



U5.5 Tuning

Name _____

Class _____

Date _____

What this lesson is about

Finding the gain where it oscillates, and working back from there to something usable.

- The Ziegler-Nichols method
- Finding Ku on this robot
- Tuning by hand, with the chart
- Do it in the right order
- The gains are not universal

Questions

7 marks in all

1. The Ziegler-Nichols PID row from the lesson, for a measured Ku and Tu. What does it print? [1 mark]

```
KU, TU = 10.0, 1.6
kp = 0.6 * KU
ki = 1.2 * KU / TU
kd = 0.075 * KU * TU
print(round(kp, 2), round(ki, 2), round(kd, 2))
```

2. Ku = 8 and Tu = 2 s. What Ki does the Ziegler-Nichols PI row give? Give two decimal places. [1 mark]

3. Ku = 9. What Kp does the Ziegler-Nichols P-only row give? [1 mark]

4. Ziegler-Nichols gains make the robot swing lively, each swing a quarter of the last. What is a common and sensible next move? [1 mark]

- ☐ A Halve Kp
- ☐ B Double Ki
- ☐ C Remove Kd
- ☐ D Double Ku and recompute

5. The response arrives, settles short of the target, and stays short. What should change? [1 mark]

- ☐ A Add or raise Ki
- ☐ B Raise Kd
- ☐ C Lower Kp
- ☐ D Filter the measurement

6. The response shows a slow, wallowing oscillation. What should change?

[1 mark]

- ☐ A Lower Ki
- ☐ B Raise Kp
- ☐ C Raise Kd
- ☐ D Run the loop slower

7. In what order does the lesson say to bring in the three terms?

[1 mark]

- ☐ A P, then D, then I
- ☐ B P, then I, then D
- ☐ C I, then P, then D
- ☐ D All three at once from Ziegler-Nichols, then fine tune

The task: find the ultimate gain

Run the heading loop at several gains, print the swing at each, and print `ku:` and `tu:`.

```
from bugbot import *  
connect()  
  
DT = 0.25
```

Plan your program here, then type it in and press Run.



Do it on the robot

www.bugbotlab.com/learn/u5-5-tuning/

The simulator checks it and tells you when it passes. Nothing to install, no account.

Challenges

1. Apply the Ziegler-Nichols PID row and run it on the quarter turn. Is it as lively as the table warns, and which term is to blame?
2. Halve the resulting Kp and compare the two responses. Then try cutting Ki instead.
3. Find Ku again with the loop looking ten times a second, DT = 0.1. How much does Ku rise, and why?