HW 2 Planar Mechanisms - Part 2

Graded

Student

Shihong Yuan

Total Points

24.3 / 25 pts

Question 1

Problem 1 **9.8** / 10 pts

1.1 **(no title)** **1** / 1 pt

✔ **– 0 pts** Correct

– 1.5 pts Incorrect

– 0.5 pts Incorrect DOF value

– 1 pt Incomplete

– 0 pts Correct based on how alpha and beta are drawn

– 0.5 pts alpha and beta swapped

– 1.5 pts Show your work

– 0.5 pts 3 DOF possible with fixed output shaft and free input shaft.

– 0.5 pts For 2 DOF: output shaft fixed, input move on a slider.

– 0.5 pts Reasoning Excluded: Input and output shaft fixed OR only rotation = 1 DOF

– 0 pts Click here to replace this description.

– 0.2 pts Error in reasoning

1.2 **(no title)** **3** / 3 pts

✔ **– 0 pts** Correct

– 1 pt Not clearly defined. Joints and links not identified (numerical labels).

– 2 pts Incomplete

– 0.2 pts Wrong number of joints

– 0.6 pts 3 or more joints missing

– 0.3 pts Joints not numbered correctly

– 0.5 pts Identification not numbered correctly

– 0.2 pts Wrong Link number

– 0.5 pts Missing Joint Identification (numerical on sketch)

– 0.5 pts Missing link identification (numerical on sketch)

– 0.2 pts Ground link invalid

– 3 pts MIssing

1.3 **(no title)** **2** / 2 pts

✔ **– 0 pts** Correct

– 0 pts Correct based on identified links/joints

– 1 pt Not clearly defined. Show calculation.

– 0.5 pts Incorrect DOF calculation

– 2 pts Missing

1.4 **(no title)** **0.8** / 1 pt

– 0 pts Correct

– 1 pt Missing

✔ **– 0.2 pts** Include presence of parallel link.

– 0.5 pts Incorrect/Incomplete

– 0.2 pts Correct based on calculations; missing explanation for discrepancy

1.5 **(no title)** **2** / 2 pts

✔ **– 0 pts** Correct

– 0.1 pts wrong number of links

– 0.1 pts wrong number of joints

– 0.2 pts wrong DOF

– 2 pts Missing

– 1 pt incorrect

– 0.5 pts missing equation

1.6 **(no title)** **1** / 1 pt

✔ **– 0 pts** Correct

– 0.05 pts Include Structural Rigidity

– 1 pt Incorrect inversion type

– 1 pt Identify Grashof class

– 1 pt Incomplete

Question 2

Problem 2 — **9.5** / 10 pts

2.1 **(no title)** — **3.5** / 4 pts

- **– 0 pts** Correct
- ✔ **– 0.5 pts** Small error in reasoning
- **– 1.5 pts** Not clearly defined
- **– 4 pts** No Answer
- **– 2 pts** Incorrect DOF
- **– 2 pts** No reasoning given

Looking for that the input crank determines all the positions of the links on the mechanism.

2.2 **(no title)** — **6** / 6 pts

- ✔ **– 0 pts** Correct
- **– 1 pt** Incorrect # of links
- **– 1 pt** Incorrect # of joints
- **– 3 pts** Incorrect/Incomplete DOF calculation
- **– 3 pts** Incorrect/Incomplete kinematic diagram
- **– 6 pts** No answer
- **– 1 pt** No mention of removing redundancies and/or no recalculation after removing redundancies.
- **– 1 pt** Error in initial DOF calculation
- **– 1 pt** Error in DOF calculation after removing redundancies
- **– 1 pt** No diagram with redundancies removed

Question 3

Problem 3 **5** / 5 pts

3.1 **Page** **5** / 5 pts

✔ **– 0 pts** Correct

– 1 pt No picture attached

– 1 pt No explanation of purpose

– 0.5 pts Missing one configuration

– 1 pt Missing both configurations

– 0.5 pts Incorrect link/joint identification

– 1 pt Missing link/joint identification

– 0.5 pts Error in DOF calculation

– 1 pt Missing DOF calculation

– 5 pts No attempt

– 0.5 pts Missing sentence results agree with prediction

Question 4

Penalties **0** / 0 pts

✔ **– 0 pts** No penalties

– 6.2 pts Pages not correctly assigned in Gradescope

– 5 pts < 1 day late

– 10 pts 1-2 days late

– 15 pts 2-3 days late

Questions assigned to the following page: 1.3, 1.4, 1.5, 1.6, 1.1, and 1.2

ME 370

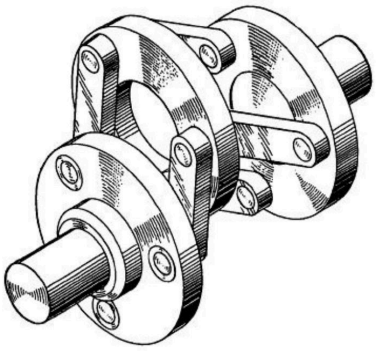
Homework 2: Planar Mechanisms – Part 2

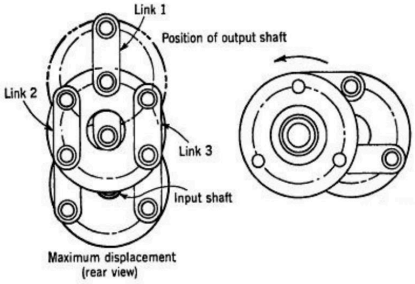
NAME: Shihong Yuan (syuan19) UIN: 665249431

Deadlines and submission information listed on Canvas

Total Points: 25 Points

Problem 1 [10 pts]: Schmidt Coupler



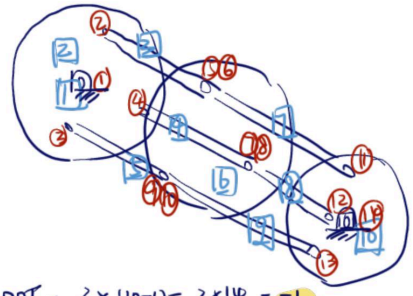


The mechanism on the left, called a Schmidt coupler, is used to transmit rotational motion between 2 parallel shafts with small offset. Watch the following videos:

(a) DOF = 1

Because when right rotate, all of the left move to a center angle, and don't have other freedom.

(b)



(c) DOF = $3\times(10-1)-2\times14=-1$

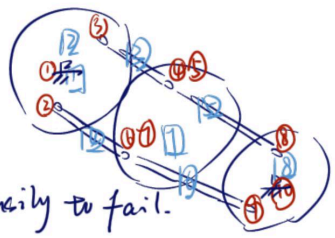
(d) not same, because their are two links are extra, and overconstrained, only two links between two input circle is enough They are additional links

https://www.youtube.com/watch?v=PKXc7EzgJh4
https://www.youtube.com/watch?v=-ymq2IkL4aI

In this problem, assume that the input and output shafts cannot translate, and can only rotate (as seen in the second video)

a) From the videos, how many degrees of freedom do we expect in this mechanism? Explain. (1 pts)

(e)



DOF = $3\times(18-1)-2\times10=1$

(f) Because they can make the mechanism more easily to stable and not easily to fail.

rotation

No questions assigned to the following page.

b) Sketch an equivalent kinematic diagram, with links, joints and ground clearly identified. Assume both the input and output shaft are fixed in position with respect to ground but allowed to freely rotate.
(3 pt)

c) Calculate the degrees of freedom making no special assumptions. (2 pt)

d) Does the computed DOF match the DOF observed? Explain the difference. (1 pts)

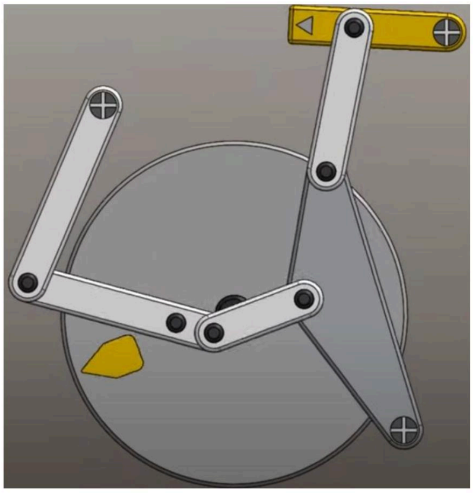
e) How do we correctly compute the number of degrees of freedom in this mechanism? Do it! Identify the kind of degrees of freedom. e.g. translation vs rotation (2 pts)

f) If the additional links do not contribute to the degrees of freedom, why are they still included in the mechanism? (1 pt)

Questions assigned to the following page: 2.2 and 2.1

Problem 2 [10 pts]: Mechanism Analysis

Watch a video of the mechanism below



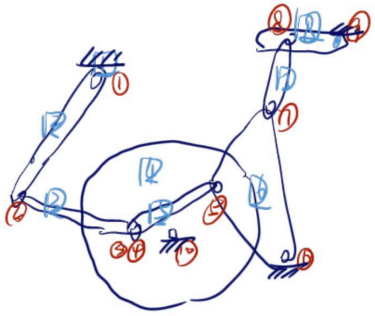
https://www.youtube.com/watch?v=ahFrHYJrorE&t =106s

a) From intuition and experience, how many degrees of freedom do we expect from the mechanism? Explain. (4 pts)

b) Draw a kinematic diagram and analyze the links and joints and DOF of this mechanism. (6 pts)

(a) There is only 1, because when one of the parts move, all the other parts move follow ly.

(b)



DOF = $3 \times 18 - 1) - 2 \times 10$

$= 1$

Question assigned to the following page: 3.1

Problem 3 [5 pts]: Linkage Treasure Hunt

Once you know what to look for, you realize that linkages are everywhere, and we interact with them every day. A basic skill of mechanical design is dissecting the structure and functionality of real world mechanisms. Practice this skill: Find and analyze **a planar linkage** that you use or see everyday. Pick a mechanism that we did not discuss in class. These linkages should not include gears or cams. For
example, on my way to work today, I passed by a person using a hatchback trunk on their car, a collapsible bike rack, and an emergency fire escape.

(1) Picture

multiple

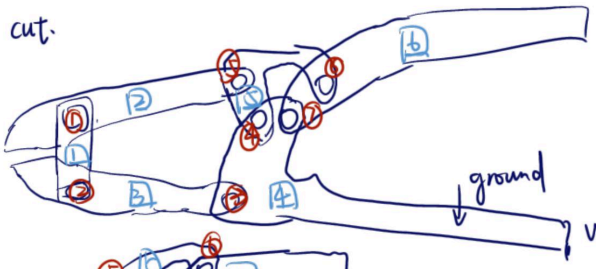
results

(2) Describing :

The purpose is to cut through hard materials, such as hardened steel bolts, chains.

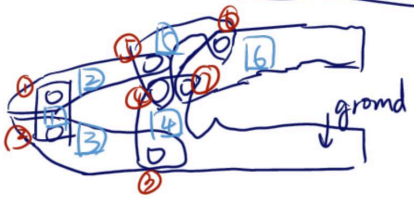
The way is works is firstly long handles act as a simple lever. Secondly between the main handle pivot and the jaw. When user give a force on the handle, the input force will be channeled through a set of short rubust links, so there are two times force becomes larger. then jaw closed and cut.

(3)(4) open.



we can think of this as ground

closed



Agreed And predict can be seen that when link 6 move, all left part move jaw closed as follows. no other freedom.

(5) link 6 full joint 7

DOF = 3x(6-1)-2x7=1 rotational freedom

Question assigned to the following page: 4

Select one of the following options:

a) My answer was created by a Gen AI algorithm, and I have not modified it
b) My answer was created by a Gen AI algorithm, and I have made some minor changes.
c) My answer was created by a Gen AI algorithm, and I have made major changes.
d) My answer was created solely by myself.
e) If I used Gen AI, I used ___ (name of program).