **06**

- Q.2** (a) Determine the discrete time PID controller if we have the following continuous time PID settings: **06**
 $K=2, \tau_d=2.5\text{sec}, \tau_i=40\text{sec}, T_s=1\text{sec}$

- (b) Give explanation on Model Predictive Control **06**

OR

- (b) Give detailed interpretation of the prediction error model (ARMAX) **06**

- Q.3** (a) Discuss 1-DOF, 2-DOF and feedforward control structures **06**

- (b) Draw the Nyquist plot of $G(Z)=\frac{1}{Z(Z-1)}$ and find out for what values of K **06**
 (gain) the system becomes unstable.

OR

- Q.3** (a) Give explanation on Dead-Beat and Dahlin Control. Design a Dead-Beat controller for $G(Z)=\frac{Z-2}{1-Z^{-1}}$ **06**

- (b) Discuss the time response specifications for digital control system **06**

- Q.4** (a) Draw a schematic of Smith predictor and give the analysis of it. **06**

- (b) Design an IMC (Internal Model Control) for the open loop plant transfer function $G(Z)=\frac{-0.075061Z^{-1}(1-1.334Z^{-1})}{(1-0.7995Z^{-1})(1-0.7863Z^{-1})}$ **06**

OR

- Q.4** (a) Discuss IMC (Internal Model Control) design for Stable Plants **06**

- (b) Determine the IMC equivalent conventional controller for plant having open loop transfer function $G(Z)=Z^{-1}\frac{0.51+1.21Z^{-1}}{1-0.44Z^{-1}}$ **06**

- Q.5** (a) Draw the schematic of 2-DOF pole placement controller and give controller design analysis with performance specification **06**

- (b) Why it is required to redefine good and bad polynomials during the pole placement controller design? **06**

Design a pole placement controller for plant transfer function $G(Z)=Z^{-1}\frac{0.0288+0.0265Z^{-1}}{1-1.7788Z^{-1}+0.7788Z^{-2}}$, sampling time T_s is chosen as 0.25 sec.

Required rise time is 3 sec and overshoot is not more than 5% for a step change in the command signal.

OR

- Q.5** (a) What is meant by internal stability? Discuss it. How internal stability ensures controller realizability? Suppose we want the closed loop transfer function $T=Z^{-1}\frac{1}{1-aZ^{-1}}$ for plant $G=Z^{-2}\frac{1}{1-0.5Z^{-1}}$. Find out controller T.F. Is it realizable? **06**

(b) Discuss the open loop and closed loop methods of Auto tuning of PID controller. Draw the flow chart for implementation of online digital controller. **06**
