Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

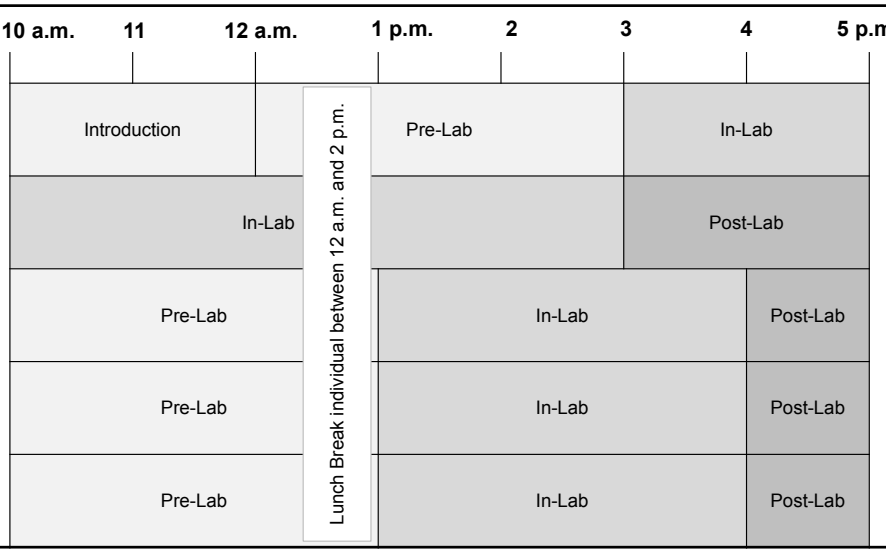
Institute for Dynamic Systems and Control
IDSC
Institut für Dynamische Systeme und Regelungstechnik

151-0593-00L

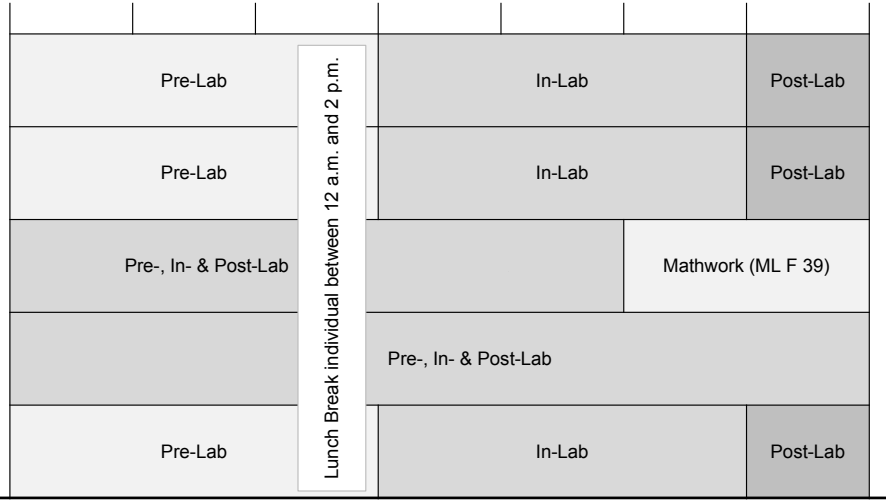
Schedule Embedded Control Systems (Fall 2023)

Dr. M. Schmid Daners Prof. J. Freudenberg

Lectures Week 1 (8 to 10 a.m.) ML H 41.1			Lab in Room ML J 44.0 - 44.1	
No.	**Date**	**Topic**	**No.**	**Topic**
1	**2023-09-11**	Course introduction. Start on A/D conversion, sampling and aliasing; simple anti-aliasing filter design	**1**	Familiarization and Digital I/O. Reading in S32K144 Reference Manual, introduction to hardware (oscilloscope, signal generator, etc.)
2	**2023-09-12**	Finish A/D conversion, sampling and aliasing; simple anti-aliasing filter design; introduction to Matlab and Simulink; demonstrate Simulink by doing "Problem set 1" filter design.	**1**	Continue with Lab 1
3	**2023-09-13**	Introduction to Stateflow, in particular, demonstrate problem set 2, building a Stateflow quadrature decode model. Introduction to DC motors; derive steady-state motor equations. Present lecture material on optical encoders, quadrature decoding, over/underflow and typecasting.	**2**	Quadrature Decoding using the FlexTimer Module
4	**2023-09-14**	Discuss motor control (speed control, torque control, power amplifiers); Pulse width modulation; virtual worlds, wall "chatter" and the virtual wall.	**3**	Analog-To-Digital Conversion
5	**2023-09-15**	Dynamic systems and transient specifications (review); develop dynamic motor model block diagram and implement in Simulink (domonstrate problem set 3). Develop motor frequency response and demonstrate input PWM attenuation.	**4**	Pulse Width Modulation and Simple Virtual Worlds



Lectures Week 2 (8 to 10 a.m.) HG E 23			Lab in Room ML J 44.0 - 44.1	
No.	**Date**	**Topic**	**No.**	**Topic**
6	**2023-09-18**	Develop Stateflow model of the virtual wall (demonstrate problem set 5). Develop virtual spring-mass system dynamics (harmonic oscillator). Introduce Euler Integration and pseudo-code for the spring-mass system.	**5**	Interrupts, Timing, and Frequency Analysis of PWM Signals
7	**2023-09-19**	Introduction to z-transforms and numerical instability. Develop the virtual spring-mass-damper (calculate how much damping is required to create a discrete harmonic oscillator using Forward Euler). Introduce state-space notation. Discuss other numerical integration methods; discuss how Matlab does numerical integration.	**6**	Virtual Worlds with Dynamics
8	**2023-09-20**	Software architecture, real-time operating systems and scheduling algorithms. Rapid prototyping and automatic code generation.	**7**	Introduction to Autocode Generation
9	**2023-09-21**	Software architecture; presentation of MathWorks on Autocode generation with SIMULINK	**7**	Continue with Lab 7
10	**2023-09-22**	Introduction to CAN networks.	**8**	Controller Area Network



IMPORTANT: You must attend 8 lab sessions and hand in all 8 assignments (pre-, in- and post-lab) to receive credit for the course. Pre-labs are due at the start of the In-labs, Post-labs are due at **5 p.m.**