

Course schedule: Modeling Process Dynamics

January 2, 2020

This page lists the days of class, and the topics we will probably cover on those days. If there is no topic on a day, that just means I have not decided what we will talk about on that day. Do not be surprised if these are updated only a few days in advance.

1 Class schedule

- 1.1 **<2020-01-07 Tue 09:30> Introduction** ./lectures/00-intro.org
- 1.2 **<2020-01-09 Thu 09:30> Python/Jupyter** ./lectures/01-jupyter.org
- 1.3 **<2020-01-14 Tue 09:30> Mathematical modelling** ./lectures/01-modelling.org
- 1.4 **<2020-01-16 Thu 09:30> Q1 First principle modelling** ./lectures/02-modelling.org
 - conservation of mass
 - conservation of momentum
 - conservation of energy
 - examples
 - lumped parameter system
- 1.5 **<2020-01-21 Tue 09:30> Integration of models given by first order ordinary differential equations and numerical integration** ./lectures/03-fode-1.org
 - Solution to $y' = -ay$ numerical and analytical
 - Python coding of numerical solution
 - solution by Eulers method for scalar equation

- 1.6 <2020-01-23 Thu 09:30> Systems of first-order differential equations ./lectures/04-fode-1.org
- systems of equations
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- 1.7 <2020-01-28 Tue 09:30> Linear systems ./lectures/05-Lin-1.org
- 1.8 <2020-01-30 Thu 09:30> Basic Models in Chemical Engineering ./lectures/06-Lin-2.org
- 1.9 <2020-02-04 Tue 09:30> Preparation Exam
- 1.10 <2020-02-06 Thu 09:30> Exam I
- 1.11 <2020-02-11 Tue 09:30> Continuous and discrete models and representation ./lectures/07-Cont-Discr-1.org
- 1.12 <2020-02-13 Thu 09:30> Time delay systems ./lectures/07-Cont-Discr-2.org
- 1.13 <2020-02-18 Tue 09:30> Reading Week
- 1.14 <2020-02-20 Thu 09:30> Reading week
- 1.15 <2020-02-25 Tue 09:30> Q2 Transfer function models ./lectures/08-Transfer-function-01.org
- 1.16 <2020-02-27 Thu 09:30> Transfer function link to State Space ./lectures/08-Transfer_function-02.org
- 1.17 <2020-03-03 Tue 09:30> Mathematical model properties, controllability and observability ./lectures/09-Linear-System-properties.org
- 1.18 <2020-03-05 Thu 09:30> Q3 Discrete based models ./lectures/10-discrete-Linear-System-setting.org
- represent general linear discrete system
 - provide a difference equation
 - provide an operator representation
 - shifting back operator realization

- graphical representation
- Z-transform and linear system
- Response of the system

1.19 <2020-03-10 Tue 09:30> Discrete model response and properties ./lectures/11-discrete-system-setting-response.org

- link continuous and transfer function representation by Caley
- Response of the system $G(z) = k \frac{1}{z-a}$
- Controllability and observability revisited

1.20 <2020-03-12 Thu 09:30> Preparation II

1.21 <2020-03-17 Tue 09:30> Exam II

1.22 <2020-03-19 Thu 09:30> Linear regression I ./lectures/12-linear-regression.org

- Curve fitting problem (John Kitchen)
- An example of polynomial fit
- Confidence interval on parameters
- Regularisation
 - Ridge regression
 - Lasso regression

1.23 <2020-03-24 Tue 09:30> Least square estimation ./lectures/13-least-square-estimation.org

- Least square estimation
- Estimation of constant
- Weighted least square
- recursive least square - curve fitting revisited

1.24 *<2020-03-26 Thu 09:30>* **System identification** ./lectures/14-system-identification.org

- Response of the system $G(z) = k \frac{1}{z-a}$
 - 1 st order response - step system identification
 - * Example: data based modeling of linear system
 - * Data modeling based identification
 - * first -order model

1.25 *<2020-03-31 Tue 09:30>* **Principal Component Analysis** ./lectures/15-PCA.org

1.26 *<2020-04-02 Thu 09:30>* **Final Exam Preparation**