E3252 Embedded Systems Design for Power Applications (3:1)

The first part of the course is about learning the MCU (TMS320F28379D). The second part is to apply all this learning for a successful embedded system design of a simple power electronic converter that captures most of the essential aspects of the subject.

Part A

Introduction to embedded systems design of a power electronic converter. Introduction to the real-time processors-microcontrollers with DSP engine. Reading the datasheet of an MCU. Minimum hardware design to make an MCU operational: Introduction to the concept of a launchpad. Software initialization: clock, watchdog timer, Flash memory etc. Introduction to embedded C and modular programming (LAB1). Introduction to interrupts and peripherals-Timer and GPIO (LAB2). Memory organization-ROM, RAM (local, global, message etc.), linker files, structure, and location of special function registers. Placing a table in ROM (LAB3). Inter-processor communication (IPC-LAB3), control law accelerator (CLA-LAB3). PWM peripheral (complimentary with deadtime, HRPWM, Trip zone) (LAB4), quadrature encoder peripheral (QEP-LAB4). UART communication with a GUI developed in visual studio on PC over MODBUS protocol (SCI-LAB5). SPI communication with an external DAC IC (LAB6). I2C communication with an external EEPROM IC (LAB6). Analog signal conditioning, biasing and calibration, ADC and DAC peripheral (LAB7). Fixed point arithmetic with C, intrinsic and mixed assembly coding (LAB8).

Part B

Embedded systems design of a simple power converter-multiloop programming-protection, supervisory control, communication, monitoring, debugging etc. Codesign with CPU1, CPU2 and CLA (LAB9). Dynamic modelling of the converter, nested loop feedback controller design, modelling the ADC and PWM modulator, digital implementation in fractional arithmetic, limit cycle oscillation (LAB10). Controller implementation using FPU and CLA (LAB10).