Assignment 1

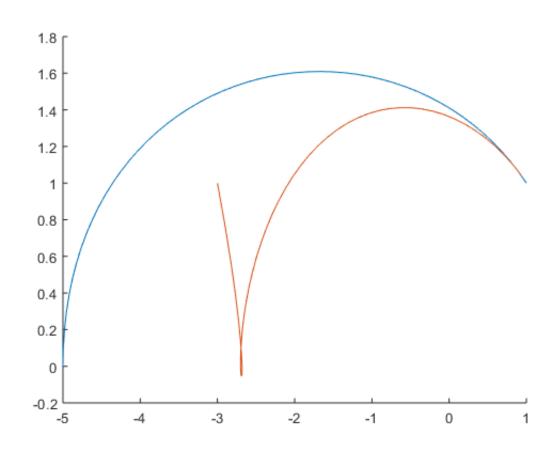
	- Aishwany Jagetia
	Considering the double integrator
A]	State rector n=[n, n2] and input u writing in the form ne = An + Bu
	$\frac{d \left[\mathcal{H}_{1} \right]}{d \left[\mathcal{H}_{2} \right]} = \begin{bmatrix} 0 & 1 & \left[\mathcal{H}_{1} \right] & \left[0 \right] \mathcal{H}_{2} & \left[0 \right] \\ 0 & 0 & \left[\mathcal{H}_{2} \right] & \left[1 \right] \end{bmatrix}$
F	$A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} - \bigcirc$
	$B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} - 3$
0 - 101	For the system to be reachable runk ([B AB]) = Full rank.
1 - 540 c	[B M3] = [0] > rank([B AB]) = 2 = no. of rows det ([B AB]) = 0 System is reachable.
B)	Feedback u=-kx
	characteristic polynomial det [(A-Bk)-XI] = 0 considering A, B from eg D & 3
(0.	
	[-K1-K2] [0] -K1 -K2-]

Suy $-\lambda(-k_2-\lambda)-(-k_1)=0$ 1K2+12+K1=0 12+1k2+k1:0 - @ Given characteristic polynomial 82 + 26,0 wos + wo2 has wo=1, 30 = 0.7. i.e 82 + 1.48 + 1 = 0 - 5 Comparing 445. K2 = 1.4 Given initial state $n_0 = (-5,0) \rightarrow n_{1d}(0) = -5$, $\times_{2d}(0) = 0$ $n_1 = (1,1) \rightarrow \times_{1d}(1) = 1$, $\times_{2d}(1) = 1$ Desired trajectory Xd = AXd + Bud ×d(0) = X0 X9(2) = Xt X/d(t) = ao + ait + azt2 + ast3 - 1 Azd (t) = xid(t) = a1 + 20, t + 30, t2 ×10(0) = 00 = -5 X2d(0) = 01 = 0 for t=5 x1d(s) = -5+2592+12503=1 (a100) xed (5) = 1002 + 7503 = 1

Onti	25 az + 125 a3 = 6	113
	25 az + 125 a3 = 6 10 az + 75 as = 1	
	Solving for az + az	
	d a2 = 0.52	
	2 2 2 2 5 6	
10/11/2012/0	1, (8-30000 -) - 1X 11, V 1X -= N	
	1. XId(t) = -0.056 t3 + 0.52t2-5	
	×2d(t) = -0.168 = + 1.04 =	
	we know nizi = ud	
	we know ned = ud	
. ()	Print - 15 19 19 19 20 20 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
	u'(t) = -0.336 = +1.04 (8)	
117-1	1+" = + 10 31 289 + 11 - " yangto " 3 220 0 - 0 14	a
5	Given stale xy= Axy+ Buy	
	$elt) = nlt) - x^d(t)$	
	e(t) = x(t) - xd(t)	
	= Ax +Bu - Axa - Bud	
	= A (x-xd) + B(u-ud) -6	
	By= Bke= B(u-ud) - a	
	Substituting (1) in eq (6)	
	elt) = Ae + Bke	
	e(t) = Ae + Bke e(t) = (A+Bk)e he as the new state }	
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E	To design the conterol input a such that the system eventually converges to a desired trajectory xd(t)
	To design the content input a such that the system
	desired tradeclary with
	eventually converges to a desired trajectory x cc)
	1
	From eq 19 Ke = u - ud
H	THOW EN (1)
	or us ke + ud
	V. W.
	0,000,000
	[1. 1.][X1 - (-0.056+ +0.52+ -5)], (-D. 336++1.04)
H	U=[K1 K2] 1
	x2 - (-0.168 t + 1.04t)
	$u = -\left[k_1 \ k_2\right] \left[\begin{array}{c} x_1 - \left(-0.056t^3 + 0.52t^2 - 5\right) \\ x_2 - \left(-0.168t^2 + 1.04t\right) \end{array} \right] + \left(-0.336t + 1.04t\right)$
	2 1 1 1 4 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5
	We know k1=1, k2=1.4
+	u=-((x1+0.056t3-0.52t2+5)+1.4(x2+0.168t2-1.04t)
	- (v. + 0.056+3-0.52+45)+1.4 (x, +0.168+2-1.04+)
1	4 = (() + 0.0300
	+ (-0.336t + 1.04)) (1) (e))
	1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
	$u = -(0.056 t^{3} - 0.2848 t^{2} - 1.792 t + 6.04 + x_{1}^{(t)} + 1.4 x_{2}^{(t)})$
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clc;
clear;
A = [0, 1; 0, 0];
B = [0; 1];
K = [1, 1.4];
dt = 0.1;
x_t = [-3;1];
x d = [-5;0];
desired_posi = [x_d];
new_posi = [x_t];
for t=0:dt:5
    x1_d = -(0.056*(t^3)) + (0.52*(t^2)) -5;
    x2_d = -(0.168*(t^2)) + (1.04*t);
    x_d = [x1_d; x2_d];
    u_d = -(0.336*t)+1.04;
    u_t = (-K^*(x_t - x_d)) + u_d;
    x_t_dot = (A*x_t) + (B*u_t);
    desired_posi = [desired_posi,x_d];
    new_posi = [new_posi,x_t];
    x_t = (x_t_dot*dt) + x_t;
end
figure
hold on
plot(desired posi(1,:),desired posi(2,:))
plot(new_posi(1,:),new_posi(2,:))
hold off
```



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