# Motor & Energy Control Study and Research Checklist

## 📆 8-Week Learning Checklist

### Week 1 – Motor Fundamentals

* - Study types: DC, AC, BLDC, PMSM, SRM
* - Watch MIT OCW or NPTEL lectures
* - Read: Electric Machinery by Stephen Chapman

### Week 2 – Power Electronics Basics

* - Study MOSFETs, IGBTs, and H-Bridge inverters
* - Simulate H-Bridge with PWM in LTSpice
* - Review protection circuits: flyback diodes, snubbers

### Week 3 – DC Motor Control

* - Design PID controller in MATLAB Simulink
* - Test closed-loop speed control on Arduino or STM32
* - Tune PID gains for optimal response

### Week 4 – BLDC Motor Control

* - Study commutation with Hall sensors and sensorless methods
* - Simulate BLDC in MATLAB Simulink
* - Implement open-loop control on microcontroller

### Week 5 – Field-Oriented Control (FOC)

* - Learn Clarke & Park transformations
* - Use ST Motor Control Workbench or TI InstaSPIN
* - Simulate FOC strategy in MATLAB

### Week 6 – Energy Efficiency & Regenerative Braking

* - Study regen braking in electric vehicles
* - Simulate bidirectional inverter with regen mode
* - Calculate energy recovery efficiency

### Week 7 – Advanced Control Techniques

* - Study Model Predictive Control (MPC), fuzzy logic, and neural networks
* - Simulate AI-assisted motor control
* - Read 2–3 IEEE papers on intelligent motor control

### Week 8 – Publication Phase

* - Choose article topic (e.g., Embedded FOC for BLDC)
* - Collect 10+ academic papers
* - Run simulations, create plots and figures
* - Draft abstract, intro, methodology, and results

## 📝 Suggested Article for Publication

\*\*Title:\*\* Sensorless Field-Oriented Control of a BLDC Motor Using Low-Cost Microcontroller Platform

### Abstract

This paper presents the design and implementation of a sensorless field-oriented control (FOC) algorithm for a BLDC motor using a low-cost STM32 microcontroller. The study aims to enhance efficiency and reduce hardware complexity in embedded motor control applications, especially for electric mobility and energy-sensitive systems.

### Keywords

BLDC motor, Field-Oriented Control, Sensorless control, STM32, Embedded systems, Energy efficiency

### Sections Outline

1. 1. Introduction – background, motivation, and objectives
2. 2. BLDC Motor Modeling – equations and simulation model
3. 3. Sensorless FOC Algorithm – Clarke/Park, PI control, estimation method
4. 4. Embedded Implementation – STM32 setup, coding structure, interrupt routines
5. 5. Results – simulation plots, waveforms, efficiency
6. 6. Discussion – comparison with traditional methods, benefits and challenges
7. 7. Conclusion – key takeaways and future work