

## Home Work #3

Ali BaniAsad 96108378

July 7, 2021

## Contents

<b>1</b>	<b>Question 1</b>	<b>1</b>
1.1	part a . . . . .	1
1.2	part b . . . . .	2
1.3	part c . . . . .	3
<b>2</b>	<b>Question 2</b>	<b>4</b>
2.1	part a . . . . .	4
2.2	part b . . . . .	4
2.3	part c . . . . .	5
2.4	part d . . . . .	6
<b>3</b>	<b>Question 3</b>	<b>7</b>
3.1	part a . . . . .	7
3.2	part b . . . . .	10
3.2.1	I . . . . .	12
3.2.2	II . . . . .	13
3.3	part c . . . . .	13
3.3.1	I . . . . .	13
3.3.2	II . . . . .	21
3.4	part d . . . . .	28
<b>4</b>	<b>Question 4</b>	<b>34</b>

## List of Figures

1	System simulation with $K_1$ matrix . . . . .	8
2	System simulation with $K_2$ matrix . . . . .	9
3	System control effort $u(t)$ . . . . .	10
4	System simulation for $\beta = 1000$ . . . . .	11
5	$u(t)$ cost in different $\beta$ . . . . .	12
6	$x^2 + \dot{x}^2$ cost in different $\beta$ . . . . .	13
7	$K(t)$ in $t_f = 3$ sec . . . . .	14
8	$u(t)$ in $t_f = 3$ sec . . . . .	14
9	System States $\vec{x}(t)$ in $t_f = 3$ sec . . . . .	15
10	$K(t)$ in $t_f = 5$ sec . . . . .	15
11	$u(t)$ in $t_f = 5$ sec . . . . .	16
12	System States $\vec{x}(t)$ in $t_f = 5$ sec . . . . .	16
13	$K(t)$ in $t_f = 10$ sec . . . . .	17
14	$u(t)$ in $t_f = 10$ sec . . . . .	17
15	System States $\vec{x}(t)$ in $t_f = 10$ sec . . . . .	18
16	$K(t)$ in $t_f = 15$ sec . . . . .	18
17	$u(t)$ in $t_f = 15$ sec . . . . .	19
18	System States $\vec{x}(t)$ in $t_f = 15$ sec . . . . .	19
19	$K(t)$ for all simulated $t_f$ . . . . .	20
20	$u(t)$ for all simulated $t_f$ . . . . .	20
21	System States $\vec{x}(t)$ for all simulated $t_f$ . . . . .	21
22	$K(t)$ in $H = 1I$ . . . . .	22
23	$u(t)$ in $H = 1I$ . . . . .	22
24	System States $\vec{x}(t)$ in $H = 1I$ . . . . .	23
25	$K(t)$ in $H = 10I$ . . . . .	23
26	$u(t)$ in $H = 10I$ . . . . .	24
27	System States $\vec{x}(t)$ in $H = 10I$ . . . . .	24
28	$K(t)$ in $H = 100I$ . . . . .	25
29	$u(t)$ in $H = 100I$ . . . . .	25
30	System States $\vec{x}(t)$ in $H = 100I$ . . . . .	26
31	$K(t)$ for all simulated $H$ . . . . .	26
32	$u(t)$ for all simulated $H$ . . . . .	27
33	System States $\vec{x}(t)$ for all simulated $H$ . . . . .	27
34	$K(t)$ in $\alpha = 1$ . . . . .	28
35	$u(t)$ in $\alpha = 1$ . . . . .	29
36	System States $\vec{x}(t)$ in $\alpha = 1$ . . . . .	29
37	$K(t)$ in $\alpha = 5$ . . . . .	30
38	$u(t)$ in $\alpha = 5$ . . . . .	30
39	System States $\vec{x}(t)$ in $\alpha = 5$ . . . . .	31
40	$K(t)$ in $\alpha = 10$ . . . . .	31
41	$u(t)$ in $\alpha = 10$ . . . . .	32
42	System States $\vec{x}(t)$ in $\alpha = 10$ . . . . .	32
43	$K(t)$ for all simulated $\alpha$ . . . . .	33
44	$u(t)$ for all simulated $\alpha$ . . . . .	33
45	System States $\vec{x}(t)$ for all simulated $\alpha$ . . . . .	34
46	$u(t) = 1$ , $x_1$ and $x_2$ for different $C_5$ . . . . .	36
47	switch curve in $u(t) = 1$ . . . . .	36
48	$u(t) = -1$ , $x_1$ and $x_2$ for different $C_5$ . . . . .	37
49	switch curve in $u(t) = -1$ . . . . .	38