Control Theory-

Though control theory is very very wide, like I am not informed enough to explain to you what it's application is, but from my understanding-

Take any system, a robot, a plane, a washing machine, anything. The Dynamics of the system represents all the parameters controlling it. Understanding the dynamics means that knowing what input will give you what output.

Eg- In a car, pressing the accelerator would speed up the car.

Now what control theory does is, if you know the dynamics, you got to determine the input to be put to get the desired output. Uses a lot of mathematical tools and maybe you'll see it is also what RL Does.

Now it's not as easy as it sounds because the world is not perfect, it has dissipative forces and so our actual output is rarely equal to the desired output, there is always some error initially, and for this, we take continuous feedback from the system regarding the current state, then we calculate the error by comparing it with the desired state and then try and reduce the error. This is done by taking continuous feedback from the system.

Aim-

Now control theory has many applications, I think a nice one would be-

Develop a flight controller for a quad-copter.

This may be focused on drones but if you follow it properly, you can apply it for any control project. Drone is chosen because of how accessible the resources are. So it's basically just a representation for any system.

Things you'll learn-

1) PID Control
2) Dynamics of a quad-rotor
3) Mathematical Modelling using Newton Euler equations and Quaternions
4) MATLAB
5) Simulating in MATLAB
6) Finally building your own flight controller
7) Tuning the gain parameters.

Sources-

- Basic PID-

Link- https://www.youtube.com/watch?v=wkfEZmsQqiA&list=PLn8PRpmsu08pQBgjxYFXSsODEF3Jqmm-y

These tutorials are great, PID is one of the most basic concept of Control theory, but is has so many uses, the simplest of which you might be aware of is Line Follower Bot.

- Basics of Robotics-

Book- Robot Dynamics and Control Paperback by M. Vidyasagar ,Mark W Spong

Read the first 5 chapters, they very nicely explain how to model any robotic system

- Aerial Robotics-

Link- https://www.coursera.org/learn/robotics-flight/home/welcome

A great course by Penn University will make you understand the process of working of autonomous Quadcopter, you will also work on simulations in MATLAB, it's like a really good thing. Ensure that you do all the assignments

- Programming in Matlab-
  Link-
  https://www.youtube.com/watch?v=6iN56l7dEMY&list=PLYdXvSx87cgRJfv6gZl7GjAs0GNvyg-uS
  Refer to these tutorials as Matlab is the Environment where we'll be running our simulations.

- Make your own Flight Controller from Scratch-

Link-
https://www.youtube.com/watch?v=hGcGPUqB67Q&list=PLn8PRpmsu08oOLBVYYIwwN_nvuyUqEjrj

A very nice series, by Brian Douglas and Matlab techtalk. Complete in itself, you don't need anything else.

More Projects-

https://matlab.projectsqa.com/c/control-systems-projects

Matlab Control Tutorials:

Link: http://ctms.engin.umich.edu/CTMS/index.php?aux=About_Tutorials