**VII SEMESTER B.TECH (CHEMICAL ENGINEERING)**

**END SEMESTER EXAMINATIONS, MAY 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.

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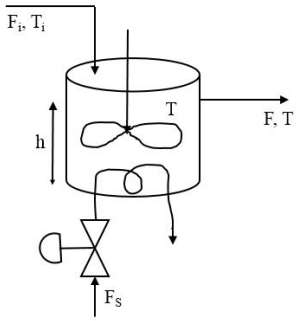
| **1A** | With a neat sketch explain the components of feedback control system. State roles of each component | **08** |
| **1B** | Design a dynamic feedforward controller for continuous stirred tank heater as shown below (see Figure 6C). The control objective is to keep the exit temperature (T) at desired value by regulating steam flow (i.e. Fs) for changes in an inlet temperature of the feed ($T_i$). Assume that level in the tank remain constant. State all the assumptions made.<br>  <br><br>Figure: 1B | **12** |
| **2A.** | Discuss the different adaptive control strategy. | **10** |
| **2B.** | Discuss the ratio control and auctioneering control strategy with an example. | **10** |
| **3A.** | Discuss systematic approach to develop RGA in the presence of process models. | **12** |
| **3B.** | The transfer function for a 2x2 subsystem extracted from the 4x4 model for an industrial distillation column is as follows:<br>$G(s) = \begin{bmatrix} \frac{1.318}{20s+1} & \frac{-e^{-4s}}{3s} \\ \frac{0.038}{(20s+1)(10s+1)(6.5s+1)} & \frac{0.36}{s} \end{bmatrix}$<br>Obtain the RGA for this system and use it to recommend loop pairing. | **08** |
| **4A.** | Explain the detailed procedure of designing a de-coupler for 2x2 system. You are expected to show the block diagram of 2x2 system with decoupler. | **08** |

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| **4B.** | Consider the following system<br>$$x(k+1)=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -5 & -5\end{bmatrix}x(k)+\begin{bmatrix}0\\ 0\\ 2\end{bmatrix}u(k)+w(k)$$<br>$$y(k)=\begin{bmatrix}1 & 0 & 0\end{bmatrix}x(k)+v(k)$$<br>It is desired to develop a state feed feedback control law of the form $u(k)=-Kx(k)$<br>Find the matrix '*K*' such that the poles of $(\Phi-\Gamma K)$ are placed at $s_{1,2}=-2\pm 4j;\ s_3=-5$ | **12** |
| **5A** | Define a Final value and Initial value theorem of Z-transform. | **06** |
| **5B** | The characteristic equation for a certain closed loop digital control system is given as:<br>$$1+0.4z^{-1}-0.69z^{-2}-0.256z^{-3}+0.032z^{-4}=0$$<br>Using Jury's method determine whether this system is stable or not. | **14** |
| **6A** | Discuss the Controllability and Observability concept in general terms and how is obtained from model equations. | **10** |
| **6B** | Discuss the working principle of Luenberger observer | **10** |