# eCOLAB 4.0

"Innovative, collaborative and interoperable tools for improved higher education curricula on sustainable Industry 4.0 manufacturing"

## Collaborative Exercise Proposal


**Co-funded by the European Union**

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VNiVERSiDAD D SALAMANCA

DEX Desarrollo de Estrategias Exteriores

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## The Challenge

The proposal is to design a vehicle spoiler (Fig.1) whose size will be 180x740 mm2, that will provide additional downforce to the vehicle at speeds between 80 and 180 km/h.

Figure 1. a. Sport car b. Rear spoiler detail c. Mechanism spoiler detail

The Spoiler support mechanism is a four-bar mechanism driven by a crank-rod mechanism (Fig.2). The mechanism will be capable of reaching four positions: folded, deployed and two intermediate positions.

Figure 2. a. at the front it can be seen the crank-rod mechanism b. General view of the support mechanism

The designation of the bars appears in figure 3 whose dimensions are (Table 1).

**Important**: Two options are presented, the full mechanism (real) and a simplified version of the mechanism, that can serve as a starting point; the student decides the strategy to follow

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Figure 3. Designation of the bars

| Bars | dimensions (mm) | | Distances | length (mm) |
|---|---|---|---|---|
| r2 | 100 | | AB | 60 |
| r3: | 130 | | O3-D | 45 |
| r4 | 35 | | 0102 (original) | See Fig. 4 |
| r5 | 80 | | O1O3(original) | See Fig. 4 |
| r 6 | 100 | | 0102= O1O3 (simplified model) | 100 |

Table 1. Dimensions of the bars & Distances (Original mechanism & simplified model)

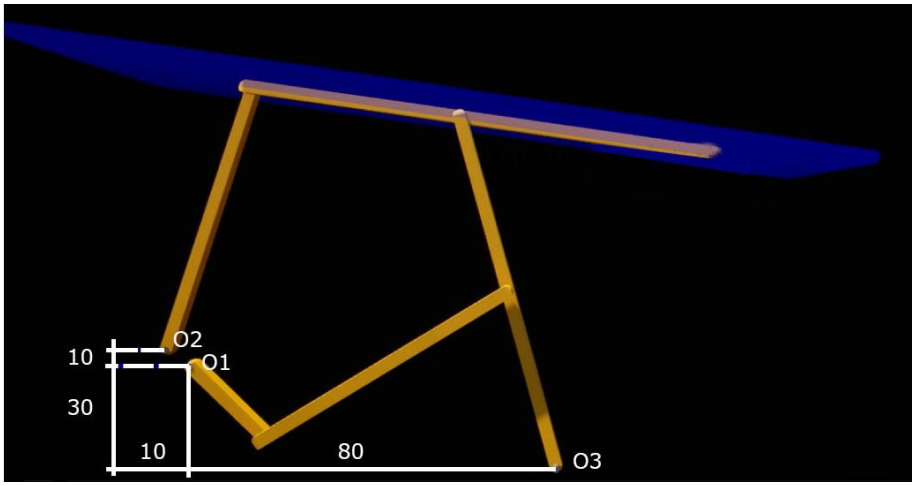



Figure 4. Distances between centres of rotation (points on the fixed element - chassis), mm.

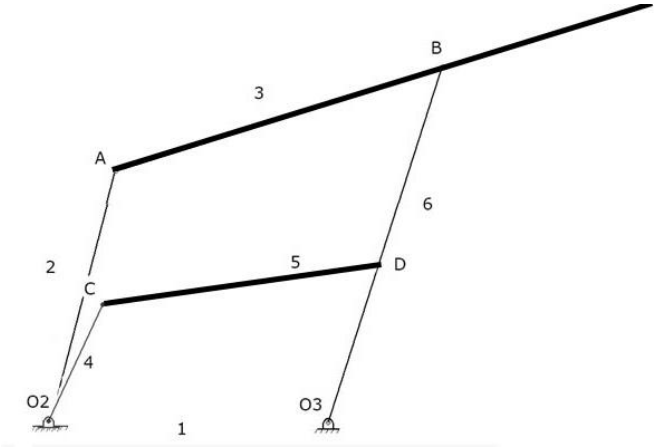
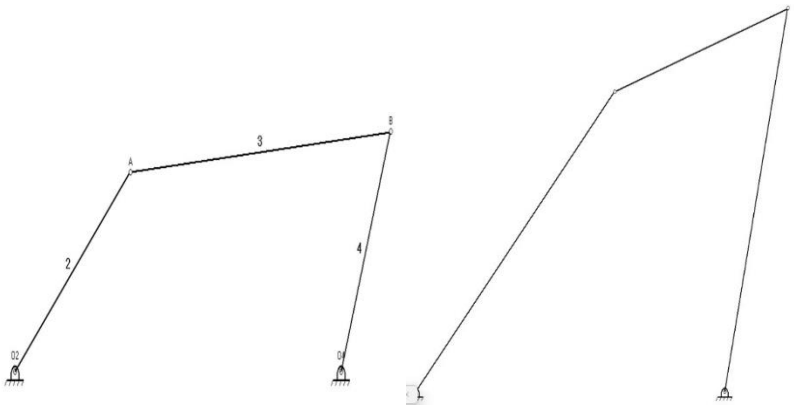



Figure 5. bone structure of the mechanism: simplified version



b. c.

Figure 6.a bone structure of the mechanism: b. Driven mechanism c. Spoiler support structure

Remember, you can select the version to run: the full version or the simplified version.

## Design aspects to be selected:

### Compulsory task :

1. 3D design of the spoiler and the links of the mechanism
2. Kinematic simulation of the mechanism

## Optional task:

A minimum of 1 task must be selected, optionally 2

1. Structural design of the links: Design the bars to withstand the dynamic load exerted by the air pressure on the spoiler
2. Aerodynamic design of the spoiler: Spoiler design: relates the force exerted by the air (pressure on the spoiler) as a function of the extreme positions that the mechanism can reach.
3. Material selection: Select the best material based on the strength-to-weight ratio.
4. Industrial design from an aesthetic perspective: Create an attractive product design aimed at the vehicle modification market.
5. Automation: mechanism actuation and control: Design the control system and/or the motorization of the mechanism
6. Manufacturing process, prototyping: Design the manufacturing process for the mechanism and/or evaluate manufacturing costs. Another alternative is to generate the G-code for 3D printers.
7. Digital Twin: Create a digital twin using Unreal Engine

## Evaluation

- Teamwork dynamics and individual contributions.
- Problem-solving process
- Technical achievements.
- Collaborative work