Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

VII SEMESTER B.TECH (CHEMICAL ENGINEERING)

MAKE UP EXAMINATIONS, 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 suitably assumed.

1A	Distinguish between Feedback control and Feedforward control schemes with suitable example	**08**
1B.	Discuss the Cascade control strategy with an example.	**06**
1C.	Explain the application of soft sensor in process industry with an example.	**06**
2A.	How can the RGA be obtained and used for loop pairing in the presence of process models.	**06**
2B.	The following incomplete RGA was determined experimentally (after very long and tedious experiments) for a 4x4 system with outputs y_1,y_2,y_3,y_4 to be paired with the inputs m_1,m_2,m_3,and m_4. What input/output pairing is recommended? $\begin{bmatrix} ? & 0.15 & ? & -0.09 \\ -0.01 & ? & 0.29 & 1.15 \\ ? & 3.31 & 0.27 & ? \\ 0.22 & ? & ? & 1.84 \end{bmatrix}$ Obtain the RGA for this system and use it to recommend loop pairing.	**06**
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.	**08**
3A	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., $x(t)=\begin{cases}t, & 0\le t\\ 0. & t<0\end{cases}$	**08**

3B.	Consider the following system $x(k+1)=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -10 & -10\end{bmatrix}x(k)+\begin{bmatrix}0\\0\\2\end{bmatrix}u(k)+w(k)$ $y(k)=\begin{bmatrix}1 & 0 & 0\end{bmatrix}x(k)+v(k)$ 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 $s_{1,2}=-3\pm 4j;\ s_3=-10$	**12**
4A.	Find y(k) for k=0,1,2,3,4 when y(z) is given by, $y(z)=\dfrac{10z^{-1}+10z^{-2}}{1-1.5z^{-1}+5z^{-2}+z^{-3}}$	**10**
4B.	Consider AR model of the form $v(k)=\dfrac{1}{(1-0.5q^{-1})(1-0.25q^{-1})}e(k)$ Using long division, convert the model into moving average(MA) form	**10**
5A.	Develop a parameter estimation problem for Impulse response model of the form, $y(k+1)=y(0)+\sum_{i=1}^{N}h_i u(k-i+1)$ Where h_i-Impulse coefficients	**08**
5B.	The characteristic equation for a certain closed loop digital control system is given as: $1+0.4z^{-1}-0.69z^{-2}-0.256z^{-3}+0.032z^{-4}=0$ Using Jury's method determine whether this system is stable or not.	**12**
6A.	Distinguish between grey box and black box model with an example	**04**
6B.	Consider fourth order system as $y(k)=G(q)u(k)=\dfrac{b_1q^2+b_2q+b_3}{q^3+a_1q^2+a_2q+a_3}$, 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**
6C.	Discuss the Controllability and Observability concept in general terms and how is obtained from model equations.	**08**