Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.TECH. (CHEMICAL ENGINEERING)

MAKE-UP EXAMINATIONS, DEC/JAN 2016

SUBJECT: ADVANCED PROCESS DYNAMICS AND CONTROL [CHE-443]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Missing data may be suitable assumed.

1A.	Explain the working principle of cascade control strategy with an example.	**08**
1B.	Distinguish between Feedback control and Feedforward control schemes with suitable example.	**08**
1C.	Why do you think the performance of the smith predictor scheme will be sensitive to the modelling errors?	**04**
2A.	The characteristic equation for a certain closed loop digital control system is given as: $1+0.4z^{-1}-0.2z^{-2}-0.4z^{-3}-0.5z^{-4}=0$ Using Jury's method determine whether this system is stable or not.	**10**
2B.	Consider an ARMA model of the form $y(k)=-ay(k-1)+e(k)+ce(k-1)$ Which equivalent to $y(k)=H(q)e(k)=\frac{1+cq^{-1}}{1+aq^{-1}}e(k)$ e(k) is a sequence of independent normal random variables. Develop one step ahead predictor $\hat{y}(k+1\mid k)$, which uses only the current and the past measurements of y.	**06**
2C.	Solve the following difference equation using z-transform method. $y(k+2)+3y(k+1)+2y(k)=0;$ $\text{Given,}\quad y(0)=0; y(1)=1.$ Obtain y(k) series for k=0,1,2,3,4.	**04**
3A.	Derive the parameter estimation problem for given model structure shown below. $y_1(k)=\frac{b_1}{q+a_1}u_1(k)+\frac{b_2q+b_3}{q2+a_2q+a_3}u_2(k)$ You are expected to demonstrate all the steps involved.in the estimation problem.	**10**
3B.	Explain the detailed procedure of designing de-coupler for 2x2 system. You are expected to show the block diagram of 2x2 system with decoupler.	**10**

4A	The transfer function for a 2x2 subsystem extracted from the 3x3 model for an industrial de-ethanizer is as follows: $G(s)=\begin{bmatrix} \dfrac{1.318e^{-2.5s}}{20s+1} & \dfrac{-e^{-4s}}{3s} \\ \dfrac{0.038(182s+1)}{(20s+1)(10s+1)(6.5s+1)} & \dfrac{0.36}{s} \end{bmatrix}$ Obtain the RGA for this system and use it to recommend loop pairing.	**08**
4B	Find the Z-transform of the a) unit step function i.e., $x(t)=\begin{cases} 1.(t) & 0 \le t \\ 0. & t<0 \end{cases}$ b) Unit Ramp function i.e., $x(t)=\begin{cases} t, & 0 \le t \\ 0. & t<0 \end{cases}$	**06**
4C	Discuss the different condition for stability of linear continuous time state space model.	**06**
5A.	Consider the following system $x(k+1)=\begin{bmatrix} 1/2 & 1/4 \\ -1/2 & 0 \end{bmatrix}x(k)+\begin{bmatrix} -2 \\ 1 \end{bmatrix}u(k)+w(k);\;\; y(k)=\begin{bmatrix} 1 & 0 \end{bmatrix}x(k)+v(k)$ It is desired to develop a state feed feedback control law of the form $u(k)=-Gx(k)$. Find the matrix 'G' such that the poles of $(\Phi-\Gamma K)$ are placed at $\lambda=-0.3\pm j0.3$	**12**
5B.	Discuss the Controllability and Observability concept in general terms and how is obtained from model equations	**08**
6A.	Consider fourth order system as $y(k)=\; G(q)u(k)=\; \dfrac{b_1q^2+b_2q+b_3}{q^4+a_1q^3+a_2q^2+a_3q+a_4}u(k)$, Obtain the state space realization (controllable canonical) of the form $x(k+1)=\Phi x(k)+\Gamma u(k)$ $y(k)=Cx(k)$ Such that, $C\left[qI-\Phi\right]^{-1}=G(q)$.	**06**
6B.	Develop a parameter estimation problem for Impulse response model of the form, $y(k+1)=y(0)+\sum_{i=1}^{N}h_iu(k-i+1)$ Where h_i-Impulse coefficients	**08**
6C.	Discuss the working principle of model predictive control with state estimator	**06**

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