Identification	**Subject**	ME 475 System Dynamics and Control, 8 ECTS	
	Department	Mechanical Engineering	
	Program	Undergraduate	
	Term	Spring, 2024	
	Instructor	Dr. Mehdi Kiyasatfar	
	E-mail:	mkiyasatfar@khazar.org	
	Phone:		
	Classroom/hours		
	Office hours		
Prerequisites	Theory of Machines		
Language	English		
Compulsory/Elective	Compulsory		
Required textbooks and course materials	Modern Control Engineering- Fifth Edition, Katsuhiko Ogata, Pearson 2009 Modern Control Systems, Richard C. Dorf, Robert H. Bishop-Addison Wesley		
Course website			
Course outline	System dynamics and control is one of the most important courses in the field of mechanical engineering. This course examines the performance of dynamic systems and its control methods and provides the basic knowledge on control systems at the senior level.		
Course objectives	This course is design to provide students with basic knowledge on system dynamics and automatic control and to introduce basic controller design methods with a curriculum enriched by application example.		
Learning outcomes	On successful completion of this course students will be able to: 1. Learn general knowledge on control system structure. 2. Modeling and analysis of dynamical systems. 3. Transient response analysis of linear systems. 4. Application of basic control algorithms and PID tuning methods. 5. Stability analysis of the system. 6. Learn basic design methods of frequency response. 7. Set up controller design experience based on industrial application examples.		
Teaching methods	**Lecture**		x
	Group discussion		x
	Experiential exercise		--
	Tutorials once a month on weekends		--
	Case analysis and assignments		x
	Course paper		--
	Others		--
Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Midterm Exam		25
	Class Participation		5
	Assignment		20
	Quiz		10
	Project		--
	Final Exam		40
	Total		100
Policy	▪ **Ethics** Copy of other students' work is highly discouraged. All assignments must be handled by the student himself. This is a university policy and violators will be reprimanded accordingly. ▪ **Preparation for class** The structure of this course demands your individual effort outside the classroom		

for extra practice of many problems within the textbook. After each session, every student needs to put sufficient time to practice and finish the assignments by the predetermined date.

- **Withdrawal (pass/fail)**
  This course strictly follows grading policy of the School of Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.

- **Cheating/plagiarism**
  Cheating or other plagiarism in handling the assignments, Mid-term and Final Examinations will lead to course failure. In this case, the student will automatically get zero (0), without any considerations.

- **Professional behavior guidelines**
  The students shall behave in the way to create favorable academic and professional environment during the class hours.

- **Attendance**
  Students who attend the sessions will get 5 marks. For three absence student loses 1 mark.

- **Quiz**
  There will be quizzes for checking understanding of content during class. We are not going to give make up for a missing Quiz due to any reason other than medical report.

- **Assignment**
  There will be a homework assignment for every chapter composed of problems.

- **Final exam**
  The final exam in this course includes solving problems, definitions, and basic concepts of the course.

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/Assignments
1		Syllabus. Introduction and basic concepts. Definition of Control system basic elements. Control Cycle Types. Applications of automatic control system.	Textbook – 1&2
2		Laplace transformation: Basics of Laplace transform. Theorems of laplace transform. Laplace transforms of certain functions.	Textbook – 1&2
3		Laplace transformation: Inverse Laplace transform Solution of linear differential equations with partial fraction separate method.	Textbook – 1&2
4		Mathematical modeling of physical systems and system dynamics: Model, Mathematical model and definition of physical model. Simple system elements and similarity.	Textbook – 1&2
5		Mathematical modeling of physical systems and system dynamics: Generalized Impedance. Impedance in electrical and mechanical systems.	Textbook – 1&2

6		Transfer function: Definition of transfer function. Basic features of transfer function. Calculation of transfer function of open. closed cycle system and system which exposed to disturbing entrance.	Textbook – 1&2
7		Block diagram: Block diagrams. Basic features of block diagram. Reduction of block diagrams.	Textbook – 1&2
8		Review, **Midterm Exam**	
9		Signal diagrams: Signal flow diagrams, Basic features of signal flow diagram. Operations of signal flow diagram, Signal flow diagrams of control systems. Mason gain formula for signal flow diagrams and its applications.	Textbook – 1&2
10		Transfer functions of control systems: Electrical systems. Mechanical systems. Mechanical rectilinear systems. Mechanical rotational systems. Including of gears mechanical rotational systems.	Textbook – 1&2
11		Transfer functions of control systems: Including of gearbox and electric motor mechanical rotational systems. Hydraulic systems. Thermal systems. Electro-mechanical systems. Pneumatic and electro-pneumatic systems.	Textbook – 1&2
12		Transfer functions of control systems: Proportion element and its dynamic behavior, Capacity, or integral element. Time constant, first order systems, type of vibration element or second order systems.	Textbook – 1&2
13		Steady state response and error of control systems: Steady state error and classification of systems. Static error coefficients. Disturbing entrance errors.	Textbook – 1&2
14		Methods of frequency response and bode diagrams: Frequency domain or response of sinusoidal entrance, Bode diagrams and its drawing.	Textbook – 1&2
15		Methods of frequency response and bode diagrams: Polar curves. Nypquist stability criteria.	Textbook – 1&2
16		**Final Exam**	