Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

I SEMESTER M.TECH. (CHEMICAL ENGINEERING)

MAKE UP EXAMINATIONS, DECEMBER 2017

SUBJECT: Advanced Process Dynamics & Control [CHE5104]

REVISED CREDIT SYSTEM

Time: 3 Hours Date of Examination: 28/12/2017 MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A.	Describe the various adaptive control strategies with neat block diagram.	**4**
1B.	Explain the concept of cascade control strategies with example and discuss the stability of the same.	**4**
1C	Discuss the different conditions for stability of linear continuous time state space model.	**2**
2A.	Explain the procedure to obtain a RGA to be used for loop pairing in the absence of process models.	**6**
2B.	Define a Final value and Initial value theorem of Z-transform. And find the value of y(∞) if the z-transform of y(k) is given as $$Y(z)=\frac{(1-e^{-T})z^{-1}}{(1-z^{-1})(1-e^{-T}z^{-1})}$$	**4**
3A	The characteristic equation for a certain closed loop digital control system is given as: $$1+0.2z^{-1}-0.2z^{-2}-0.2z^{-3}+0.5z^{-4}=0$$ Using Jury's method determine whether this system is stable or not.	**04**
3B.	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**
3C	Why do you think the performance of the smith predictor scheme will be sensitive to the modelling errors?	**02**
4A	Consider second order ARX model with delay=2 $$y(k)+a_1y(k-1)+a_2y(k-2)=b_1u(k-3)+b_2u(k-4)+e(k)$$ Develop a parameter estimation problem and present the solution to the above through least square optimization. You are expected to demonstrate all the steps.	**04**

4B	Consider the following system $$x(k+1)=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -15 & -10\end{bmatrix}x(k)+\begin{bmatrix}0\\0\\2\end{bmatrix}u(k)$$ $$y(k)=\begin{bmatrix}1 & 0 & 0\end{bmatrix}x(k)+v(k)$$ 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 $(\Phi-\Gamma\mathrm{K})$ are placed at $s_{1,2}=-2\pm 4j;\ s_3=-15$	**06**
5A	Discuss the Controllability and Observability concept in general terms and how is obtained from model equations. Consider a discrete time system as $$\begin{bmatrix}x_1(k+1)\\ x_2(k=1)\end{bmatrix}=\begin{bmatrix}1/2 & 1\\ -1/2 & 0\end{bmatrix}\begin{bmatrix}x_1(k)\\ x_2(k)\end{bmatrix}+\begin{bmatrix}1\\ -2\end{bmatrix}u(k)\ ;\ y(k)=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1(k)\\ x_2(k)\end{bmatrix}+v(k)$$ Is this system observable?	**04**
5B	Discuss the Kalman filter algorithm.	**04**
5C	Explain the application of soft sensor in process industry with an example.	**02**

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