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Detailed Course outline for ChemE 466, Fall 2008

Date	Topics	Reading and Lecture assignments	Lecture feedback due	Homework Due
9/2	• Introduction, course organization • Modeling Basics, 1. Verbal Modeling	**Lecture:** #1, #2, #3 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Help http://controls.engin.umich.edu/wiki/index.php/VerbalModeling		
9/4	• Modeling Basics, 2. incidence graphs	**Lecture:** #4 **Reading:** http://controls.engin.umich.edu/wiki/index.php/IncidenceGraphs	Lecture #1, #2, #3, #4	
9/9	• Modeling Basics, 3. Excel modeling part 1	**Lecture:** #5 **Reading:** http://controls.engin.umich.edu/wiki/index.php/ExcelModelingGeneral	Lecture #5	HW #1
9/11	• Modeling Basics, 3. Excel modeling part 2	**Lecture:** #6 **Reading:** http://controls.engin.umich.edu/wiki/index.php/ExcelModelingGeneral http://controls.engin.umich.edu/wiki/index.php/NoiseModeling http://controls.engin.umich.edu/wiki/index.php/Fitting_ODE_parameters_to_data_using_Excel	Lecture #6	
9/16	• Modeling Basics, 4. Numerical ODE solving in Excel • Modeling Basics, 5. Solving ODEs with Mathematica	**Lecture:** #7 **Reading:** http://controls.engin.umich.edu/wiki/index.php/ExcelModelingODE http://controls.engin.umich.edu/wiki/index.php/Solving_ODEs_with_Mathematica	Lecture #7	HW #2

9/18	**IN CLASS EVENT: Industrial speakers** • Modeling Case study: 1. Surge tank model • Level and pressure sensors and valve selection	**Lecture:** #8 **Reading:** http://controls.engin.umich.edu/wiki/index.php/LevelSensors http://controls.engin.umich.edu/wiki/index.php/Surge_Tank_Model http://controls.engin.umich.edu/wiki/index.php/ValveModeling http://controls.engin.umich.edu/wiki/index.php/ValveTypesSelection http://controls.engin.umich.edu/wiki/index.php/PressureSensors	Lecture #8	
9/23	• Modeling Case study: 2. Surge tank model • Temperature and flow sensors	**Lecture:** #9 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Heated_Surge_Tank_Model http://controls.engin.umich.edu/wiki/index.php/CSTRHeatExchangeModel http://controls.engin.umich.edu/wiki/index.php/TemperatureSensors http://controls.engin.umich.edu/wiki/index.php/FlowSensors	Lecture #9	HW #3
9/25	• Piping and Instrumentation Diagrams	**Lecture:** #10 **Reading:** http://controls.engin.umich.edu/wiki/index.php/PIDStandardNotation http://controls.engin.umich.edu/wiki/index.php/PIDStandardStructure http://controls.engin.umich.edu/wiki/index.php/PIDStandardPitfalls http://controls.engin.umich.edu/wiki/index.php/PIDSafetyFeatures	Lecture #10	
9/30	• Logical Modeling • Logical control programs	**Lecture:** #11 **Reading:** http://controls.engin.umich.edu/wiki/index.php/BooleanModels http://controls.engin.umich.edu/wiki/index.php/LogicalPrograms	Lecture #11	HW #4
10/2	Exam I	**Exam I**		

10/7	• PID controllers	**Lecture:** #12 **Reading:** http://controls.engin.umich.edu/wiki/index.php/PIDIntro http://controls.engin.umich.edu/wiki/index.php/PIDDownsides	Lecture #12	HW #5
10/9	• Tuning PID controllers	**Lecture:** #13 **Reading:** http://controls.engin.umich.edu/wiki/index.php/PIDTuningClassical http://controls.engin.umich.edu/wiki/index.php/PIDTuningOptimization	Lecture #13	
10/14	• Dynamical systems analysis: fixed points and linearization	**Lecture:** #14 **Reading:** http://controls.engin.umich.edu/wiki/index.php/FixedPoints http://controls.engin.umich.edu/wiki/index.php/LinearizingODEs	Lecture #14	HW #6
10/16	• Evaluating stability using eigenvectors and eigenvalues	**Lecture:** #15 **Reading:** http://controls.engin.umich.edu/wiki/index.php/EigenvaluesEigenvectors http://controls.engin.umich.edu/wiki/index.php/EigenvalueStability	Lecture #15	
10/21		**Fall Break: no class**		
10/23	• Evaluating stability using phase portraits	**Lecture:** #16 **Reading:** http://controls.engin.umich.edu/wiki/index.php/PhasePlaneAnalysis	Lecture #16	HW #7
10/28	• Root locus plots • Routh stability	**Lecture:** #17 **Reading:** http://controls.engin.umich.edu/wiki/index.php/RootLocusPlots http://controls.engin.umich.edu/wiki/index.php/RouthStability	Lecture #17	

10/30	• Control architectures: feedback, feed forward, ratio, and cascade control	**Lecture:** #18 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Feedback_control http://controls.engin.umich.edu/wiki/index.php/FFControl http://controls.engin.umich.edu/wiki/index.php/CascadeControl http://controls.engin.umich.edu/wiki/index.php/RatioControl	Lecture #18	
11/4	• MIMO control with Model Predictive Control, part 1	**Lecture:** #19 **Reading:** http://controls.engin.umich.edu/wiki/index.php/MPC	Lecture #19	HW#8 Election day! Vote!
11/6	• MIMO control with Model Predictive Control, part 2	**Lecture:** #20 **Reading:** http://controls.engin.umich.edu/wiki/index.php/MPC	Lecture #20	
11/11	Exam II	Exam II		HW#9
11/13	• Basic statistics: mean, median, average, standard deviation, z-scores, and p-value • Six sigma • Control charts	**Lecture:** #21 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Basic_statistics:_mean%2C_median%2C_average%2C_standard_deviation%2C_z-scores%2C_and_p-value http://controls.engin.umich.edu/wiki/index.php/What_is_6_sigma%3F http://controls.engin.umich.edu/wiki/index.php/SPC:_Basic_control_charts:_theory_and_construction%2C_sample_size%2C_x-bar%2C_r_charts%2C_s_charts	Lecture #21	
11/18	• Factor analysis and ANOVA	**Lecture:** #22 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Factor_analysis_and_ANOVA	Lecture #22	HW#10

11/20	• Correlation, mutual information, and clustering	**Lecture:** #23 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Correlation_and_Mutual_Information	Lecture #23	
11/25	• Bayes rule, probability • Markov chain models • Multinomial distributions	**Lecture:** #24 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Bayes_Rule%2C_conditional_probability%2C_independence http://controls.engin.umich.edu/wiki/index.php/Occasionally_dishonest_casino:_crimes_or_just_noise%3F http://controls.engin.umich.edu/wiki/index.php/Multinomial_distributions	Lecture #24	HW#11
11/27		**Thanksgiving Recess: No class**		
12/2	• Bayesian networks and Dynamic Bayesian networks	**Lecture:** #25 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Bayesian_network_theory	Lecture #25	HW#12
12/4	• Learning and analyzing Bayesian networks	**Lecture:** #26 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Learning_and_analyzing_Bayesian_networks_with_Genie http://www.cs.duke.edu/~amink/software/banjo/documentation/banjo.user.pdf	Lecture #26	
12/9	• Design of experiments using orthogonal arrays	**Lecture:** #27 **Reading:** http://controls.engin.umich.edu/wiki/index.php/Design_of_experiments_via_taguchi_methods:_orthogonal_arrays	Lecture #27	HW #13
12/12	FINAL due at 3:30 PM			