Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: ADVANCED PROCESS DYNAMICS AND CONTROL [CHE 443]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

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

1A.	Design a controller incorporating a smith predictor for a time delay process.	**08**
1B.	Why do you think the performance of the smith predictor scheme will be sensitive to the modelling errors?	**04**
1C.	Discuss the different adaptive control strategy.	**08**
2A.	How can the RGA be obtained and used for loop pairing in the absence of process models.	**06**
2B.	The transfer function for a 2x2 subsystem extracted from the 3x3 model for an industrial de-ethanizer is as follows: $G(s)=\begin{bmatrix} \frac{1.318e^{-2.5s}}{20s+1} & \frac{-e^{-4s}}{3s} \\ \frac{0.038(182s+1)}{(20s+1)(10s+1)(6.5s+1)} & \frac{0.36}{s} \end{bmatrix}$ Obtain the RGA for this system and use it to recommend loop pairing.	**08**
2C.	Explain the detailed procedure of designing de-coupler for 2x2 system. You are expected to show the block diagram of 2x2 system with decoupler.	**06**

3A.	Consider the following system $x(k+1)=\begin{bmatrix}1/2 & 1/2\\ -1/2 & 1/2\end{bmatrix}x(k)+\begin{bmatrix}-2\\ 2\end{bmatrix}u(k)+w(k)$ $y(k)=\begin{bmatrix}1 & 0\end{bmatrix}x(k)+v(k)$ It is desired to develop a state feed feedback control law of the form $u(k)=-Kx(k)$ Find the matrix 'K' such that the poles of $(\Phi-\Gamma K)$ are placed at $\lambda=0.25\pm0.25j$	**12**
3B.	First order system expressed using a difference equation is as follows, $y(k+)+a_1y(k-1)=b_1u(k-1)$ Develop its pulse transfer function and Calculate the response (y(k), k=0,1,2,3,4) for unit step input (Given a_1=-0.368 and b_1=1.264) using z-transform	**08**
4A.	Define a Final value and Initial value theorem of Z-transform. And find the value of y(0) if the z-transform of y(k) is given as $Y(z)=\frac{(1-e^{-T})z^{-1}}{(1-z^{-1})(1-e^{-T}z^{-1})}$	**04**
4B.	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.	**08**
4C.	Solve the following difference equation using z-transform method. $y(k+2)+3y(k+1)+2y(k)=0;$ Given, $y(0)=0; y(1)=1.$ Obtain y(k) series for k=0,1,2,3, ……	**08**
5A.	The characteristic equation for a certain closed loop digital control system is given as: $1+0.3z^{-1}-0.5z^{-2}-0.5z^{-3}+0.32z^{-4}=0$ Using Jury's method determine whether this system is stable or not.	**12**

5B.	Consider FIR model of the form $y(k) = h_1 u(k-1) + ... + h_N u(k-N) + v(k)$ Show that least square estimates of impulse response coefficients are given by equation $\hat{\theta} = \left[\varphi(k)\varphi(k)^T \right]^{-1} \varphi(k) y(k)$ Where $\varphi(k) = [u(k-1).....u(k-N)]^T$ $\hat{\theta} = [\hat{h}_1.....\hat{h}_N]^T$.	**08**
6A.	Consider fourth order system as $y(k) = G(q)u(k) = \frac{b_1 q^3 + b_2 q^2 + b_3 q + b_4}{q^4 + a_1 q^3 + a_2 q^2 + a_3 q + a_4}$, 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, $C\left[qI - \Phi\right]^{-1} = G(q)$.	**08**
6B.	Distinguish between an open loop observer and Luenberger observer.	**06**
6C.	Discuss the working principle of model predictive control strategy.	**06**