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National Institute of Technology Hamirpur, Hamirpur (HP)

Name of Examination: B.Tech, End Semester Theory Examination, December-2022

Branch:	**Electrical Engineering**	**Semester :**	**VIIth**
Course Name:	**Process Modeling and Control**	**Course Code :**	**EE-433**
Time: 3:00 Hours		**Maximum Marks: 50**	

Note: All questions are Compulsory. Assume suitable value for any missing information.

Question 1: **(5+5=10)**

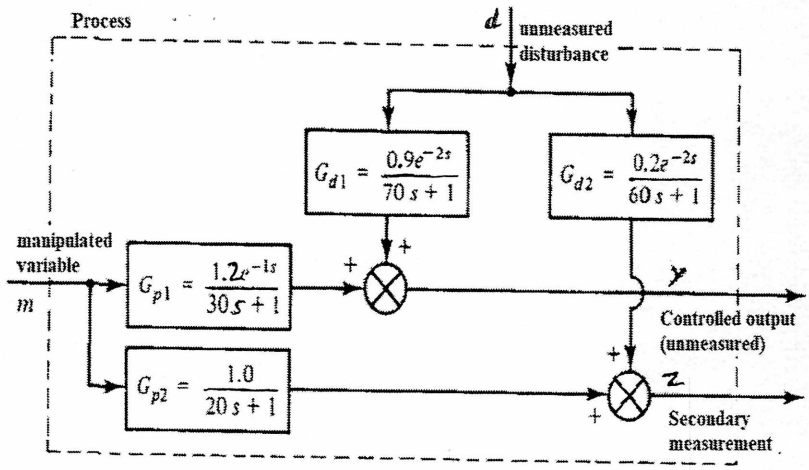
(a) Discuss the various difficulties and requirements of process control implementation.

(b) Explain servo and regulatory control operations with an example. Also explain the importance of modeling and simulation with suitable example.

Question 2: **(5+5+5=15)**

(a) Differentiate between conventional and adaptive control. Classify the adaptive control techniques and explain model reference adaptive control technique with suitable diagram.

(b) A process can be represented as integrating element and a first order element in cascade, having all characterizing parameters as unity. It is controlled by a PD controller having a proportional gain K and derivative time as (15/K) sec. All other transfer function in the closed loop has unity. Input to the process is summation of disturbance D(s) and output of controller. Output of the process is Y(s) and R(s) is the reference input. (i) Draw the process control loop, (ii) Express Y(s) in terms of R(s) and D(s), (iii) Find static error and offset for K= 30, (iv) If the process control loop also has a delayed first order measuring element (lag of 0.2 sec) with all characterizing parameters are unity, find the parameters of PID controller using ZN tuning method. Use first order Pade's approximation.

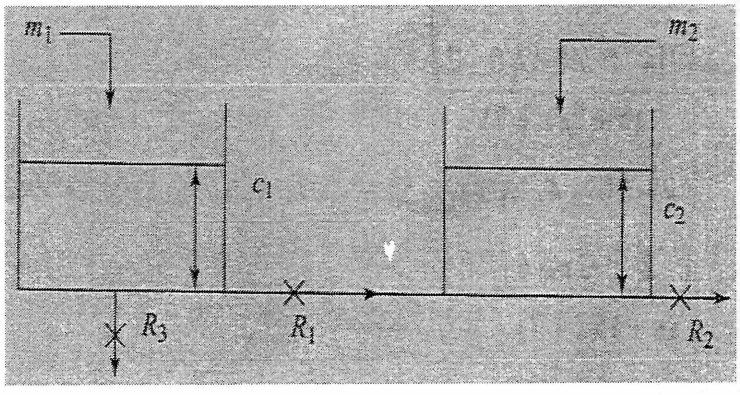


(c) What is the need of inferential control in process industry. Consider a process as shown in figure right side. Design the inferential control architecture for the given process.

Question 3: **(5+5+5=15)**

(a) For the process described by $y_1 = \left(\frac{5}{s+1}\right)m_1 + \left(\frac{2}{s+1}\right)m_2$ and $y_2 = \left(\frac{3}{s+1}\right)m_1 + \left(\frac{8}{s+1}\right)m_2$, Find the relative gain λ_{11}, and comment upon the pairing. If cross controllers are needed, then design those, and find C_1/R_1 and C_2/R_2 for a completely decoupled system. The primary controllers have gains K_1 and K_2 respectively. All other elements have unity transfer function.

(b) Figure shown right side is a two interacting tanks with areas A_1=1m^2 and A_2=0.5m^2 with m_1 flowing in tank 1 and m_2 flowing in tank 2, and resistances are R_1=0.5 sec/m^2, R_2= 2 sec/m^2 and R_3=1 sec/m^2. Identify the process elements G_{11}, G_{12}, G_{21} and G_{22}. Also find the relative gains λ_{11}, λ_{12}, λ_{21}, and λ_{22}, and comment upon the possible pairing.



(c) What is decoupler. Also, explain the interaction of control loops in a stirred tank heater with suitable diagram.

Question 4: **(5+5=10)**

(a) What is the role of computer in industrial process control system? Discuss the types and characteristics of the real time control system.

(b) Explain distributed process control system, and also discuss its advantages over supervisory control.