

RBE 2001 Homework 2

1a.

Open: $\theta_3 = 19.766$, $\theta_4 = 108.925$

Closed: $\theta_3 = 278.383$, $\theta_4 = 189.224$

$$a := 2 \quad b := 5 \quad c := 6 \quad d := 7 \quad \text{theta2} := 85 \text{ deg}$$

$$K_1 := \frac{d}{a} = 3.5 \quad K_2 := \frac{d}{c} = 1.167 \quad K_3 := \frac{(a^2 - b^2 + c^2 + d^2)}{2 \cdot a \cdot c} = 2.667$$

$$A := \cos(\text{theta2}) - K_1 - K_2 \cdot \cos(\text{theta2}) + K_3 = -0.848$$

$$B := -2 \cdot \sin(\text{theta2}) = -1.992$$

$$C := K_1 - (K_2 + 1) \cdot \cos(\text{theta2}) + K_3 = 5.978$$

$$\text{theta4}_2 := 2 \cdot \text{atan}\left(\frac{-B + \sqrt{B^2 - 4 \cdot A \cdot C}}{2 \cdot A}\right) = -152.448 \cdot \text{deg}$$

$$\text{alternate_theta4}_2 := \text{theta4}_2 + 2 \cdot \pi = 207.552 \cdot \text{deg}$$

$$\text{theta4}_1 := 2 \cdot \text{atan}\left(\frac{-B - \sqrt{B^2 - 4 \cdot A \cdot C}}{2 \cdot A}\right) = 119.903 \cdot \text{deg}$$

$$K_4 := \frac{d}{b} = 1.4 \quad K_5 := \frac{c^2 - d^2 - a^2 - b^2}{2 \cdot a \cdot b} = -2.1$$

$$D := \cos(\text{theta2}) - K_1 + K_4 \cdot \cos(\text{theta2}) + K_5 = -5.391 \quad E := -2 \cdot \sin(\text{theta2}) = -1.992$$

$$F := K_1 + (K_4 - 1) \cdot \cos(\text{theta2}) + K_5 = 1.435$$

$$\text{theta3}_2 := 2 \cdot \text{atan}\left(\frac{-E + \sqrt{E^2 - 4 \cdot D \cdot F}}{2 \cdot D}\right) = -72.468 \cdot \text{deg}$$

$$\text{alternate_theta3}_2 := \text{theta3}_2 + 2 \cdot \pi = 287.532 \cdot \text{deg}$$

$$\text{theta3}_1 := 2 \cdot \text{atan}\left(\frac{-E - \sqrt{E^2 - 4 \cdot D \cdot F}}{2 \cdot D}\right) = 39.924 \cdot \text{deg}$$

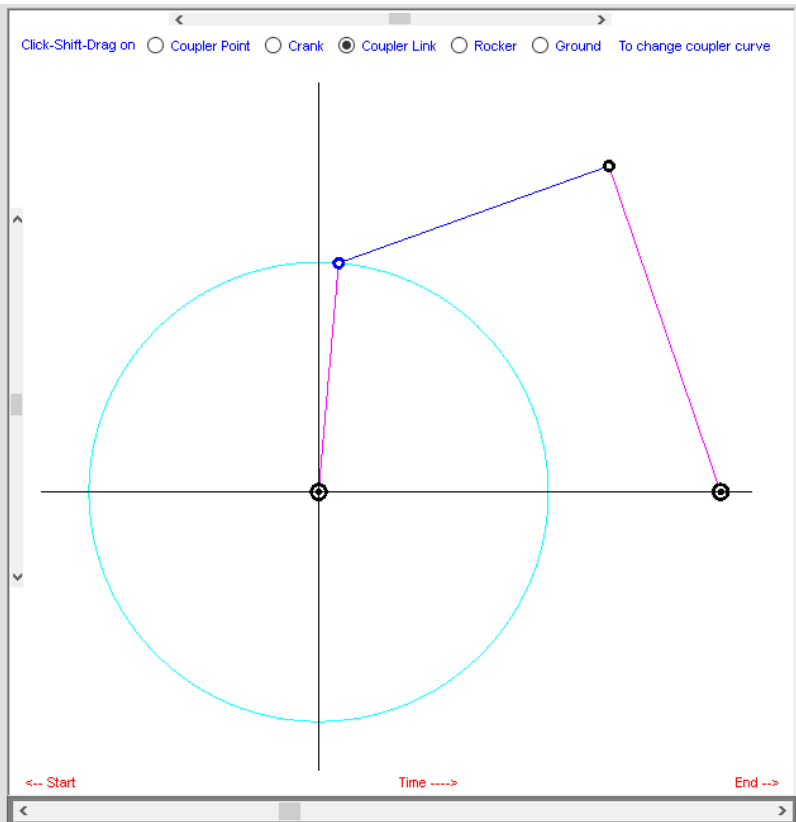
1b.

Fourbar Linkage - Cognate 1		Value	Unit
Number of Links	4		
Length of Link 2	scrie		in
Length of Link 3	5		in
Length of Link 4	6		in
Length of Link 1	7		in
Angle of Link 1	0.00		deg
Distance to Coupler Point From Pin I23	0.000		in
Angle to Coupler Point W/In Link 3	0.00		deg

Initial Conditions for Calculation		Value	Unit
Start Angle of Input Link	85		deg
End Angle of Input Link	445		deg
Delta Angle of Input Link	3		deg
Omega of Input Link	10		rad/s

Animation Control

Cycles Range



Print To Screen

Theta2

Ang

3

Theta3

Ang

3

Theta4

Ang

3

Trans Ang

Ang

3

Next

Print Every

1

Set Angle Dec Plcs

3

Set Data Dec Plcs

3

Functions

☐ 1
☐ 2
☒ 4

Coordinate System

☒ Global
☐ Local

Theta magnitudes for all links

Refresh

Current Model Parameters

Fourbar Linkage	Value	Unit
Links	4	
Link 2	4.000	in
Link 3	5.000	in
Link 4	6.000	in
Pivot O4x	7.00	in
Pivot O4y	0.00	in
I23-CplrPt	0.000	in
CplrPtAng3	0.00	deg

Initial Conditions	Value	Unit
Start	85.0	deg
End	445.0	deg
Delta	3.0	deg
Omega2	10.0	rad/s

Input Angle (deg)	Theta2 Ang (deg)	Theta3 Ang (deg)	Theta4 Ang (deg)	Trans Ang Ang (deg)
85.000	85.000	19.766	108.925	89.159
88.000	88.000	18.815	110.769	88.046
91.000	91.000	17.906	112.664	85.242
94.000	94.000	17.036	114.608	82.428
97.000	97.000	16.201	116.594	79.606
100.000	100.000	15.398	118.621	76.777
103.000	103.000	14.625	120.684	73.941
106.000	106.000	13.880	122.781	71.099
109.000	109.000	13.160	124.908	68.252
112.000	112.000	12.463	127.064	65.399
115.000	115.000	11.787	129.246	62.541
118.000	118.000	11.131	131.452	59.679
121.000	121.000	10.493	133.680	56.813
124.000	124.000	9.872	135.928	53.944
127.000	127.000	9.266	138.195	51.071
130.000	130.000	8.673	140.479	48.195
133.000	133.000	8.094	142.778	45.316
136.000	136.000	7.526	145.092	42.434
139.000	139.000	6.970	147.419	39.551
142.000	142.000	6.423	149.758	36.665
145.000	145.000	5.884	152.107	33.777
148.000	148.000	5.354	154.467	30.887
151.000	151.000	4.831	156.835	27.996
154.000	154.000	4.314	159.210	25.104
157.000	157.000	3.803	161.593	22.210
160.000	160.000	3.297	163.982	19.315
163.000	163.000	2.795	166.376	16.420
166.000	166.000	2.297	168.774	13.523

Theta2 Ang

Max 445.000 deg

Min 85.000 deg

P - P 360.000 deg

Theta3 Ang

Max 111.772 deg

Min 0.327 deg

P - P 111.446 deg

Theta4 Ang

Max 179.925 deg

Min 92.750 deg

P - P 87.174 deg

Trans Ang Ang

Max 89.911 deg

Min 0.966 deg

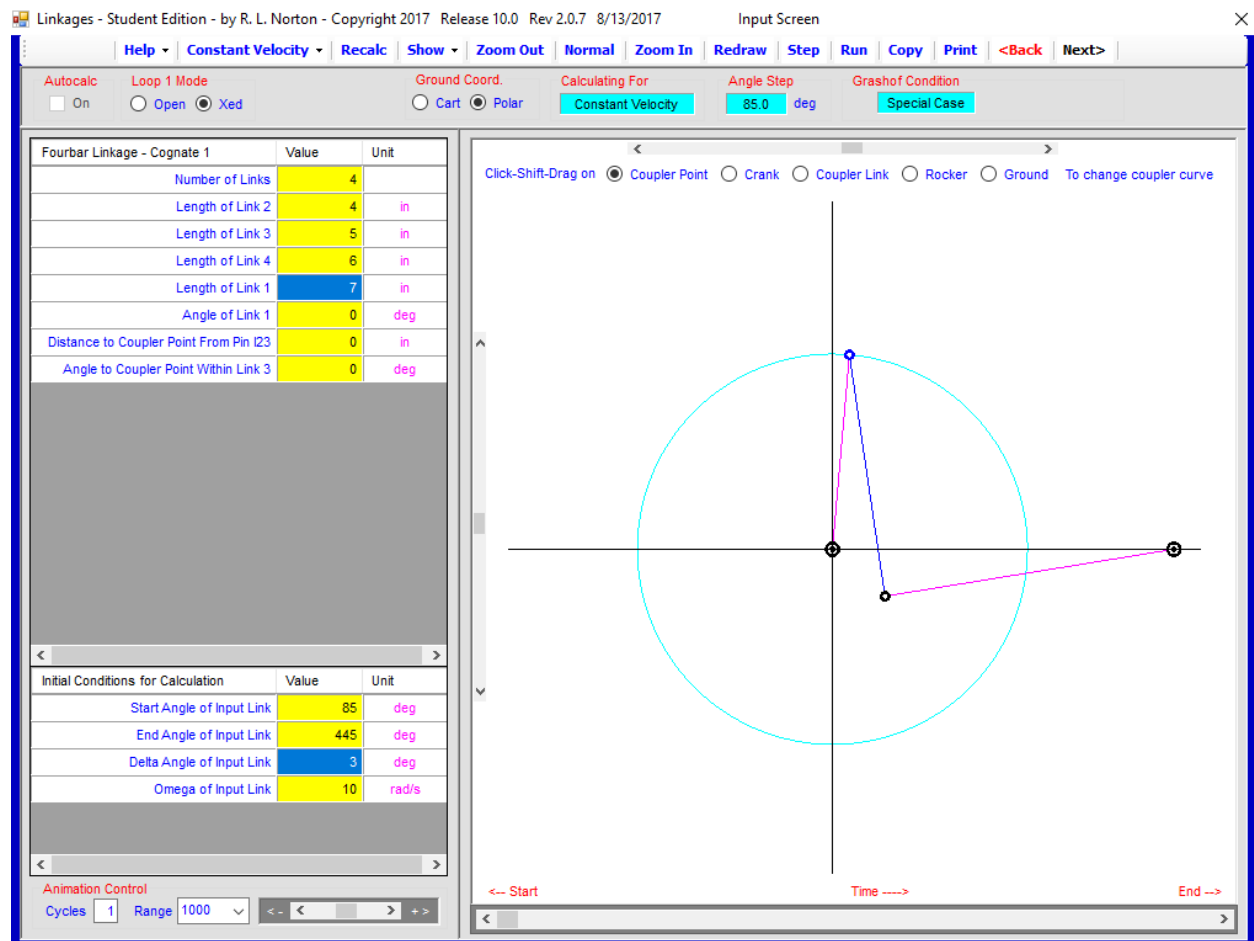
P - P 88.945 deg

Liam Godin

Design No. 1

09-16-2020 at 00:45:03

File: Model_1



Print To Screen Theta2 Ang 3 Theta3 Ang 3 Theta4 Ang 3 Trans Ang Ang 3 Next >

Print Every 1 Set Angle Dec Plcs 3 Set Data Dec Plcs 3 Functions Coordinate System ☐ 1 ☐ 2 ☒ 4 ☒ Global ☐ Local Refresh

Current Model Parameters			Input Angle (deg)	Theta2 Ang (deg)	Theta3 Ang (deg)	Theta4 Ang (deg)	Trans Ang Ang (deg)
Fourbar Linkage	Value	Unit	85.000	85.000	278.383	189.224	89.159
Links	4		88.000	88.000	280.726	188.773	88.046
Link 2	4.000	in	91.000	91.000	283.100	188.342	85.242
Link 3	5.000	in	94.000	94.000	285.503	187.931	82.428
Link 4	6.000	in	97.000	97.000	287.931	187.537	79.606
Pivot O4x	7.00	in	100.000	100.000	290.382	187.159	76.777
Pivot O4y	0.00	in	103.000	103.000	292.855	186.796	73.941
I23-CplrPt	0.000	in	106.000	106.000	295.347	186.446	71.099
CplrPtAng3	0.00	deg	109.000	109.000	297.857	186.109	68.252
			112.000	112.000	300.384	185.783	65.399
			115.000	115.000	302.926	185.467	62.541
			118.000	118.000	305.482	185.161	59.679
			121.000	121.000	308.050	184.864	56.813
			124.000	124.000	310.630	184.574	53.944
			127.000	127.000	313.221	184.292	51.071
			130.000	130.000	315.822	184.017	48.195
			133.000	133.000	318.432	183.748	45.316
			136.000	136.000	321.050	183.484	42.434
			139.000	139.000	323.675	183.226	39.551
			142.000	142.000	326.307	182.972	36.665
			145.000	145.000	328.945	182.722	33.777
			148.000	148.000	331.589	182.477	30.887
			151.000	151.000	334.238	182.234	27.996
			154.000	154.000	336.891	181.995	25.104
			157.000	157.000	339.549	181.759	22.210
			160.000	160.000	342.209	181.525	19.315
			163.000	163.000	344.873	181.292	16.420
			166.000	166.000	347.539	181.062	13.523

Theta2 Ang

Max 445.000 deg

Min 85.000 deg

P - P 360.000 deg

Theta3 Ang

Max 359.837 deg

Min 248.198 deg

P - P 111.638 deg

Theta4 Ang

Max 267.263 deg

Min 180.151 deg

P - P 87.112 deg

Trans Ang Ang

Max 89.911 deg

Min 0.966 deg

P - P 88.945 deg

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09-16-2020 at 00:45:03

File: Model_1

1c.

The fourbar linkage is Grashof. $L + S \leq P + Q$ is true in this case.

1d.

