

Course Number: EE623P

Course Name: Practicum on Digital Control of Power Electronics and Drives

Credits: 1-0-4-3

Prerequisites: Switch Mode Power Conversion (EE504), Fundamentals of Electric Drives (EE508), Analysis and Design of Power Electronic Converters (EE527)

Intended for: PG/UG

Distribution: Core for M. Tech (PED), Elective for UG and other PG courses

1. Preamble: Practicum on Digital Control of Power Electronics and Drives is a lecture + laboratory course designed to provide the students with a hands-on experience on practical implementation of digital control of power electronic converters and motor drives using microcontroller/Field Programmable Gate Array (FPGA). This course will help the students to explore the benefits and challenges of implementing digital control.

2. Course Modules with Quantitative Lecture Hours: This course has an hour of lecture session accompanied by four hours of laboratory session per week. List of course modules and experiments are provided below.

- I. Introduction to digital control, microprocessor/FPGA **(5+20 hours)**
Lecture: Why digital control, challenges in digital platform, fixed-point and floating-point representations, sampling, mathematical modelling of sampling, quantization and its impact on stability, s-domain to z-domain mapping (tustin, forward difference, backward difference), stability analysis in z-domain, discretization of analog controllers.
Laboratory: Implementation of various building blocks (ADC sampling, PWM block, controller block) required for closed-loop control of power electronic converters (using C/Verilog coding).
- II. Closed-loop control of DC-DC converters **(5+20 hours)**
Lecture: Controller design techniques, discretization of analog controllers, different types of delays introduced by the digital controllers.
Laboratory: Implementation of digital voltage mode control, load transient performance, soft start-up, anti-windup arrangement.
- III. **Lecture:** Digital Proportional-Resonant and Proportional Integral controller design for a single-phase and a three-phase voltage source inverter
Laboratory: Implementation of a single-phase voltage source inverter with different loads (standalone case), digital controller design and implementation of different modulation techniques in a three-phase voltage source converter **(2+8 hours)**
- IV. **Lecture:** Design of a digital controller in a buck fed DC motor
Laboratory: Digital implementation of closed-loop control **(1+4 hours)**
- V. **Lecture:** Digital V/F controller design in an induction machine
Laboratory: Implementation of digital V/F control **(1+4 hours)**

3. Textbooks:

B. C. Kuo, *Digital Control Systems*, Oxford University Press, 2012

N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics Converters, Applications, and Design*, 3rd ed., Wiley India, 2008



4. References:

[S. N. Vukosavic](#), *Digital Control of Electrical Drives*, springer, 2017

R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, 2nd ed. Dordrecht, The Netherlands: Kluwer, 2001.

Similarity Content Declaration with Existing Courses: N/A

Justification for new course proposal if cumulative similarity content is >30%: N/A

Approvals:

Other faculty interested in teaching this course: Dr. Himanshu Misra

Proposed By: Dr. Amit Kumar Singha

Signature:

Recommended/Not Recommended, with comments:

Chairman, CPC

Approved/Not Approved

Chairman, Senate

School: SCEE

Date:

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Institute of
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