Exam Date & Time: 18-Jun-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH END SEMESTER MAKEUP EXAMINATIONS, JUNE 2024

BIOPROCESS CONTROL AND INSTRUMENTATION [BIO 3252]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) What are the different physical, chemical and biological parameters measured in bioreactor? (3)

A)

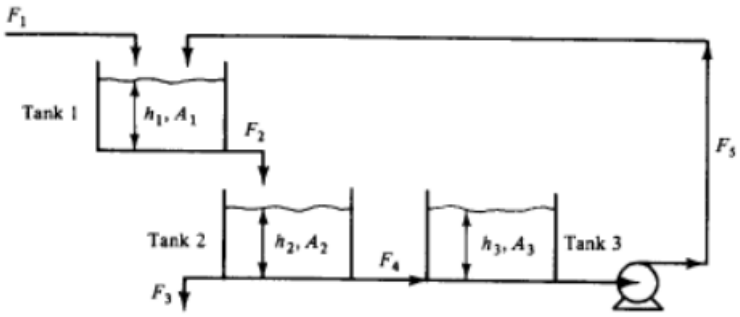
B) What are the advantages and disadvantages of using feedback systems in industrial processes? (3)

C) What are the basic requirements of a sensor or transducer and briefly explain them. (4)

2) Using partial fraction expansion, find x(t) for $X(s) = \frac{(s+1)}{(s+2)(s+3)(s^2+4)}$ (3)

A)

B) Develop the mathematical model for the system shown in Figure. What are the state variables for this system. All the flowrates are volumetric. A_1, A_2 and A_3 are cross sectional area of tanks. The flow rate F_5 is constant and does not depend on h_3, while all other effluent flow rates are proportional to the corresponding hydrostatic liquid pressures that cause the flow **($F_2=R_1*h_1$; $F_3=R_2*h_2$; $F_4=R_3*(h_2-h_3)$).**



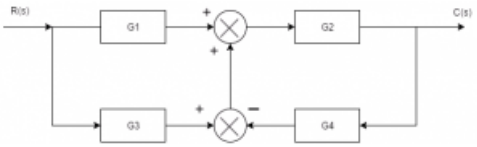
(4)

C) Let c(t) be the unit step response of a system with transfer function K(s+a)/(s+K). If c(0+) = 2 and c(∞) = 10, then find the values of a and K. (3)

3) Briefly explain the overshoot, decay ratio, rise time and response time with a neat diagram. (4)

A)

B) For the block diagram given in the following figure, find the expression of C/R. (3)

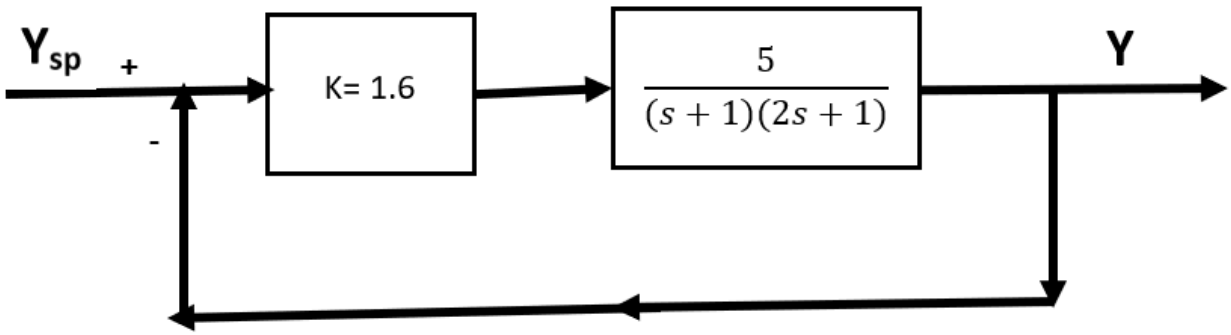


C) What are the relative advantages and disadvantages of the proportional, integral, and derivative control actions? (3)

4) What are the 3 categories, where the second order or higher dynamics can arise from several physical situations. (2)

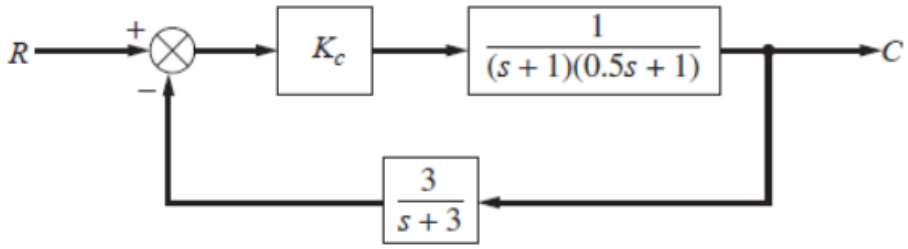
A)

B) The setpoint of the control system in figure given a step change of 0.1 unit. Determine



(4)

C) Write the characteristic equation and construct the Routh array for the control system shown in below figure. Is the system stable for (a) Kc = 9.5, (b) 12?

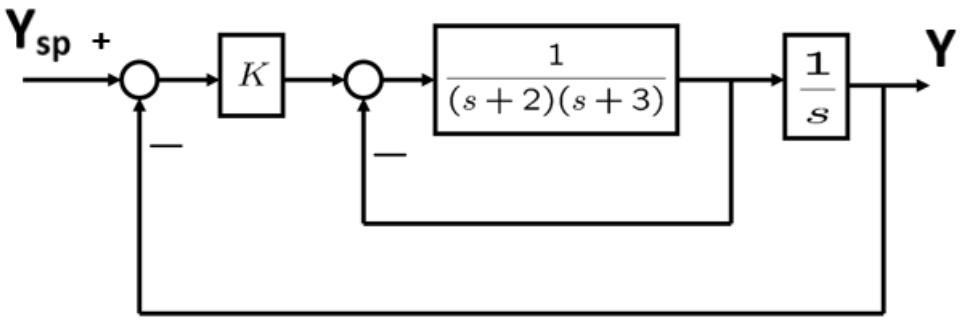


(4)

5) Briefly explain the steps involved to find the tuning parameters using continuous cycling method. (3)

A)

B) Determine the range of K that stabilizes the below closed loop system



(4)

C) Briefly explain the trouble shooting of common control loops. (3)

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