



Name :
Roll No. :
Invigilator's Signature :

CS/M.TECH (CHE)/SEM-1/CHE-02/2010-11

2010-11

ADVANCED PROCESS CONTROL

Time Allotted : 3 Hours

Full Marks : 70

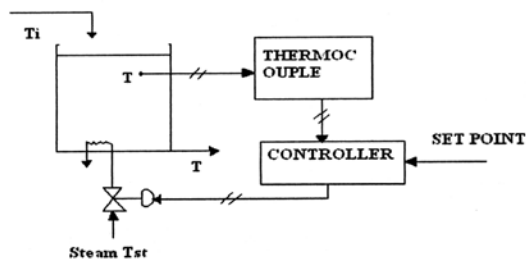
*The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words
as far as practicable.*

Answer any *five* questions taking at least one from each Group.

5 × 14 = 70

GROUP - A

1. a) What do you mean by servo problem and regulator problem ?
- b) Develop the block diagram and also find out the closed loop temperature response of a tank heater given below :



3 + 3 + 8

2. a) What do you mean by an ideal sampler ? Draw typical input-output waveforms of an ideal sampler.

40510

[Turn over



- b) For an ideal sampling operation, show that

$$F(s)^* = \sum_{k=0}^{\infty} f(kT)e^{-kTs}$$

where $k = 0, 1, 2, \dots$

T is the sampling period

and s is the Laplace operator.

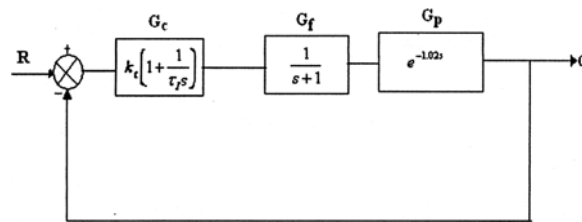
- c) Perform inverse z -transformation by Partial - Fraction Expansion.

$$\hat{y}(z) = \frac{z}{z^2 - 4z + 3}$$

3 + 5 + 6

GROUP - B

3. a) What is "Bode Stability Criterion" ?
 b) For an open loop transfer function $G_{OL} = \frac{k_c e^{-0.1s}}{0.5s + 1}$, determine crossing over frequency using the above criterion.
 c) For tuning of a controller, explain Ziegler - Nichols rule.
 d) Again from the diagram given below determine the values for k_c and τ_I using the above tuning rule.



$2 \frac{1}{2} + 4 + 2 \frac{1}{2} + 5$



4. a) What do you understand by controller tuning ?
- b) Discuss how you will compensate the effect of inverse response origination from the conflict of two first order systems with opposing effects.
- c) State the basic areas where selective control systems are employed.
- d) Explain the use of split range control in a chemical reactor where a gas phase reaction is taking place.

2 + 6 + 2 + 4

GROUP - C

5. a) What do you mean by gain scheduling control ?
- b) Discuss the logic of an inferential control scheme.
- c) Why is this control scheme needed ?
- d) How is inferential control used in a distillation column ?
- e) What does the term 'estimator' means ?

3 + 2 + 2 + 6 + 1

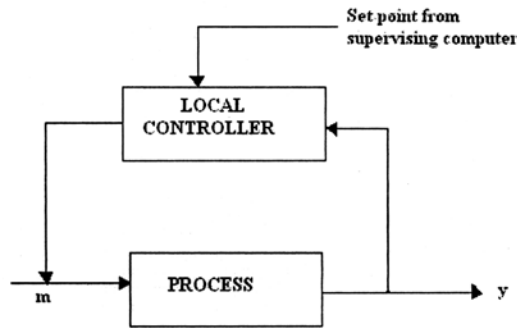
6. a) Determine the number of controlled and manipulated variables for a flash drum.
- b) What is meant by decoupling of two control loops ?
- c) What is one-way decoupling of two control loops ?

5 + 5 + 4



GROUP - D

7. a) Elaborate the effect of feed-effluent heat exchange on reactor control.
- b) Discuss how poor process designs lead to control problems in case of a vaporizer.
- c) What do you mean by safe operation of a plant ?
- 5 + 5 + 4
8. a) Explain the application of supervisory control in case of single loop system given below :



- b) Discuss the discrete time response of a digital PID controller.
- 7 + 7