Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

I SEMESTER M.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

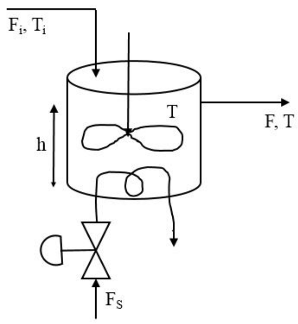
SUBJECT: **ADVANCED PROCESS DYNAMICS AND CONTROL [CHE 507]**

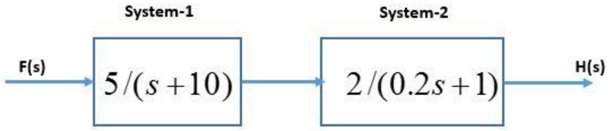
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

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

1A.	Explain the basic components of feedback control strategy.	**06**
1B.	Distinguish between Feedback control and Feedforward control schemes	**04**
1C.	Design a dynamic feedforward controller for continuous stirred tank heater as shown below. 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. Assume that level in the tank remain constant. State all the assumption made. 	**10**

2A	Draw a Bode plot for system connected in series is as follows: 	**12**
2B	Explain the different Adaptive control algorithm schemes.	**08**
3A	Design a controller incorporating a smith predictor for a time delay process.	**10**
3B.	Explain the procedure to obtain a RGA and to be used for loop pairing in the absence of process models.	**10**
4A.	Explain the detailed procedure of designing a de-coupler for 2x2 system. You are expected show the block diagram of 2x2 system with decoupler.	**08**
4B	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 $Y(z)=\dfrac{(1-e^{-T})z^{-1}}{(1-z^{-1})(1-e^{-T}z^{-1})}$	**06**
4C	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	**06**
5A	The dynamic model of Process is as follows, $M_1\dfrac{d^2x_1}{dt^2}+D\dfrac{dx_1}{dt}+K(x_1-x_2)=0$ $M_2\dfrac{d^2x_2}{dt^2}+K(x_2-x_1)=f(t)$ Obtain the state space model of the form, $\dot{x}=Ax(k)+Bu(k)$ $y=Cx(k)$	**08**

5B.	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 $(\Phi-\Gamma K)$ are placed at $$s_{1,2}=-2\pm 4j;\ s_3=-15$$	**12**
6A.	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.	**12**
6B.	Consider FIR model of the form $$y(k)=h_1u(k-1)+......+h_Nu(k-N)+v(k)$$ 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**