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NAME OF THE LABORATORY : control systemy Engineering

Name G-Svi Granga Palanav Roll No. 1602-21-735-47 Page No.

Steady State Error Analysis

Aim: To analyze the steady state error of different types of control systems.

Apparatus: - Ac loaded with MATLAB

Theory :-

Steady state error analysis is crucial in control systems engineering because it helps engineers understand how well a control system performs under steady state conditions. By analyzing steady-state conditions, engineers can assess the system's ability to accurately track and maintain the clestred output in response to various disturbances and reference inputs. This analysis is essential for designing and tuning control systems to meet performance specifications, ensuring stability, nesponsivenes, and accuracy in real coord applications. Additionally, steady state error analysis provides insights into system behaviour and helps in optimizing control system behaviour and helps in optimizing control system behaviour and helps in optimizing control system performance for different operation conditions.

1 801 :

0= & ((12)&

$$e_{K} = \frac{1}{1+Kp}$$
 $e_{K} = \frac{1}{kv}$ 
 $e_{K} = \frac{1}{kv}$ 

$$= \frac{108}{8+2} = 0.$$

$$es = 1$$
 $kv$ 
 $es = 1$ 
 $ka$ 

$$|S_{N}| = 0.$$

$$|S_{$$

### to verticus alterrepenses and reference inpits 9981

# Unit step: de moneros has peroverogene etilende

# Unit ramp: Pascabola:

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Name G. Sri Cranga Peranal Roll No. 1602-21-735-117 Page No. Code: %. Program 1 - To analyse steady state errors of type o, type 1, type 2 systems 11 = 11 1 close all; clear; t = -10:0.01:10; x>= (t, 06(t>=0)) + (0,00 (t(0)); x = (1. \*(t>=0))+(0. \*(t<0)); X3 = t. 12/2; % Type 0 8= tf ('s'); n=GoJ d=[1 2] 9 = tf (n,d) kp=dcgain(g) h 1= con v (n, [1 0]) gi=tf(nid) kv=dcgain(g))

n2 = conv (n, (1 0 oJ)

g 2 = tf(n2,d)

ka = digain(g2)

$$= \frac{10(3+1)}{3(3+2)}|_{3=0} = 10(3+1)$$

$$= \frac{10(3+1)}{3(3+2)}|_{3=0} = 10(3+1)$$

$$= \frac{10(3+1)}{3(3+2)}|_{3=0} = 10(3+1)$$

TO DITALIJEC

$$=\frac{10[1+1]}{(3+2)}$$
  $=\frac{10}{2}$   $=\frac{10}{2}$   $=\frac{1}{2}$ 

Control Charles Present

8=(181)0

(01)=N

e = tf(n,d)

kp = deguin (g)

n 1= cenv (n, (1 o])

gr= tfinid)

Ev= dequintal

ME convince of

9 = tf (n2/d) Ka = digain(gr)

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eus - step = 1/LI+kp) en - ramp = #1/kv ess - parabola = 1/ka the feedback (g,1); supplot (2,2,1) impulse (tf1) title l'Impulse vesponse - Type 0 -- 1602-21-735-117) subplot(2,2,2) lsim (tfl, 17, x,t) title ( step response - Type 0 - - 1602 - 21 - 735 - 47) supplot(2,213) leim (tf1, (1) x21t) title ( ramp response - type 0-- 1602-21-735-1171) subplot(2,2,4) lim (tfl, Vt, x31t) title ( Parabolic response - Type 0 -- 1602-21-735-117) % Type 1 n=[Lo] d=[1 20] 3= Efcnid) kp = degaing) ni=conv(n,(1 0]) 8 = tf(nid)

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Name Grsvi Granga Pranav Roll No. 1602-21-735-117 Page No. kv=dcgain(g1) nz=conv(n,C1 0 0J) 92=tf(n2rd) ka=degainegz) ess-step= 1/(1+10p) ess - ramp=UEV ex-parabola = 1/1ca Ef 1 = feedback (g11); figure(2) subplot (2,211) impulse (tti) title l'Impulse response-Type 1 -- 1602-21-735-1171) subplot (2,2/2) Lim Ltfi, ri, net) title ('step response-Type 1 -- 1602-21-735-117') supplot (2,2,3) la smitfly 14/24t) title ( Ramp response - Type 1 -- 1602-21-735-117) subplot (2,2,4) lsim(tf1, 1/1 x3,6) title ( Parabolic response - Type 1 -- 1602-21-735-1181)

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Name GTSTI GROUPS PAGENON PAGENON

Name Grsvi Ganga Page No. 1602-21-735-117 Page No. % Type 12 mil to constant from the grant of n=Cro rolling as the will be possible of the state of the d=[1200] rowades only bt 9 = Ef (nid) (D) N. 2 1 - V3 kp=degaineg) n1=conv(n,c1 oJ) 14 (1180) & 3 g1=tf(n1,d) kv = degain(g) n2 = conv (n, C1 00]) 92=tf(n2,d) ba=dcgain(g) ess-step = 1/Litter) es\_ramp=1/cv en - pagabola = 1/ba figure (3) KI= 60. tfl=feedback(g;1); subplot(2,2,1) impulse (tfo) title (Impulse response - Type 2 - 1602-21-735-117) supplot(2,2,2) lein (tfi, 'r', ait) title ('step response - Type 2 - 1602-21-735-117') subplot (2,2,3)

G1= \$1() 8+1) input = (1+6+) 3 (53+1) (1+1)2 It is type I hystem for type, system, ramp input is preferrable and also the steady state error due to constant function is zero in type 1' system. so, neglect 1 in LIF6t) input and consider only 6t B= Ef (n,d) kv= lt s. (1/3) KP = digwing) M= conv(mor o3) = 3(28+1) k1 91= (f(n),d) 3153+1)(1+3)73=0. kr = degainege 12 = LON (11, C1 c03) = K1 (b,en) 1- (p KV= b1 ta = degain(9) ess = 6 x L ess - 8tep = 1/(4tep) en ramp - yev  $(0 \circ) = \frac{6}{k_1}$ CH - pasakola = 1/th figure (3) K1=60. the feedbacks; 1); subplates, 2,1) inpulse (Eft) (1811-188-16-6011-6 2661- Hustral 2010 145) 1311) Suppliet (2,2,2) limitety y ant (1611-186-10-6091-6 2-1603-31-382-1131)

Subplat (2,2,3)

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lsim(tf1, 181, 22,t)

title (1 Ramp response - Type 2 -- 1602-21-735-1171)

suppliet (2,2,4)

lim (tf1, 1r1, x3,t)

Atte l'Parabolic response-74Pe 2 -- 1602-21-735-117)

% Program 2 - Sum.

% G1= K1(25+1) 8(58+1)(1+5)2 ; input=(1+6+)

% Determine min. value of k1 so that steady state error is less than 0.1

clc;

close all;

clear;

% Type 1

s=tf(31);

9= 60 x (2x st1) ((3\*(5\*s+1) x(1+s)^2)

bv=dequen(gas)

ess\_ramp=6/kv

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Observation:-

-> For type 0 systems,

ess-step=finite => Acceptable

ess-ramp=00 2 nevt preferrable es- parabola = 00

- For type I system,

en-step=0

ess\_ramp=constant } Acceptable

ex-parabola = 0 => nlot preferrable.

-> For type 2 systems,

ex\_step=0

en\_ramp=0

· Acceptable

ess - parahola = constant

Result: Analyzed the steady state errors of typeo, type, and type 2 systems.