

Description: The exam has two parts. On the front of this page you have three problems to be answered by hand on paper and delivered to the professor when you are done. On the back of this page you have two problems to be delivered at <https://examens.fib.upc.edu> before the exam ends. Both consist of thinking and programming something, and both include writing some explanation in the HTML file.

Duration: 4 hours.

Publication of final grades: Wednesday, June 28, through the Racó.

Revision: Anyone wishing to revise his grades should 1) send us an e-mail before Thursday, June 29 at 23:59 and 2) show up in the following room on Friday, June 30 at 10:00: Campus Nord, Omega Building, 4th floor, door 422.

Problem 1. [2 points] Deliver on paper. Let C_1 and C_2 be two Bézier curves of degree 9 in the plane, with the last control point of C_1 equal to the first control point of C_2 . We want to connect them so that the resulting curve is C^2 -continuous at the connecting point.

1. Describe what we need to do.
2. Prove why it works.

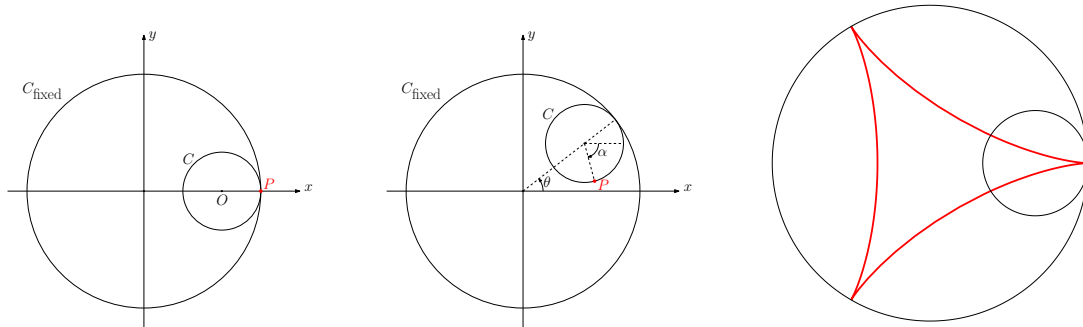
Problem 2. [1 point] Deliver on paper. We need to construct a piece-wise curve in the plane, where one of the pieces of the curve must be a half-circle.

1. Which of the many types of curves studied in class would you use?
2. Why?
3. Describe all the necessary details of how you would do it.

Problem 3. [1 point] Deliver on paper. Describe the strategy you would use to design in 3D a pipe like the one in the image.



Problem 4. [3 points] Deliver through the Racó. In the plane, let C_{fixed} be a circle centered at the origin $(0,0)$. The radius of C_{fixed} is three times the radius of another circle C , which is interior to C_{fixed} and tangent to it at a point P belonging to the positive semi-axis Ox^+ , as illustrated in the left figure. Assume that the interior circle C rolls inside the fix circle C_{fixed} . Your goal is to parametrize the curve described by point P along this rolling movement, and to write a program to show the result on your screen. The result should be similar to the red curve in the rightmost figure.



In order to obtain a parametrization of the curve, please use the parameter θ , which is the polar angle of the center O of the rolling circle C , as illustrated in the middle figure. Hint: It may become useful for you to compute the value of the angle α that you can see in the middle figure.

Note: In the HTML file that you will deliver, please include a brief description of the strategy you have followed and a justification of the correctness of your steps.

Problem 5. [3 points] Deliver through the Racó. Write a program to draw the outer surface (ignoring all little details) of the following canteen:



front



back

Note: In the HTML file that you will deliver, please include a brief description of the strategy you have followed and the design decisions you have made.