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M. TECH. DEGREE EXAMINATIONS: MAY 2009

Third Semester

BIOTECHNOLOGY

P07BTE31 Bioprocess Modeling and Simulation

Time: Three Hours **Maximum marks: 100**

Answer ALL Questions:-

PART A (10 x 2 = 20 Marks)

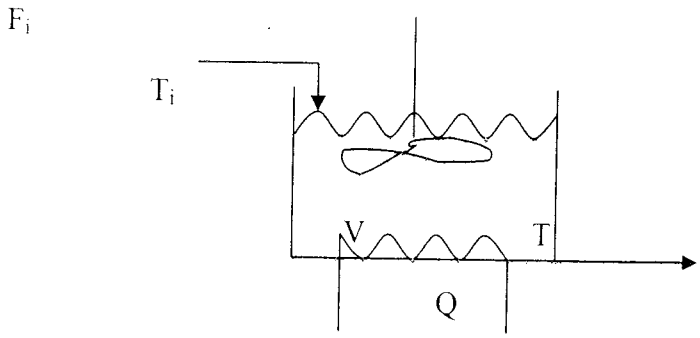
1. What is the concept of 'fail-safe'?
2. What is actuator?
3. What is the use of Taylor series approximation?
4. What is a damping factor?
5. Define Rise time and overshoot.
6. What are common responses of process outputs to step changes in process inputs?
7. What is a Z-transform?
8. Differentiate between on/off controller and P-I controller.
9. Define poles and zeros.
10. What are the major objectives for developing a dynamic process model?

PART B (5 x 16 = 80 Marks)

11. a). Explain in detail to linearize nonlinear models for control systems design and analysis purposes (Taylor series approximation and generalization). (16)

(OR)

b) Consider a perfectly mixed stirred tank heater with a single feed stream and a single product stream as shown. Assuming that the flow rate and temperature of the inlet stream can vary that the tank is perfectly insulated and that the rate of heat added per unit time Q can vary. Develop a model to find the tank liquid temperature as a function of time.



12. a) (i) Write the Routh Stability Criterion theorem and determine the stability by routh criterion for the characteristic equation $s^4+3s^3+5s^2+4s+2 = 0$ (10)

(ii) Find the long term and short term behavior of the time domain function y (t) using the final and initial value theorems on the laplace domain function

$$Y(s) = 4/s\ (2s+1)\ (3s+1)$$ (6)

(OR)

b) (i) Discuss in detail about the general linear state space models and stability. (8)

(ii) Find the Eigen values of (1) $A = \begin{Bmatrix} 1 & -1 \\ 1 & 3 \end{Bmatrix}$

(2) $A = \begin{Bmatrix} 3 & 2 & 2 \\ 1 & 4 & 1 \\ -2 & -4 & -1 \end{Bmatrix}$ (8)

13. a) Explain the following

(i) Lead - lag Behavior

(ii) Poles and Zeros

(iii) Dead time

(iv) Pade approximation (4x4)

(OR)

b) (i) Define transfer function and explain the properties of transfer function. (8)

(ii) Explain the steps to convert general state space model to transfer function form. (8)

14. a) (i) Explain the general form of discrete model for the Discrete-time models. (8)

(ii) Explain the Poles/zeros of discrete models with example and the initial and final value theorem for discrete systems. (8)

(OR)

b) (i) Explain about the Lorenz equation and stability analysis (8)

(ii) Explain about the cob web diagram and Bifurcation. (8)

15 a) Develop the material & energy balances, dynamic model, steady state condition, state space models for isothermal CSTR.

(OR)

b) Develop the material balance, model, steady state and dynamic behavior and linear analysis Adsorption.

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