

THAPAR INSTITUTE OF ENGINEERING & TECHNOLOGY  
(DEEMED UNIVERSITY), PATIALA  
END SEMESTER EXAMINATION

Subject: IN-002, Process Modeling & Control (M.E. (EIC))

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Course Faculty: Dr. Yaduvir Singh

Maxm. Time: Three Hours

Maxm. Marks: 45

Note: Attempt any five (05) questions. Support your answers with the practical control cases, if applicable. Make suitable assumptions, if required.

Q. No. 1

- (a) What is real time control? Give complete instrumentation in the case of an industrial real time control system, as an example.
- (b) Obtain a generalized expression for Z-transform of time function  $f(t) = t^{k-1}; t > 0$ .  
( 4.5 X 2=9.0 marks )

Q. No. 2

- (a) Define various terms involved in state space modeling.
- (b) What is an integrating process? Mention an example, and with the help of mathematical derivations, prove that it is an integrating process.  
( 4.5 X 2=9.0 marks )

Q. No. 3

For a heated mixing tank, derive and obtain, the two most relevant state space equations. Suitably assume various parameters, inputs, initial conditions etc., and their notations.  
( 9.0 marks )

Q. No. 4

- (a) Obtain Laplace transform of time domain function  $(t^n / n!) e^{-at}$ .
- (b) Define controllability and observability. Explain their role and importance in control system analysis.  
( 4.5 X 2=9.0 marks )

Q. No. 5

Obtain (derive and plot) unit step time response for a process having overall transfer function given as  $(e^{-10s}) / (5s+1)$ .  
( 9.0 marks )

Q. No. 6

- (a) Differentiate Fourier Series and Fourier Transform. Mention their individual importance in engineering system analysis. If both can be mutually related, derive and obtain their relationship.
- (b) Explain second method of Liapunov Stability.

OR

List and define various properties of Petri Nets.

( 4.5 X 2=9.0 marks )

Q. No. 7

- (a) Consider a second order unity feedback process having an open loop transfer function given as below.

$$G(s) = 1 / [(2s+1)(3s+1)]$$

- (b) Elaborate the following.
  - (i) Self-tuning regulators
  - (ii) Model reference adaptive controllers
  - (iii) RGA

( 4.5+ 1.5 X 3=9.0 marks )