



Name :

Roll No. :

Invigilator's Signature :

CS / B.TECH (EIE-NEW) / SEM-7 / EI-702 / 2010-11

2010-11

PROCESS CONTROL-II

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.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

- i) A real sampler when sampling an analog signal acts as an / a
- a) impulse modulator
 - b) pulse amplitude modulator
 - c) pulse width modulator
 - d) pulse code modulator.
- ii) The output of a closed-loop sampled-data system is given by $y(z) = \frac{z(z + 0.2)}{(z - 0.2)(z - 1)}$. The steady-state output is
- a) 0
 - b) 1.25
 - c) 1.5
 - d) infinite.



- iii) The minimum sampling interval required to avoid aliasing for the analog signal

$$x(t) = 5 \sin(200\pi)t + 3 \cos(100\pi)t \text{ is}$$

- a) 10 msec b) 5 msec
c) 2.5 sec d) 20 sec.
- iv) pH control is
- a) linear b) non-linear
c) both (a) and (b) d) none of these.
- v) Fuzzy concept applies to the imprecision in
- a) calculation b) logic
c) data d) none of these.
- vi) To start reconstructing the continuous-time counterpart from its sampled values, the number of past values required for an n -th order hold device is
- a) $n - 2$ b) $n - 1$
c) n d) $n + 1$.
- vii) The selection of sampling rates can be based on the bandwidth of the closed-loop
- a) 40 to 50 times of bandwidth
b) 10 to 30 times of bandwidth
c) 50 to 60 times of bandwidth
d) 1 to 10 times of bandwidth.



viii) OCS is developed using

- a) component based design
- b) structural based design
- c) control based design
- d) communication based design.

ix) Ideal sampler output for a continuous signal $f(t)$, for a sampling period T can be represented as

a) $f^*(t) = \sum_{k=0}^{\infty} f(KT) \delta_T(KT)$

b) $f^*(t) = \sum_{k=0}^{\infty} f(kt)$

c) $f^*(t) = \sum_{k=0}^{\infty} f(KT) \delta_T(t - KT)$

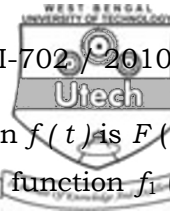
d) $f^*(t) = \sum_{k=0}^{\infty} \delta_T(t - KT)$

x) The w transform is given by

- a) $w = [\ln(z)] / T$
- b) $w = T [\ln(z)]$
- c) $z = [\ln(w)] / T$
- d) $z = T [\ln(w)]$

xi) For a sampled-data system to be stable, the z -domain poles must be

- a) within the unit circle
- b) outside the unit circle
- c) exactly on the perimeter of the unit circle
- d) anywhere in the z -plane.



- xii) The Z-transform of a continuous function $f(t)$ is $F(z)$. The Z-transform of another continuous function $f_1(t)$ yields $z^p F(z)$ where, p is an integer and T is the sampling period. Then

- a) $f_1(t) = f(t - pT)$ b) $f_1(t) = f(te^{-pT})$
 c) $f_1(t) = f(t + pT)$ d) $f_1(t) = f(te^{pT})$.
- xiii) Network protocol used in multi-drop DCS communication is
- a) Token bus b) Token ring
 c) both (a) and (b) d) TCP / IP.

GROUP - B

(Short Answer Type Questions)

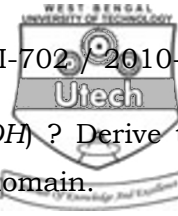
Answer any *three* of the following. $3 \times 5 = 15$

2. Find $E^*(s)$ for the following function using the Direct method, i.e. from the time sequence. Express $E^*(s)$ in closed form.

- a) $e(t) = e^{-at}$
- b) $e(t) = \frac{e^{-2T}}{(S - a)}$.
- c) What is the relationship between the answer to part (b) and the answer to part (c) ? $2 + 2 + 1$

Hints: (i) $E^*(S) = \frac{1}{[1 - e^{(a-s)T}]} e^{(a-s)T} < 0$

(ii) $E^*(S) = \frac{e^{-2TS}}{[1 - e^{(a-s)T}]}$



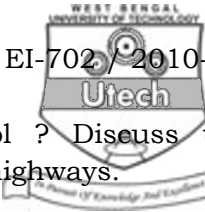
3. What is a sampler with zero order hold (ZOH) ? Derive the transfer function of ZOH in S-domain and Z-domain. 5
4. What are the different International Field Bus standards for DCS ? What is meant by data highway ? Why is fiber optic more attractive for data highway design ? 3 + 2
5. What is Nyquist frequency ? Explain aliasing phenomenon indicating the difference between the aliasing frequency and the Nyquist frequency. 1 + 4
6. Draw a schematic block diagram of a Fuzzy Logic Control System (FLCS) and outline the functions of each block element. 2 + 3

GROUP – C

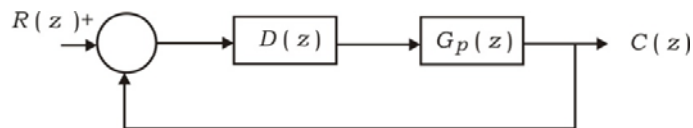
(Long Answer Type Questions)

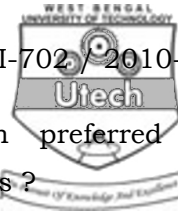
Answer any *three* of the following. $3 \times 15 = 45$

7. a) How does a PID type controller different from a on-off controller ? What is integral saturation ? $2\frac{1}{2} + 2\frac{1}{2}$
- b) Explain a digital control loop with computer as a controller. Draw it's block diagram & explain each part briefly. Why is process part & measurement part different in the same loop ? 10
8. a) Explain the structure of a distributed control system with a neat sketch. Discuss the functioning of its various parts. 5



- b) What is a network access protocol ? Discuss the methods used for distributed control highways. 3
- c) What are the advantages of distributed control system ? 4
- d) How is fuzzy logic different from crisp logic ? 3
9. a) What device is used for signal reconstruction ? How can a signal be constructed from a sequence of data points ? Compare zero-order hold and first-order hold devices. 1 + 2 + 3
- b) Why is z-transform required for analysis of discrete-data systems ? 2
- c) State and prove the initial value and final value theorems of z-transform. 4
- d) Find inverse z-transform of the function $F(z) = z / (z^2 - 4z + 2)$. 3
10. a) Find the closed-loop transfer function in z-domain for a sampled-data linear time-invariant system, where the plant is preceded by an ideal sampler & zero-order hold assembly. 5
- b) What is a deadbeat response ? Design a deadbeat controller for the all-digital system given below, for unit step and unit ramp inputs, where $G_p(z) = (z + 0.5) / (z^2 - z - 1)$. 1 + 2 + 2





- c) Why is w-domain transfer function preferred to z-domain transfer function for Bode plots ? 1
- d) For the following discrete-time open loop transfer function for a unity feedback control system find the minimum value of K such that the steady-state error due to ramp input is $K_v \geq 4/\text{sec}$. 1

$$G_{zoh} G_p(z) = K(z + 0.76)/[16(z - 1)(z - 0.45)]. \quad 4$$

11. Write short notes on any three of the following : $3 \times 5 = 15$

- a) DCS architecture
- b) Jury's stability test
- c) Nyquist frequency and aliasing
- d) Bode plot analysis
- e) Deadbeat tester

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