ELECTRONICS & ROBOTICS CLUB
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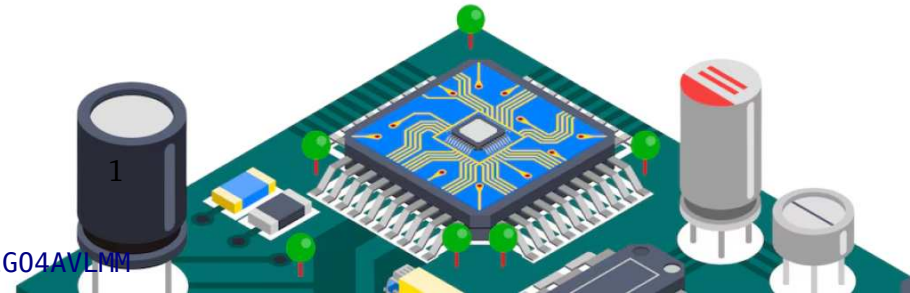
Control Theory Bootcamp
Course Outline

Detailed Week-wise Plan of Content Coverage

Week 1:
This week lays the theoretical groundwork for control systems. You'll learn how to model dynamic systems using differential equations and transfer functions, analyze system stability, and understand the role of feedback in control. Core concepts such as open-loop vs. closed-loop systems, time and frequency domain analysis, and performance metrics like rise time, settling time, and overshoot will be covered. This week ensures you have a strong analytical base before moving into simulation and design.

Week 2:
This week marks the transition to practical implementation using MATLAB Simulink. You'll learn to simulate control systems and implement classical PID controllers, understanding how to tune them using methods like Ziegler–Nichols and trial-and-error in a visual modeling environment. The week also introduces the Linear Quadratic Regulator (LQR) — a state-space-based optimal controller — giving you a deeper perspective on modern control techniques. You'll compare PID and LQR in terms of design philosophy, performance, and application.

Week 3:
Here, theory meets application. Using the simulated model of a self-balancing bot (inverted pendulum on wheels), you'll apply the controllers designed in Week 2 to stabilize the system. This involves identifying system dynamics, designing appropriate feedback loops, and fine-tuning controller parameters like step rise, output, LQR gain factors, and experience handling real-world challenges like noise, disturbance rejection, and control signal saturation.



Week 4:
In the final week, you'll extend the functionality of the stabilized bot to include movement and steering. This includes designing control logic for smooth forward, backward, and turn motions — while maintaining balance. You'll also work on refining your system's response to varying setpoints and potentially integrating higher-level command inputs. By the end of the week, you'll have a fully simulated, controllable self-balancing robot built from the ground up.

Further Weeks (if needed):
These can be planned based on participant progress and interest in advanced topics.

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