

Fall 2019

# ME 305-103: Introduction to System Dynamics

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<b>COURSE NUMBER</b>	<b>ME 305</b>		
<b>COURSE TITLE</b>	<b>Introduction to System Dynamics</b>		
<b>COURSE STRUCTURE</b>	(3-0-3) (lecture hr/wk - lab hr/wk – course credits)		
<b>COURSE COORDINATOR</b>	Z. Ji		
<b>COURSE DESCRIPTION</b>	Principles of dynamic system modeling and response with emphasis on mechanical, electrical, and fluid systems. Application of computer simulation techniques.		
<b>PREREQUISITE(S)</b>	Mech 236 – Dynamics ME 231 – Kinematics Math 222 – Differential Equations		
<b>COREQUISITE(S)</b>	None		
<b>REQUIRED, ELECTIVE OR SELECTED ELECTIVE</b>	Required		
<b>REQUIRED MATERIALS</b>	<ol style="list-style-type: none"> <li>1. Katsuhiko Ogata, System Dynamics, 4th Ed., Pearson Prentice-Hall, 2004, ISBN: 0-13-142462-9</li> <li>2. Software: MATLAB</li> </ol>		
<b>Supplemental materials (not Required)</b>	None		
<b>COMPUTER USAGE</b>	MATLAB software		
<b>COURSE LEARNING OUTCOMES/ EXPECTED PERFORMANCE CRITERIA:</b>	Course Learning Outcomes	SOs*	Expected Performance Criteria
	1 develop models of mechanical, electrical/electromechanical and fluid systems.	1	<b>Exam Question</b> (80% of the students will earn a grade of 70% or better on this question)
	2. analyze dynamic systems through the application of the Laplace transforms, block diagrams, and transfer functions.	1	<b>Exam Question</b> (80% of the students will earn a grade of 70% or better on this question)
	3. determine transient and steady state response of dynamic systems.	1	<b>Exam Question</b> (80% of the students will earn a grade of 70% or better on this question)
	4. calculate frequency response and use the results for vibration isolation	1, 2	<b>Exam Question</b> (80% of the students will earn a grade of 70% or better on

								this question)
	5. perform basic calculation related to automatic controllers and system response specification.	1, 2						<b>Exam Question</b> (80% of the students will earn a grade of 70% or better on this question)
	6. use computer software (MATLAB) in analyzing dynamics systems and control systems	1						<b>Homework Problems</b> (80% of the students will earn a grade of 80% or better on these problems)
<b>CLASS TOPICS</b>	<ol style="list-style-type: none"> <li>1. Complex Algebra, Linear Algebra, Laplace Transforms, Inverse Laplace Transforms.</li> <li>2. Linear Differential Equations.</li> <li>3. Modeling of Mechanical Systems.</li> <li>4. Block Diagrams, Transfer Functions.</li> <li>5. Electrical Systems, Electromechanical Systems.</li> <li>6. Transient Response Analysis.</li> <li>7. Impulse Response.</li> <li>8. Analysis in Frequency Domain, Frequency Response, Vibration Isolation.</li> <li>9. Feedback Control Systems and Automatic Controllers.</li> <li>10. System Response Analysis and Specification.</li> </ol>							
<b>STUDENT OUTCOMES (SCALE: 1-3)</b>	1	2	3	4	5	6	7	
	3	2						
	3 – Strongly supported		2 – Supported		1 – Minimally supported			

\* Student Outcomes

# ME 305

## Introduction to System Dynamics

**Text-Book:** K. Ogata, SYSTEM DYNAMICS, Prentice-Hall, 4th Ed. 2004.

**Prerequisites:** ME 231, Mech 236 and Math 222

Topic	Reading	Homework
Introduction, Complex Algebra, Laplace Transforms, Inverse Laplace Transforms	Ch.1 Ch.2.1-2.4	B-2-1,B-2-2(b),B-2-3, B-2-5,B-2-10, B-2-15,B-2-19, B-2-20
Linear Differential Equations, review	Ch. 2.5	B-2-24, B-2-25
Modeling of Mechanical Systems	Ch. 3.1-3.3	B-3-7, B-3-8, B-3-10, B-3-12, B-3-13, B-3-14
Mechanical Systems: Work, Energy, Energy Method	Ch. 3.4	B-3-12 (energy method) B-3-17, B-3-20
Block Diagrams , Transfer Functions	Ch. 4	B-4-1, B-4-3, B-4-13, B-4-16
Electromechanical Systems	Ch. 6.1-6.3, 6.5	B-6-19
Transient Response Analysis	Ch. 8.1-3	B-8-4, B-8-7
Impulse Response	Ch. 8.3	B-8-10, B-8-11
Analysis in Frequency Domain, Frequency Response, Vibration Isolation	Ch. 9.1-4	B-9-4, B-9-1 B-9-7
Vibration Isolation (contd.)	Ch. 9.4-5	B-9-9, B-9-10
Control Systems, Introduction	Ch. 10.1	B-10-1
Control Systems, Automatic Controllers	Ch. 10.1-3	B-10-5
Transient Response Analysis System Response Specification	Ch. 10.4-5	B-10-8, B-10-10 B-10-9, B-10-11

**Note:** All grading metrics and assigned homework problems are at the discretion of the individual instructor. Additional problems may be assigned. Also read related solved problems (A-x-x) in the textbook.

**“Not every topic will be covered in every section.”**

**Fall 2016/I.Fischer**

## Supplement to Syllabus and Assignment Sheet for Dr. Fischer's Section of ME 305

**Syllabus and Assignment Sheet.** The syllabus and assignment sheet for all ME prefix courses are posted in the department website at link <https://mie.njit.edu/students/me-required.php>.

**Textbook.** K. Ogata, *System Dynamics*, 4th Ed., Prentice-Hall, 2004, ISBN 0-13-142462-9.

**First Examination.** The first examination will be primarily concerned with Laplace transforms and equations of motion. The first examination will be held shortly after the lectures on those topics have been concluded.

**Second Examination.** The second examination will be concerned with vibrations and other topics including those which were on the first examination. The second examination will be held shortly after the lectures on those topics have been concluded.

**Third Examination.** The third examination will be concerned with control theory and other topics including those which were on the first examination and second examination. The third examination will be held at the time and place scheduled by the Registrar for the "final" examination.

**Final Grade.** The final grade for the course will be based on the average grade of the three examinations weighted equally.

**Appeals.** All appeals of grades must be submitted in class during the week after the examination has been returned, and in writing, signed and dated. The appeal of examination and course grades is discouraged.

**Attendance.** Students are expected to attend all of their classes. Absence at examinations is tolerated only in serious circumstances which have been properly documented according to university policy, and any of an imputed grade, make-up examination, or zero grade might be given as considered appropriate to the case at hand.

**Punctuality.** Students are expected to arrive for class on time and to be seated and ready before the professor enters the classroom.

**Cheating.** Students are expected to abide by the university policy on academic integrity.

**Conduct.** Students are expected to conduct themselves in a manner consistent with the civility objective of the 2020 plan.

**Office Hour.** Students may call on Dr. Fischer for help or guidance with the subject matter of the course only during 3-4pm on that day of the week when he has an evening class. This day depends on his class schedule which can change from semester to semester for which the student is referred to the course schedule in the registrar's website.

**Disclaimer.** This is not the offer of a contract. The syllabus, assignment sheet, textbook, grading, and all other policies and procedures are subject to change at any time and without notice. The scheduling of classes and examinations is subject to change because of weather and other conditions.