ELEC 521 Advanced Control Systems (Online Section)

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Main Textbooks

NSN: Norman S. Nise,"*Control Systems Engineering*", 6th Edition, Wiley, 2011

RSB: Roland S. Burns,"*Advanced Control Engineering*", 1st Edition, Butterworth-Heinemann, 2001

RDRB: Richard C. Dorf and Robert H. Bishop, "*Modern Control Systems*", 13th Edition, Pearson, 2016

Lecture	**Topic**	**Notes**	**Recording**
Lecture 1	**Chapter 3 [NSN]: Modeling in the Time Domain** **Sec 3.3** The General State-Space Representation **Sec 3.4** Applying the State-Space Representation - Linearly Independent State Variables - Minimum Number of State Variables **Sec 3.5** Converting a Transfer Function to State Space	Lecture 1	Recording
Lecture 2	**Chapter 3 [NSN]: Modeling in the Time Domain** **Sec 3.6** Converting a State Space to Transfer Function **Sec 3.7** Linearization	Lecture 2	Recording
Lecture 3	**Chapter 3 [NSN]: Modeling in the Time Domain** **Sec 3.4** Applying the State-Space Representation - Example 3.1 - Skill-Assessment Exercise 3.1 **Chapter 4 [NSN]: Time Response** **Sec 4.10** Laplace Transform Solution of State Equations **Sec 4.11** Time Domain Solution of State Equations	Lecture 3	Recording
Lecture 4	**Chapter 5 [NSN]: Reduction of Multiple Subsystems** **Sec 5.8** Similarity Transformations	Lecture 4	Recording
Lecture 5	**Chapter 5 [NSN]: Reduction of Multiple Subsystems** **Sec 5.4** Signal-Flow Graphs **Sec 5.6** Signal-Flow Graphs of State Equations	Lecture 5	Recording

Lecture	Topic	Notes	Recording
Lecture 6	**Chapter 5 [NSN]: Reduction of Multiple Subsystems** **Sec 5.7** Alternative Representations in State Space - Phase Variable Form - Cascade Form - Parallel Form - Controller Canonical Form	Lecture 6	Recording
Lecture 7	**Chapter 5 [NSN]: Reduction of Multiple Subsystems** **Sec 5.7** Alternative Representations in State Space - Observer Canonical Form - State-Space Representation of Feedback Systems	Lecture 7	Recording
Lecture 8	**Chapter 6 [NSN]: Stability** **Sec 6.5** Stability in State Space **Chapter 7 [NSN]: Steady-State Errors** **Sec 7.8** Steady-State Error for Systems in State Space	Lecture 8	Recording
Lecture 9	**Chapter 12 [NSN]: Design via State Space** **Sec 12.1** Introduction **Sec 12.2** Controller Design	Lecture 9	Recording
Lecture 10	**Chapter 12 [NSN]: Design via State Space** **Sec 12.3** Controllability **Sec 12.4** Alternative Approaches to Controller Design	Lecture 10	Recording
Lecture 11	**Chapter 12 [NSN]: Design via State Space** **Sec 12.5** Observer Design **Sec 12.6** Observability	Lecture 11	Recording
Lecture 12	**Chapter 12 [NSN]: Design via State Space** **Sec 12.7** Alternative Approaches to Observer Design	Lecture 12	Recording
Lecture 13	**Chapter 12 [NSN]: Design via State Space** **Sec 12.8** Steady-State Error Design via Integral Control	Lecture 13	Recording

Lecture	Topic	Notes	Recording
Lecture 14	**Chapter 9 [RSB]: Optimal and Robust Control System Design** **Sec 9.1** Review of Optimal Control **Sec 9.2** The Linear Quadratic Regulator (Supplemental Video 1) (Supplemental Video 2)	Lecture 14	Recording
Lecture 15	**Chapter 9 [RSB]: Optimal and Robust Control System Design** **Sec 9.4** The Kalman Filter (Linear Quadratic Estimator LQE) **Sec 9.5** Linear Quadratic Gaussian (LQG) Control System Design	Lecture 15	Recording
Lecture 16	**Non-linear Systems** • Why study non-linear systems? • Difference with linear systems • Types of non-linearities in control systems • Analysis methods of non-linear systems • Describing function analysis	Lecture 16	Recording

Full Chapter Notes

Chapter	**Topic**	**Notes**
Chapter 3 [NSN]	Modeling in the Time Domain	Chapter 3
Chapter 4 [NSN]	Time Response	Chapter 4
Chapter 5 [NSN]	Reduction of Multiple Subsystems	Chapter 5
Chapter 6 [NSN]	Stability	Chapter 6
Chapter 7 [NSN]	Steady-State Errors	Chapter 7
Chapter 12 [NSN]	Design via State Space	Chapter 12
Chapter 9 [RSB]	Optimal and Robust Control	Optimal and Robust Control
	Nonlinear Systems	Nonlinear Systems

Homework List

The list of homework questions below are based on the 6th International Edition of "Control Systems Engineering by Norman S. Nise. If you dont have this edition of the book, then please check the Blackboard folder "NSN Book Problems" in which you will find the photocopied problems for Chapter 3, Chapter 4, Chapter 5 and Chapter 12.

Homework	**Chapter**	**Problems Numbers**	**Problems Document**
HW 1	Ch 3 [NSN]	1, 3, 9, 11, 13, 14, 25, 27 , 28	Chapter 3 Problems
	Ch 4 [NSN]	37, 39, 44*	Chapter 4 Problems
		* You could use $\mathcal{L}^{-1}\left\{[sI-A]^{-1}\right\}$ in problem 44	
HW 2	Ch 5 [NSN]	22, 23, 24, 30, 32, 33, 43, 45	Chapter 5 Problems
HW 3	Ch 12 [NSN]	6, 7, 11, 18, 21, 24, 30, 32	Chapter 12 Problems

Important Dates

	Chapter	**Due Date**
Quiz 1	Ch 3 and 4 [NSN]	Monday, 14th September, 2020 (Online in-class exam)
HW 1	Ch 3 and 4 [NSN]	Monday, 14th September, 2020 at 11:59 PM (Online submission)
HW 2	Ch 5 [NSN]	Wednesday, 30th September, 2020 at 11:59 PM (Online submission)
Quiz 2	Ch 5 [NSN]	Monday, 5th October, 2020 (Online in-class exam)
Test 1	Lectures 1 to 8	Monday, 19th October, 2020 (Online in-class exam)
Midterm	Lectures 1 to 8	Wednesday, 21st October, 2020 (Online in-class exam)
HW 3	Ch 12 [NSN]	Wednesday, 11th November, 2020 at 11:59 PM (Online submission)
Quiz 3	Ch 12 [NSN]	Monday, 16th November, 2020 (Online in-class exam)
National Day		Wednesday, 2nd December, 2020
Test 2	Lectures 9 to 18	Wednesday, 9th December, 2020 (Online in-class exam)
Final	Lectures 9 to 18	Wednesday, 16th December, 2020 from 1:00 to 3:00 PM (Online)

UAEU Academic Calendar (Fall 2020)

Day	Date	Event
Sun	16 Aug	Reporting of new Faculty & Instructors and Academic Administrators
Sun - Wed	16 Aug - 19 Aug	New Student Orientation, Advising, Testing, and Registration
Tue	18 Aug	Reporting of current Faculty & Instructors
Sun	23 Aug	Classes Begin , add/drop begins
Thu	27 Aug	Last day to add courses
Sun	30 Aug	Academic Advising period begins
Thu	17 Sep	Last day to withdraw/drop without failure
Thu	01 Oct	Deadline for temporary withdrawal requests
Sun	11 Oct	Beginning of traditional mid-term examination period
Thu	22 Oct	End of traditional mid-term examination period
Sun	08 Nov	Registration for Spring semester begins
Sun	22 Nov	Application for inter-college transfer
Thu	10 Dec	Deadline for inter-college transfer
Thu	10 Dec	Last day of classes
Sat	12 Dec	Final Examinations begin
Sat	19 Dec	Final Examinations end
Tue	22 Dec	Grades announced
Tue	22 Dec	Grades due to Registrar's Office
Wed - Thu	23 Dec - 31 Dec	Winter Break (Faculty, Instructors and Academic Administrators)
Wed - Thu	23 Dec - 07 Jan	Winter Break (Students)