Mansoura University
Faculty of Engineering
Computers Eng. & Systems Dept

Second Semester
Date: 20- 6- 2012
Time allowed: 3 hours
Total Marks: [90]

Exam of: Digital Control Sys. ***For*** 2nd yr Computers Eng. & Systems Dept. Students

Question1: Explain **[20 Marks]**

a. Digital controllers present significant advantages over classical analog controllers.
b. The need for reconstruction process (holding), the construction of the most common holding device and its disadvantages.
c. The aliasing phenomenon.

Question 2: **[15 Marks]**

a. Solve the following difference equation:
$f(k+2) - 3f(k+1) + 2\,f(k) = 1$, $f(0) = f(1) = 0$

Question 3: **[20 Marks]**

a. Study the transient response of the system shown in fig. 2, with **a unit step input** and T=1 sec., Find:
   1- damping ratio ζ
   2- natural undamping frequency ω_n
   3- Peak time t_p
   4- settling time t_s
   5- Maximum overshoot Mp%
   6- steady state error
   7- time constant τ
b. Study the effect of sampling on the system's stability (i.e. study analog system then comment on system stability after introducing a sampler).

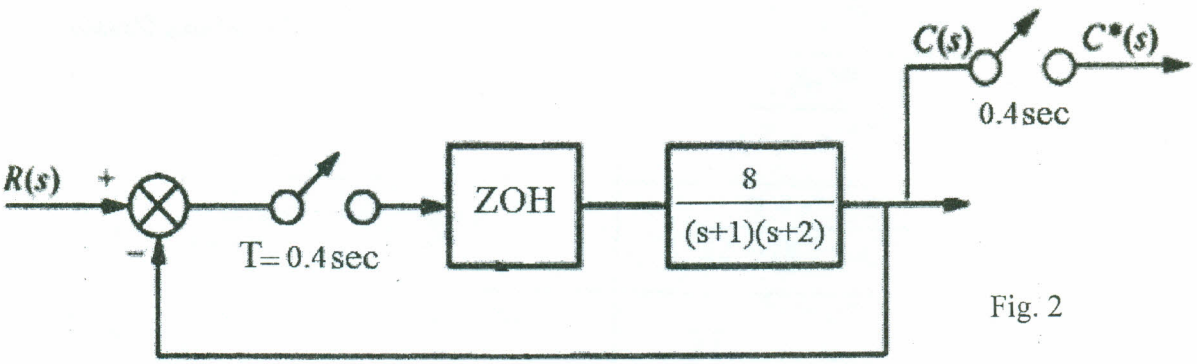

Fig. 2

Z-Transform Table

Laplace Transform	Time function	Z-Transform
1	Unit impulse $\delta(t)$	1
$\frac{1}{s}$	Unit step $u(t)$	$\frac{Z}{Z-1}$
$\frac{1}{1-e^{-Ts}}$	$\delta_T(t)=\sum_{n=0}^{\infty}\delta(t-nT)$	$\frac{Z}{Z-1}$
$\frac{1}{s^2}$	t	$\frac{TZ}{(Z-1)^2}$
$\frac{1}{s^3}$	$\frac{t^2}{2}$	$\frac{T^2Z(Z+1)}{Z(Z-1)^3}$
$\frac{1}{s^{n+1}}$	$\frac{t^n}{n!}$	$\lim_{a\to 0}\frac{(-1)^n}{n!}\frac{\partial^n}{\partial a^n}[\frac{Z}{2-e^{-at}}]$
$\frac{1}{s+a}$	e^{-at}	$\frac{Z}{Z-e^{-at}}$
$\frac{1}{(s+a)^2}$	te^{-at}	$\frac{TZe^{-at}}{(Z-e^{-at})^2}$
$\frac{a}{s(s+a)}$	$1-e^{-at}$	$\frac{(1-e^{-at})Z}{(Z-1)(Z-e^{-at})}$
$\frac{\omega}{s^2+\omega^2}$	$\sin\omega t$	$\frac{Z\sin\omega T}{Z^2-2Z\cos\omega T+1}$
$\frac{\omega}{(s+a)^2+\omega^2}$	$e^{-at}\sin\omega t$	$\frac{Ze^{-at}\sin\omega T}{Z^2-2Ze^{-at}\cos\omega T+e^{-2at}}$
$\frac{s}{s^2+\omega^2}$	$\cos\omega t$	$\frac{Z(Z-\cos\omega T)}{Z^2-2Z\cos\omega T+1}$
$\frac{s+a}{(s+a)^2+\omega^2}$	$e^{-at}\cos\omega t$	$\frac{Z^2-Ze^{-at}\cos\omega T}{Z^2-2Ze^{-at}\cos\omega T+e^{-2at}}$