(b) A thermometer having a time constant of 10 second is placed in a temperature bath. After the thermometer reaches steady state temperature of 30ºC it is suddenly placed into a hot fluid at 60º. Sketch the response of the thermometer. **10**

7. (a) A unit step change is given to a PI controller. If the proportional sensitivity or gain K_C is 5, the integral time $\tau_1 = 2$, obtain the response of the PI controller. **10**

(b) Explain on-off control. Give the transfer function for P, PI and PID controller. **10**

8. Write short notes on any *three* of the following : **20**

(a) Linearization

(b) Valve Sizing

(c) Valve characteristics

(d) Valve Positioner.

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B. Tech. EXAMINATION, May 2017

(Seventh Semester)

(Old Scheme) (Re-appear Only)

(CHE)

CHE-403

PROCESS DYNAMICS & CONTROL

Time : 3 *Hours*] [*Maximum Marks :* 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt any *Five* questions. Make suitable assumptions wherever necessary. Assume any missing data.

1. (a) Discuss translation of function. **5**

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(b) Derive the Laplace transform of the following function : **5**

$$F(s) = \frac{s^2 + 2s + 3}{s^3 + 6s^2 + 12s + 8}$$

(c) Obtain the solution of the differential equation given below : **10**

$$\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = 12e^t$$

where, $x(0) = 0$, $x'(0) = 6$.

2. Discuss Ziegler-Nichols approach for controller tuning. Also write down the limitations of this method. **20**

3. (a) Derive expression for magnitude ratio and phase angle as function of ω for the transfer function : **10**

$$G(s) = \frac{0.2}{(1+s)(1+0.2s)}$$

(b) Derive the transfer function for Transportation Lag and sketch the Bode plot for it. **10**

4. The overall transfer function of the control system is given as : **20**

$$G(s) = \frac{25}{1.5s^2 + 2.4s + 6}$$

A step change of magnitude 6 is introduced into the system. Determine :

(i) Overshoot

(ii) Period of oscillation

(iii) Natural period of oscillation

(iv) Rise time

(v) Ultimate value of response

(vi) Maximum value of response.

5. (a) Discuss the theorems of the Routh test. **5**

(b) Plot the root-locus diagram for the open-loop transfer function : **15**

$$G(s) = \frac{4K_c(s + 0.25)}{s(s+1)(s+2)}$$

6. (a) Derive the transfer function for Mixing Tank. **10**

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