

IIT Mandi
Proposal for a New Course

Course Number: EE 623P

Course Name: Practicum on Digital Control of Electric Drives

Credits: 1-0-3-3

Prerequisites: Fundamentals of Electric Drives (EE508) and Practicum on Electric Drives (EE 508P)

Intended for: UG/PG

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

Semester: Even (Feb-May)

1. **Preamble:** Practicum on Digital Control of Electric Drives is a lecture + laboratory course designed to provide the students with a hands-on experience of working with practical implementation of motor drive control using digital processors. This is a highly application-oriented course in which the prior knowledge of electrical machines and drives, control systems and microprocessors will be put to actual use. This course is very relevant and vital from the state-of-the-art drive control perspective.

2. **Course Modules with Quantitative lecture hours:** This is a lecture + laboratory course with 1-hour of classroom session accompanied by 3-hour laboratory sessions per week. Following is the list of course modules and experiments (numbered).
 - **Introduction to Microcontrollers and Digital Signal Processors (2+6 hours)**
Content: Review of microcontrollers and digital signal processors - numerical capabilities and peripheral units, Fixed and Floating point architectures, Real-time programming in assembly and C languages, Review of numerical methods for solving of ODEs
Laboratory: Numerical simulation of simple motor models (e.g. DC motors), use of look-up tables, study of numerical method errors and accuracy

 - **Digital simulation and implementation of machines and drives concepts (3+9 hours)**
Content: Reference frame transformation, PLL implementation, PWM implementation - including space vector PWM, machine models, harmonic and reactive power compensation,
Laboratory: A few lab sessions will be designed to practice the concepts taught above.

 - **Digital control of drives - simulation and implementation (7+21 hours)**
Content: Discrete time control of current, torque, flux, speed and position, cascade controllers, sensing and sampling of motor quantities, interfacing issues with digital processor, estimation of flux, torque and speed, digital implementation of FOC and DTC of induction motor, digital implementation of drive protection



Laboratory: Implementation of closed loop AC drive control using the concepts learned in this module. This session could be in the form of a course project, which can continue over multiple sessions.

- DSP based monitoring and diagnosis (2+6 hours)

Content: Introduction to fault diagnosis, early detection of fault, introduction to online condition monitoring, real-time FFT spectrum computation, introduction to parameter estimation algorithms

Laboratory: A couple of demo/experiment sessions focused on fault detection and diagnosis

3. Textbook

1. Krause, P. C., Wasynczuk, O., Sudhoff, S. D., Analysis of Electric Machinery and Drive Systems, New York, Wiley-Interscience, 2003.
2. Vas, P., Parameter estimation, condition monitoring, diagnosis of electrical machines, Oxford Science Publications, New York, 1993.

4. References:

1. W. Leonhard, Control of Electrical Drives, Springer-Verlag Berlin Heidelberg, 2001.
2. Vas, P., Sensorless vector and direct torque control, Oxford University Press, New York, 1998.

5. 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:

Proposed by: Dr Bhakti Joshi

Signature: _____

Recommended/Not Recommended, with Comments:

_____ Chairman, CPC

Approved / Not Approved

_____ Chairman, Senate

School: SCEE Date: