Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCCH 4304

Sixth Semester Regular Examination – 2014

PROCESS DYNAMICS AND CONTROL

BRANCH : CHEM

QUESTION CODE : F 213

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Define overshoot and ultimate period of oscillation.

   (b) Sketch the bode plot of a 1st order process.

   (c) Write the Bode stability criteria w.r.t. gain margin and phase margin.

   (d) What do you mean by tuning of controller ?

   (e) Write the Ziegler-Nichols controller setting of a PID controller.

   (f) What do you mean by transient response ?

   (g) If a step change of set point of magnitude 0.4 is introduced to the following open-loop transfer function, $G(s) = 1.2/3s^2 + 2s + 3$, find out the offset. Whether it is a servo problem or regulatory problem.

   (h) What is transportation lag ?

   (i) If R is resistance and C is capacitance, then time constant is given by _____ .

   (j) Write the function of sampling switch and hold element.

2. (a) Prove that U-tube manometer is a second order instrument. 8

   (b) Define time constant. 2

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3. (a) Sketch the actual Bode plot of control system having open-loop transfer function given as : $G_{(s)} = \frac{k_c(5s+1)e^{-2s}}{(2s+1)(s+1)}$. 8

(b) Define the terms : Gain margin and Phase margin. 2

4. (a) "For a first order system if a proportional controller is used it exhibit an offset." Justify the statement. 5

(b) Derive the step response equation of a first order system when a sinusoidal input of magnitude 1 is introduced. 5

5. The open-loop transfer function of a control system is given as : 10

$G(s) = K_C/s(s+1)(s+2)$

Draw the Root Locus diagram of the control system. Determine the gain of the controller K_C for which the system becomes just unstable. 10

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6. With the help of process reaction curve method find the controller setting of PI controller if the open-loop transfer function is given as : $\frac{1}{(s+1)^4}$. Solve this problem analytically. 10

7. (a) Draw the cascade control configuration of a jacketed kettle. Draw the corresponding block diagram indicating primary and secondary controller. 5

(b) What is Smith predictor ? How is it used to reduce the effect of transportation lag parameter for the control system ? 5

8. Write short notes on any **two** : 5×2

(a) Frequency response analysis

(b) Routh-Hurwitz method

(c) Internal model controller

(d) Valve sizing.