Academic Year:2023-2024	7-9-2023
Module Name - Code	Control Engineering 2128
Module Language	English
Instructor	Asst. Prof. Dr. Fadhil T. Aula
Lecturer (s)	None
College	College of Engineering – Salahaddin University-Erbil
Duration	15 weeks – 7th semester
Course Description	Introduction to theory and practice of automatic control for continuous-time systems. Representations of the system: transfer function, block diagram, signal flow graph, differential state equation and output equation. Analysis of control system components. Transient and steady-state performance. System analysis: Routh-Hurwitz, root-locus, Nyquist, Bode plots. System design: PID controller, and lead-lag compensators, pole placement via state feedback, observer, stability margins in Nyquist and Bode plots. Emphasis on design principles and their implementation. Design exercises with a MATLAB package for specific engineering problems.
Course Objectives	1. Understand the importance of automation and feedback control in modern society. 2. Identify all the subsystems in a closed loop system block diagram, and discuss their roles. 3. Reconstruct the block diagram of any feedback control application. 4. Derive mathematical models for electrical, mechanical, electromechanical, and hydraulic systems in a time domain and frequency domain. 5. Manipulate and simplify block diagrams. 6. Differentiate between transient response and steady-state response. 7. Understand and explain the step response of a proportional system, first-order lag system, and second-order lag system. 8. Model a system as a first-order system using system step response. 9. Understand and explain the frequency response of a proportional system, first-order lag system, and second-order lag system. 10. Identify the properties of the feedback system in terms of good transient response, tracking accuracy, disturbance rejection, and sensitivity to model errors. 11. Evaluate the performance of a closed system in terms of percentage of steady-state error, tracking, percentage of overshoot, rise time, settling time, gain margin, and phase margin. 12. Explain the effect of P,PI, PID controllers on closed loop system performance if the reference signal is a constant or a ramp signal and in the presence of constant disturbances. 13. Differentiate between the different implementations of PID controllers: series PID and parallel PID implementation. 14. Review Bode plots, and analyze and evaluate the frequency response of the closed loop system.

	15. Designing and analyzing systems in state space modeling. 16. Ability to use MATLAB software for studying different types of control system aspects
Course Contents	Introduction Modeling in Frequency Domain Reduction of Multiple Subsystems Time Response Analysis Stability Analysis Steady-State Error Root Locus Technique Frequency Response Methods: Bode Plot PID Controller Modeling in Time Domain
References	1. Norman S. Nise, "Control Systems Engineering," 8th Edition, John Wiley & Sons, Inc, 2019 2. Katshuhiko Ogata , " Modern Control Engineering ", 5th Edition, Prentice Hall , 2009. 3. John Van De Vegter , " Feedback Control Systems ", 3rd Edition, Prentice Hall, 1994.
Teaching Style	3 hrs. in Class
Pre-requisites	None
Preparation Modules	
Frequency	Fall Semester
Requirements for credit points	For the award of credit points, it is necessary to pass the module exam. It contains: An examination during the academic semester, Quizzes, Assignments, and Final examination. **Student's attendance is required in all classes**.
Credit point	5
Grade Distribution	The following grade system is used for the evaluation of the module exam: The module exam is based on the summation of two categories of evaluations: **First: (40%)** of the mark is based on the academic semester effort which includes - An examination during the academic semester = 20%. - Assignments = 15% - Quizzes = 5% **Second: (60%)** of the mark is based on final examination that is comprehensive for the whole of the study materials reviewed during the academic semester.
Workload	The workload is 135 hrs. It is the result of 45 hrs. attendances and 90 hrs. self-studies (Assignments, quizzes. and preparation for the exam).