NPTEL ONLINE CERTIFICATION COURSES

DIGITAL CONTROL IN SMPCs AND FPGA-BASED PROTOTYPING

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Module 01: Introduction to Digital Control in SMPCs

Lecture 02: Digital Control of SMPCs – Course Instructions, Guidelines & Resources

CONCEPTS COVERED

- Course components – Theory, programming, simulation, hardware implementation

- Course components for assignments and final exams – Theory & programming only

- Additional tutorial videos for further study, not for assignment and exam

- Hardware demonstrations – using FPGA and microcontrollers

- Theory, programming, hardware resources

Digital Control in SMPCs – Course Components

❑ *Architectures* – Digital Control architectures, modulation & sampling techniques

❑ *Model development using MATLAB*

❑ *Theory* – Modeling, analysis and design of digital control methods

❑ *Programming* – Verilog HDL programming with FPGA prototyping

❑ *Implementation* – Digital control using FPGA, STM32 and C2000 uCs

❑ *Hardware demos* – buck & boost converters, PFC & LLC converters

Interesting Features in this Course

❑ *Design and implementation* using Verilog HDL and FPGA based prototyping

❑ *Buck/Boost Converters* – Schematic, BOM, layout, Verilog HDL files to be provided

❑ *Digital Control Demos* using STM32 uC by experts from STMicroelectronics

❑ *Digital Control Demos* using C2000 uC by experts from Texas Instruments

❑ *Mixed Signal Oscilloscope Demo* by experts from Tektronix

Complete Test Set-up for Extensive Demonstration using FPGA kit
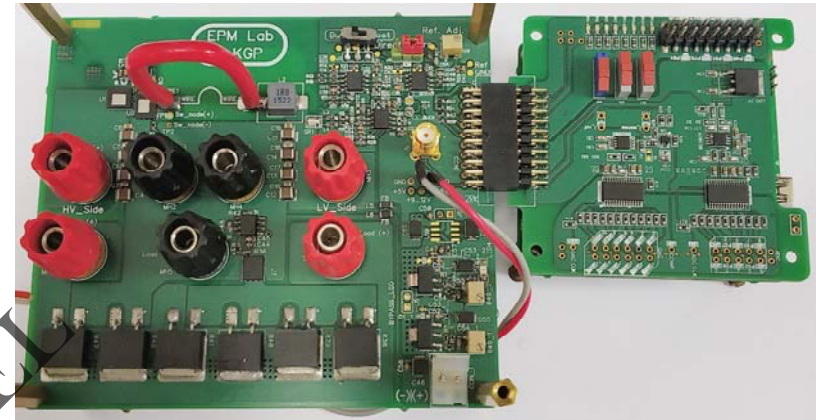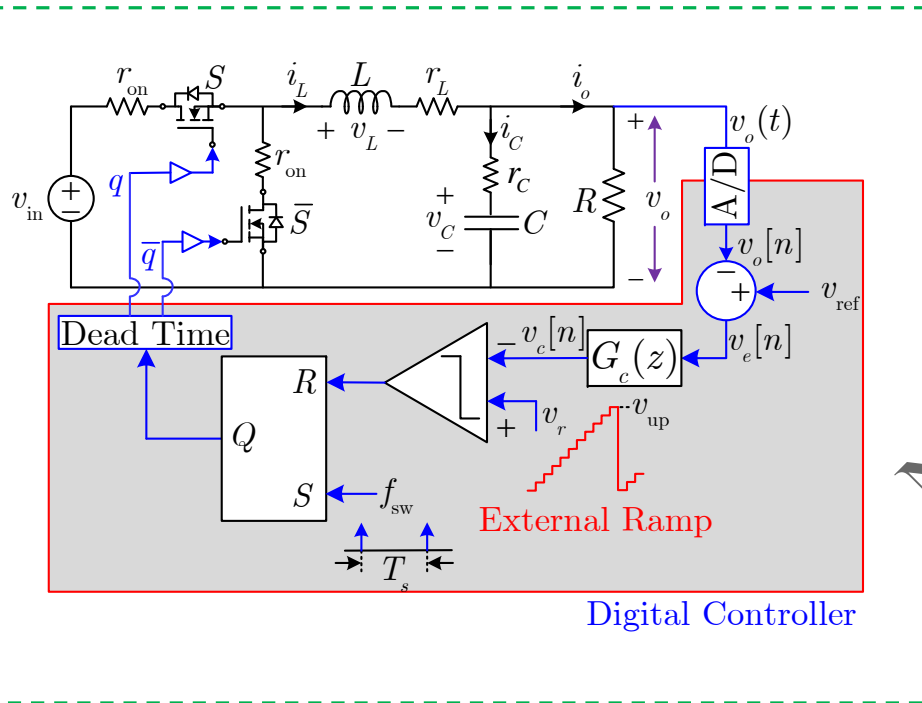
Complete closed-loop test set-up
for this online course

Course Components for Assignments and Final Exams

❑ *Architectures* – Understanding various digital control architectures to be covered

❑ *Modulation and sampling methods* – Understanding all relevant topics to be covered

❑ *MATLAB simulation* – basic digital control simulation for verifying basic concepts

❑ *Theory* – Modeling, analysis and design of digital control methods

❑ *Programming* – Verilog HDL programming with FPGA prototyping

❑ *Steps for implementation* – Understanding relevant steps to be covered

Course Components – *Not Included in Assignments and Final Exams*

❑ *Hardware implementation* – **Not mandatory !!** (interested participants may try)

❑ *Verilog HDL simulation using Xilinx ISE simulator* – **Not mandatory !!**

❑ *Xilinx FPGA prototyping* – **Not mandatory !!**

❑ *Implementation using STM32 microcontroller* – **Not mandatory !!**

❑ *Implementation using C2000 microcontroller* – **Not mandatory !!**

❑ *Simulation and hardware validation* – **Not mandatory !!**

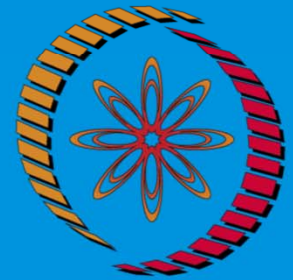# Demonstration Lectures – *Not Included in Assignments or Exams*

REFERENCES

- NPTEL online certification course "Control and Tuning Methods in Switch Mode Power Converters" – already available on YouTube (reference for various analog control methods)

- S. Kapat and P. T. Krein, "A Tutorial and Review Discussion of Modulation, Control and Tuning of High-Performance DC-DC Converters based on Small-Signal and Large-Signal Approaches" IEEE Open Journal of Power Electronics, vol. 1, pp. 339 - 371, Aug. 2020.

- R. W. Erickson and D. Maksimovic, Fundamentals of Power Electronics, 3rd Ed., Springer, 2020

- L. Corradini, D. Maksimovic, P. Mattavelli and R. Zane, Digital Control of High-Frequency Switched-Mode Power Converters, NJ, USA:Wiley, 2015.

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THANK YOU !