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10BT61

**Sixth Semester B.E. Degree Examination, Dec.2017/Jan.2018**

**Bioprocess & Automation**

Time: 3 hrs.

Max. Marks:100

**Note: Answer FIVE full questions, selecting at least TWO questions from each part.**

**PART – A**

- 1 a. With a neat sketch, discuss on the working principle of different instruments used to measure pressure and temperature taking an example. (12 Marks)
- b. Define process control. Describe the characterization of sensors in relation to the application for process control. (08 Marks)
- 2 a. With reference to the liquid level system, derive the first order lag function equation. (10 Marks)
- b. A mercury thermometer having a time constant of 0.1 min is placed in a temperature bath at 100°F and allowed to come to equilibrium with the bath. At time  $t = 0$ , the temperature of the bath begins to vary sinusoidally about its average temperature of 100°F with an amplitude of 2°F. If the frequency of oscillation is  $\frac{10}{\pi}$  cycles/min, what is the phase lag? (10 Marks)
- 3 a. Two non interacting tanks are connected in series as shown in Fig. Q3 (a). The time constants are  $\tau_2 = 1$  and  $\tau_1 = 0.5$ ,  $R_2 = 1$ . Sketch the response of the level in tank 2 if a unit step change is made in the inlet flow rate to tank 1. (10 Marks)

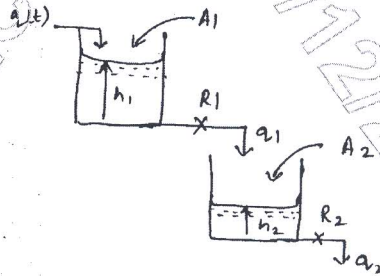


Fig. Q3 (a)

- b. Derive an equation for the transfer function for an interacting system. (10 Marks)
- 4 a. State your point of view on the following: (i) Linearization (ii) Transportation lag. (12 Marks)
- b. What are the characteristics of under damped system? Explain. (08 Marks)

**PART – B**

- 5 a. What do you understand by final control element? A pneumatic proportional controller is used to control temperature within the range of 60 - 100°F. The controller is adjusted so that the operating pressure goes from 3 psi (value fully open) to 15 psi (value fully closed) as the measured temperature goes for 71 to 75°F with set point held constant. Find gain and band. (08 Marks)
- b. Sketch and explain the principle of P, PI and PID controllers and obtain transfer functions. (12 Marks)

- 6 a. Derive an expression for servo mechanism control problem for negative feedback system. (10 Marks)
- b. Determine the overall transfer function  $\frac{C(s)}{R(s)}$  for the system as show in Fig. Q6 (b): (10 Marks)

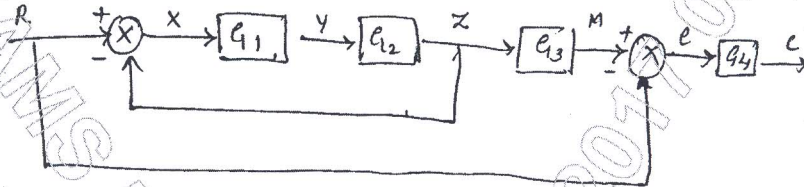


Fig. Q6 (b)

- 7 a. Explain the criteria for the stability for linear system. (06 Marks)
- b. Find out stability of the system for the characteristic equation:  
 $3s^4 + 10s^3 + 5s^2 + 5s + 2 = 0$  (04 Marks)

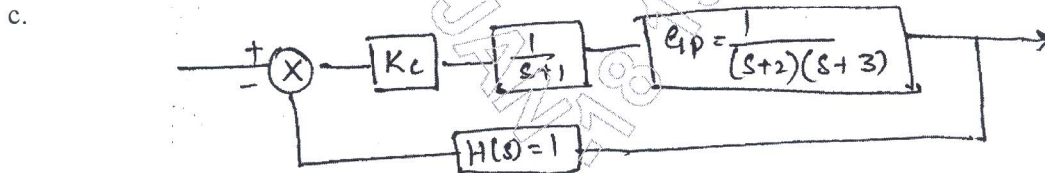


Fig. Q7 (c)

- Find : (i) Characteristic equation.  
 (ii) Determine the value of  $K_c$  for which control system is stable.  
 (iii) For which value of  $K_c$  the control system is on the threshold of stability. (10 Marks)
- 8 a. Discuss flow injection analysis for measurement of substrate. (10 Marks)
- b. What do you mean by sterilization? Explain the different ways of sterilization in a bioreactor. (10 Marks)

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